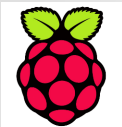


# **Your Right ARM**

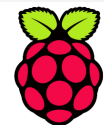
Selecting the correct tool for the job.

Jason Plum - WarheadsSE  
Arch Linux ARM

Pi



Pi

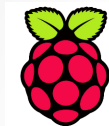


Pi

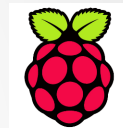
Pi

Pi

Pi



Pi



Pi

Pi

Pi

# FRIST!

Pi

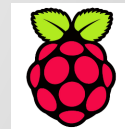
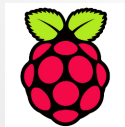
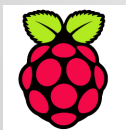


Pi

Pi

Pi

Pi



**WHARRGARBL**



# ARM Background

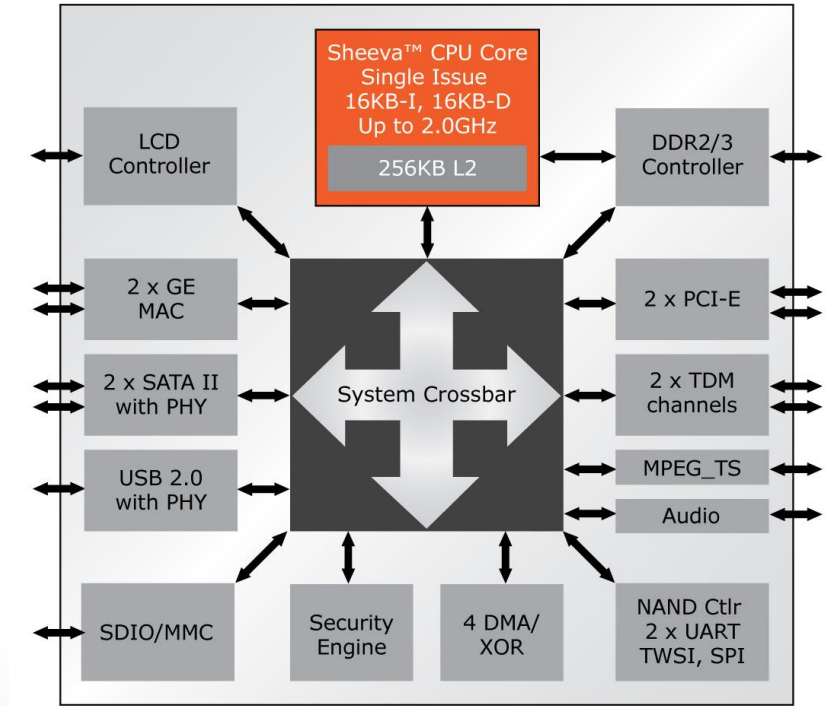
# Know Your Capabilities

Each System-on-Chip (SoC) platform is unique

- Processor Architecture
- Processor Core Type
- SoC Features
- I/O options
- Non-CPU SoC capabilities

# The System on Chip (SoC)

- Processor Cores
- Memory
- Clocks
- Peripheral Interfaces
- Various Controllers



Marvell Armada 370 Block Diagram

# Architectures, Cores & Features

Architecture	ARMv5	ARMv6	ARMv7	ARMv8
Cores	ARM9(E) Marvell Sheeva	ARM11	Cortex-A7/8/9/15 Marvell PJ4	Cortex-A53/A57
FPU	None	VFPv2 (opt)	VFPv3 VFPv4 (A15) NEON (opt)	VFPv4 NEON HW Crypto Accel
Other	1-2 Cores	1-4 Cores	1-4 Cores Virtualization LPAE Coherent SMP	1-4 Cores Virtualization LPAE Coherent SMP 64-bit

# ARMv5 SoCs and Features

SoC	Freescale i.MX233	Marvell Kirkwood 88F6281	Marvell Armada 300/310
Applications	Embedded controller	NAS, Media Server, Set-top	NAS, Media Server, Set-top
Core/Speed	ARM926EJ-S, 454 MHz	Sheeva, 1.0-1.2 GHz	Sheeva, 1.6-2.0 GHz
RAM	DDR1, up to 512MB	DDR2, up to 2GB	DDR2/3, up to 2GB
Peripherals	LCD Controller 1x USB 2.0 3x UART 2x SSP I <sup>2</sup> C 6ch 12bit ADC Serial Audio, SPDIF GPIO, SPI	1x USB 2.0 2x Gigabit Ethernet 2x SATA 2.0 + port multiplier 1x PCIe Network offload HW Crypto Accelerator DMA/XOR Engine SDIO, GPIO, SPI TWSI/SPDIF 2x UART RTC	LCD Controller (1080p) 1x USB 2.0 2x Gigabit Ethernet 2x SATA 2.0 + port multiplier 2x PCIe Network offload HW Crypto Accelerator DMA/XOR Engine SDIO, GPIO, SPI TWSI/SPDIF 2x UART, RTC



# ARMv6 SoCs and Features

SoC	WonderMedia WM8750	Broadcom BCM2835
Applications	Digital Signage, Multimedia	Mobile, Multimedia
Core/Speed	ARM1176JZ-F, 800 MHz	ARM1176JZ-FS, 800 MHz
RAM	DDR2/3, up to 1GB <sup>T</sup>	DDR, up to 1GB <sup>T</sup>
Peripherals	OpenGL-ES 2.0 GPU 1080p Decoder, H.264 Encoder HDMI, LVDS, TV-out, DVO, VGA Gigabit Ethernet HW Crypto Acceleration USB 2.0 GPIO, 6x UART, 2x I <sup>2</sup> C, 4x PWM, 2x SPI I <sup>2</sup> S, SPDIF, PCM Audio	OpenGL-ES 2.0 GPU 1080p Decoder, H.264 Encoder HDMI, TV-out USB 2.0 GPIO, 2x UART, I <sup>2</sup> C, SPI I <sup>2</sup> S, PCM Audio

<sup>T</sup> These processors lack complete specifications and documentation.

# ARMv7 SoCs and Features

SoC	TI OMAP 4460	Freescale i.MX6	Samsung Exynos 5420
Applications	Phone, Tablet, Set-top	NAS, Server, Multimedia	Phone, Tablet, Set-top
Core/Speed	2x Cortex-A9, 1.2 GHz	1-4x Cortex-A9, 1.2 GHz	4x Cortex-A15 1.9 GHz 4x Cortex-A7 1.3 GHz
RAM	LPDDR2, up to 2GB	LP/LV-DDR3, up to 4GB	DDR3, up to 4GB+ (LPAE)
Peripherals	2D/3D Encode/Decode (1080p) USB 2.0 Host/Device Image processor, video enc/dec 1080p Face detect module WDT, 3x UART, 5 I <sup>2</sup> C, 2x 8-bit HS MMC, 3x 4-bit HS MMC, 192 GPIO, keypad controller, MIPI, 4x MCSPI HW Crypto Accelerator HDMI, DVI, LVDS, Composite	2D/3D GPU, 1080p30 Enc/Dec Imaging Processing Unit 3x MMC/SD, 5x UART, 3x I <sup>2</sup> C, 5x SPI, 3x I2S/SSI, GPIO, 2x FlexCAN, 4x PWM, 2x WDT, SPDIF, NAND, MIPI HSI/DSI/CSI/CSI2, RTC, RNG SATA 2.0 (3 Gbps) Gigabit Ethernet PCIe 2.0 x1 HDMI, DVI, 2x LVDS (up to 4 displays)	6-core ARM Mali-T628 MP6 GPU OpenGL ES 3.0, OpenCL 1.1 eSD 3.0, USB 3.0, GPS, HDMI 1.4, PWM, GPIO, I <sup>2</sup> C, SPI, ADC SATA 2.0 (3 Gbps) USB 3.0 Host and OTG eMMC 4.5 Next-gen FPU: VFPv4+NEON Hardware Virtualization (Xen) Coherent SMP (8 active cores)

Define Your Task

# Use Case Examples

- NAS
- Digital signage
- Robotics
- Drone control
- 3D Printing/Scanning
- Experimental electronics engineering
- Desktop replacement

# Task Requirements

What do you need to complete your task?

- CPU: Speed? Memory? Floating Point?
- Bus: GPIO? I2C? SPI? PWM?
- Features: Video? Net? Audio?

# Example Task Evaluation

# Network Server

- Network
  - Media type
  - Connection speed
- Storage
  - Attachment
  - Expandability
- Processing
  - Limited, usually integer based
  - Possibly with security layers

# Digital Signage

- Network
  - Needed?
- Storage
  - Physical or network
  - Medium and Capacity
- Video
  - Resolution
  - Codecs
- Processor
  - As needed for decoding & processing outside video acceleration hw



# Drone

- Network
  - Probably wireless
- Storage
  - Sensor data, limited for sake of weight
- Video
  - Processing (encoding)
  - Camera
- Busses:
  - GPIO, ADC, I2C, SPI, PWM, CSI, USB
- Processor
  - Float math related to position, motion & geometry
  - Speed is key, but only as necessary.

# Experimental Electronics Eng.

- Network
  - Needed?
- Storage
  - Needed?
- Busses
  - GPIO, ADC, I2C, SPI, PWM, CAN
- Processor
  - Less of a priority to accessible expansion at the peripheral level.

# Desktop Replacement

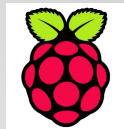
- Network
  - Media type
- Storage
  - Attachment
  - Expandability
- Video
  - Output types and resolution
  - Acceleration
- Processor
  - More oomf the better, across all types.

# Available Boards

# Marvell Kirkwood Variants

Pogoplug(s), ZyXEL NSA3xx line, Seagate GoFlex & Dockstar

- 800 - 1600 MHz Sheeva processor (ARM9E compatible)
- 128 - 512 MB RAM
- 1 to 2 100/1000 Mbit Ethernet via RGMII PHY
- 2 USB 2.0 Host buses, with some mfg placing internal hubs
- PCIe allowing for USB 3.0, internal Wifi, etc
- 2x SATA II capable, PHY connected. Supports PMP on all ports.
- Usually 64 - 512 MB of NAND
- 4x Marvell Cryptographic Engine and Security Accelerator (MV\_CESA)



# Raspberry Pi

You should have heard of this by now. Seriously, > 1.75 MM

- 700 - 1000 Mhz ARMv6 ARM1176ZJFS processor
- HDMI and RCA video out
- Very capable GPU
- Easy to access peripheral busses via pin-out
- USB attached 10/100 Mbit Ethernet (Model B)
- 2 USB ports
- Primary storage is full size SD.
- Great gateway learning tool

It's a CPU slapped on a GPU. Please remember that, and who it is intended for!

# HardKernel ODROID Family

Family of boards based on Samsung Exynos

X, X2, U, U2, XU

- 2 to 8 cores, XU is big.LITTLE A15/A7
- 1 - 2 GB RAM
- Primary storage is SD or eMMC
- HDMI
- Ethernet & Wireless
- USB 2, USB 3 on XU

# BeagleBone Black



The puppy got an upgrade *and* a price cut

- 1 GHz Cortex-A8
- 512 MB RAM
- 2 GB eMMC, uSD
- 2 on-die PRUs (programmable real-time processors)
- uHDMI & LVDS expansion header
- Peripheral busses out the wazoo
- Wide selection of “capex,” add-on boards similar to Arduino shields

BeagleBoards and BeagleBones are 100% Open Hardware



# Xilinx ZedBoard

Based on the Zynq-7000, includes on-die FPGA

- 1 Ghz dual core Cortex-A9
- 512 MB RAM
- 256 MB NAND
- Full size SD
- 1x 1000 Mbit Ethernet
- On-board JTAG programming via USB
- Multiple display outputs
- Ready for prototyping out of the box: pre-populated with switches, buttons, LEDs, OLED display, and connectors for everything else.
- FPGA: 85K Logic cells (~1.3M ASIC gates), 53,200 look-up tables, 106,400 flip-flops, 220 DSP slices, 2x 12-bit MSPS ADCs

# Olimex OLinuXino

Variety: iMX233 (MAXI, MINI, MICRO, NANO)

- 454 MHz iMX233 armv5te processor
- 64 MB RAM
- Primary storage on uSD
- NTSC/PAL video output
- Stereo audio output
- USB 2.0
- GPIO, I2C, SPI exposed via pin-out
- Variety of expansion boards available

Olimex is 100% Open Hardware

# Example Solution Choices

- Desktop Replacement
  - ODROID-XU
  - Samsung XE303
- Robotics / Drone
  - BeagleBone Black
  - Overo Gumstix
- Digital Signage
  - SabreLite
  - Nitrogen6x
  - ODROID's
  - Raspberry Pi
- Personal web server
  - Most of the above.

- Home NAS
  - Pogoplug
  - ZyXEL NSA3xx
  - OpenBlocks AX3/4
  - CuBox
- Electronics Engineering
  - BeagleBone Black
  - Raspberry Pi
  - ZedBoard & MicroZed
- Home Automation
  - OLinuXino
  - Raspberry Pi
  - BeagleBone Black

**AND WE'RE DONE**