Introduction to Embedded System





Embedded System

- An embedded system
 - combination of computer hardware and software
 - specifically designed for a particular function
- Applications
 - Mobile phone
 - Digital camera
 - Smart TV
 - Navigation system





Feature

- Designed to do some specific task
 - Low power
 - Small size
 - Special operating ranges
 - Low cost

Install OS ?





SOC RK3399

System Peripheral	RK3399		Connectivity
Clock & Reset	1		USB OTG0 3.0/2.0
PMU	Cortex-A72 Dual-Core (48K/32K L1 I/D Cache)	Cortex-A53 Quad-Core (32K/32KL1 I/D Cache)	USB OTG13.0/2.0
PLL x 8	1	(32K/32KLI (/D Cache)	Type-C x 2
System register	1 1MB L2 Cache	512KB L2 Cache	USB HOSTO 2.0
Timer x 26	CCI500		USB HOST1 2.0
PMW(4ch)	CoreSight		USIC
Watchdog x 3	L '		PCle2.1
Crypto x 2	Cortex-M0 Dual-Core		12S/PCM x 3
SAR-ADC			
TS-ADC	Multi-Media Processor		SPDIF(8ch)
Interrupt Controller	Mali-T860MP4 GPU	2D Graphics Engine	UART x 5
DMAC x 2	(256K L2 Cache)		SPI x 6
PVTM x 5	JPEG Encoder	JPEG Decoder	12C x 9
Mailbox x 2	I Ed Encoder		Giga-Ethernet
Multi-Media Interface	Image Enhancement	Dual pipe ISP	
Dual MIPI-CSI 4 Lane	Processor	Dual pipe isr	SDIO 3.0
		4K Video Decoder	GPIO x 122
eDP1.3 4 Lane	1080p Video Encoder 4K Video Decoder		Embedded Memory
Dual MIPI-DSI 4 Lane	External Memory Interface		SRAM
DP1.3 4 Lane with HDCP2.2	eMMC5.1I/F	SD3.0/MMC4.5	ROM
HDMI2.0 3 Lane with HDCP2.2	DDR3/DDR3L/LPDDR3/LPDDR4		Secure eFuse
Dual Display Controller	Hardware-based DDR frequency scaling		Non secure eFuse

http://wiki.friendlyarm.com/wiki/index.php/NanoPi_M4#Diagram.2C_Layout_and_Dimension





Component of embedded system

- Processor
 - → ARM, X86, MIPS
- RAM
 - → 8MB ~ 2 GB
- Storagee
 - → Nand, Nor flash
 - → SD/MMC/eMMc
- System Bus
 - → AMBA, AHB, APB, AXI ...





Component of embedded system

- Communication
 - I2C, I2S, USB, PCI/PCIe ...
- Media system
 - JPEG, H.264 ..
- System component
 - DMA, RTC ..





Embedded Linux?

Embedded Linux is the usage of the Linux kernel and various open-source components in embedded systems (from Free Electrons)





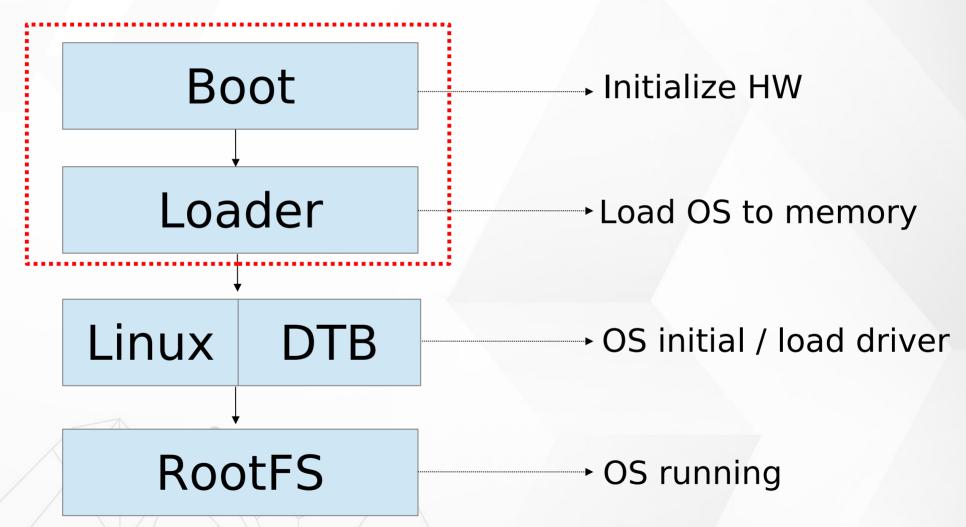
Advantages

- Re-use components
- Quickly design and develop complicated products
- No need to re-develop components
 - → TCP/IP stack, USB stack, PCI stack ...
- Allow you modify components





Embedded Linux System Booting







Embedded Linux System Software components

- Cross-compilation toolchain
- Bootloader
- Linux Kernel, DeviceTree
- Rootfs
- C library
- Libraries and applications
- BSP (Board Support Package)



Develop Environment





Develop Environment

- Host PC
- Toolchain
- Target EVB (RockPi4)
- BSP



BSP

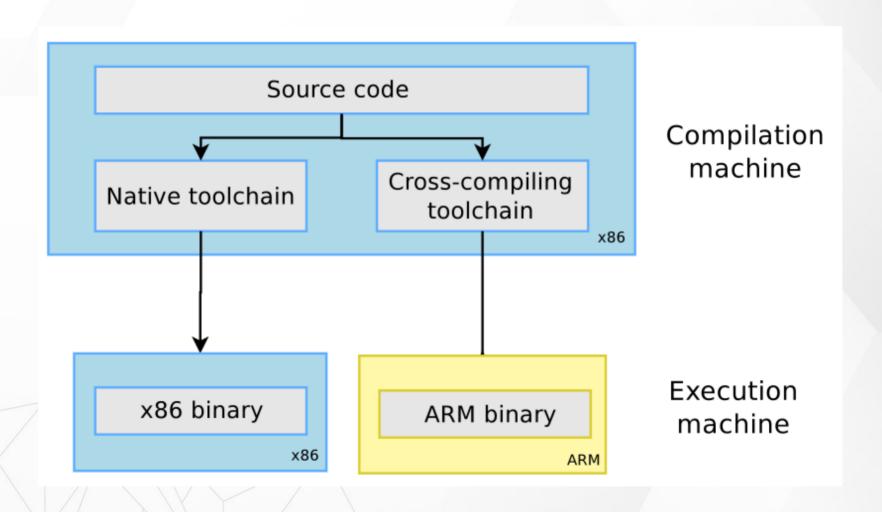


- Board Support Package
- From chip vendor
 - Distribution
 - Bootloader
 - Linux kernel
 - Device driver
 - Rootfs





Cross Compilation toolchain







Setup References - 1

Debian Image:

https://github.com/radxa/rock-pi-images-released/releases

Image Write Tool:

https://www.balena.io/etcher/

Install Image to SD Card:

https://wiki.radxa.com/Rockpi4/install/microSD





Setup References - 2

Debug Port:

https://wiki.radxa.com/Rockpi4/dev/serial-console

Linaro ToolChain:

https://releases.linaro.org/components/toolchain/binaries/7.3-2018.05/aarch64-linux-gnu/gcc-linaro-7.3.1-2018.05-x86 64 aarch64-linux-gnu.tar.xz

Install Package:

sudo apt-get install libncurses5 libncurses5-dev buildessential libssl-dev mtools bc python dosfstools liblz4-tool





Setup References - 3

u-boot: https://wiki.radxa.com/Rockpi4/dev/u-boot

Linux Kernel: https://wiki.radxa.com/Rockpi4/dev/kernel-4.4

Debian: https://wiki.radxa.com/Rockpi4/dev/Debian

RockPi4 WiKi: https://wiki.radxa.com/Rockpi4

