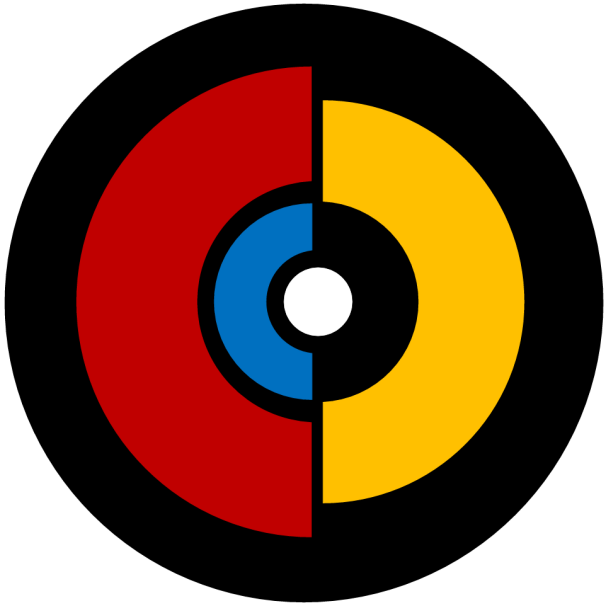
Way to GNU/Linux on ARM

Xingda Zheng



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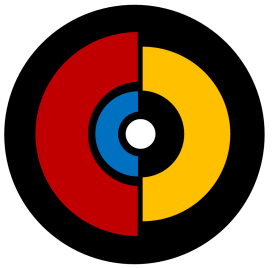


What's ARM

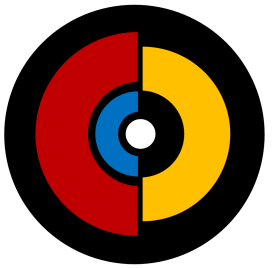
- ARM can be ARM Holdings
- ARM can also be ARM Architecture
- ARM = "Advanced RISC Machine"

Brief History of ARM

- ARMv1
  - ARM1
- ARMv2
  - ARM2 – Cloned by OpenCores now, called Amber
  - ARM3
- ARMv3
  - ARM6
    - (ARM610 used by Apple Newton)
- ARMv4T – T means Thumb
  - ARM7TDMI – traditional SoC core, even used by GBA

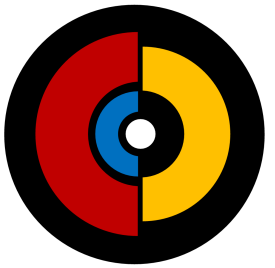
Brief History of ARM

- ARMv5TE – MMU introduced
  - ARM9 – Traditional “Embedded Linux” Core
- ARMv6 – initial SIMD support
  - ARM11 – Start of Thumb2 and Multiprocessor



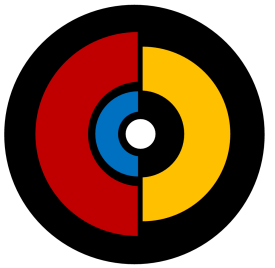
Brief History of ARM

- ARMv7A – “Cortex”ize
  - Introduce VFPv3, NEON
  - Cortex-A8
  - Cortex-A9 MPCore
  - Cortex-A5 low-end solution
  - Cortex-A7/15 – big.LITTLE, Virtualization



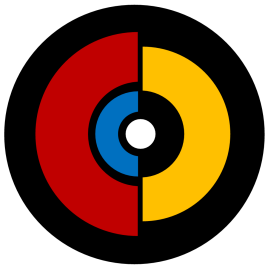
Brief History of ARM

- ARMv8A – 64-bit
  - NEON now fully IEEE-754 complicant
  - “big” core started to evolve fastly
    - Cortex-A57, A72, A73...



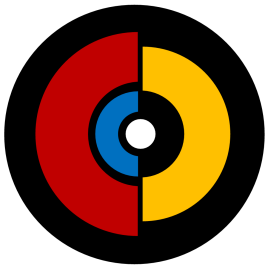
Brief History of ARM Linux

- 1.0.x – Early trial by Acron on Acron A5000. Built on RISC OS with its compiler. Kernel tree largely modified to suite RISC OS. Impossible to merge back.
- 1.1.59 – Elegant ARM support in Linux kernel because the support of ARM in GCC/Binutils.



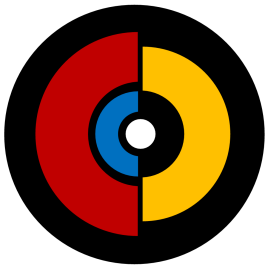
Brief History of ARM Linux

- ARMv4T can run uClinux
- ARMv5TE is suitable for running full Linux
  - Currently the most old cores supported by Debian.
- “Embedded Linux” on ARMv5TE
- Birth of Android



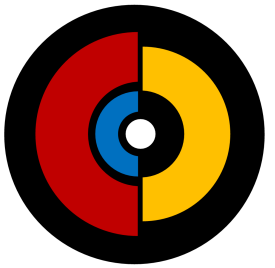
Brief History of ARM Linux

- ARMv6
  - OMAP2 (with ARM11) is chosen by Nokia for Maemo
- ARMv7A
  - A High-optimized instruction set.
  - “armhf” in Debian.
- ARMv8A
  - 64-bit.
  - “arch/arm64/” instead of “arch/arm/” in kernel
  - ABI revolution. Considered as a new architecture.



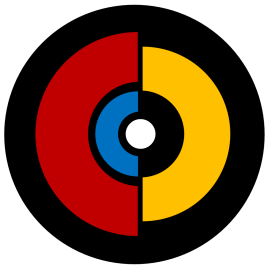
Mess: What's a SoC

- SoC – System on Chip.
- IP core model.
- Cortex series is just IP core. So do Mali series and PrimeCell series.



Mess: Boot

- On IBM/PC:
  - Power Up → BIOS/UEFI → GRUB → Linux kernel
  - Standard interface
- On ARM:
  - No such standard interface widely accepted now

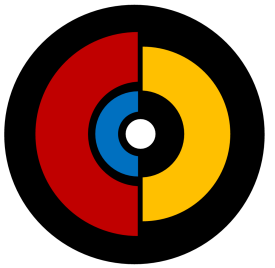


Mess: Boot

- Allwinner A33 SoC:
  - Power Up → Internal BROM (mask ROM) → Boot0 → U-Boot → Linux kernel
- Qualcomm APQ8016 SoC:
  - Power Up → PBL (on DSP) → SBL → LK → Linux kernel
- Broadcom BCM2836 SoC:
  - Power Up → Proprietary Bootloader (on GPU!) → Unknown loader (on ARM core) → Linux kernel

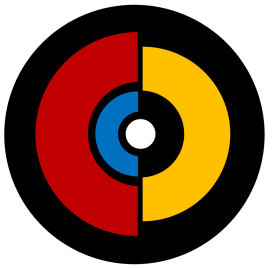
Mess: Boot

- Problems:
  - No generic Bootloader.
  - No generic kernel storage standard.



Mess: SoC and board

- Multiple boards per SoC
- Early kernel uses a .c file per board
  - A zImage/uImage per board – Disaster to distributions
  - A machine ID per board – complex
  - Source modify and kernel recompilation when board changed

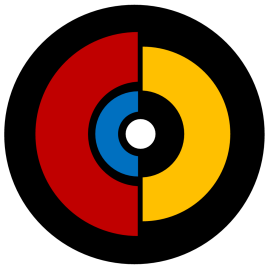


Mess: SoC and board

- Why?
  - Innumerable Buses
    - AMBA inside SoC
    - I²C, SPI outside SoC
  - Lack of standard
    - On x86, DSDT table in ACPI solved the difference

Mess: Out-of-mainline source

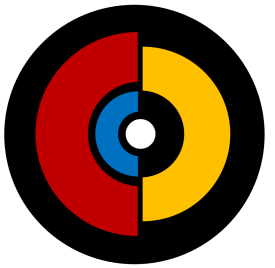
- Low quality of BSPs
  - Lots of BSPs are for Android
  - Dirty and unmainlineable code
- Lower quality of Vendor sources
  - For example, Huawei
- Android problem
  - Some Android drivers keep to be unmainlined
  - Android does not require higher kernel version (3.4 for Marshmallow is also allowed)



Mess: Lines out-of-mainline table

Phone	Manufacturer	SoC Vendor	Lines out-of-mainline
G3	LG	Qualcomm	2.616M
Galaxy 4	Samsung	Qualcomm	1.795M
Galaxy S5	Samsung	Samsung Exynos	1.100M
Xperia Z3	Sony	Qualcomm	1.794M
Xperia C	Sony	MediaTek	1.935M
E2	Acer	MediaTek	1.411M
Zenfone 6	Asus	Intel Atom	2.163M
P6	Huawei	HiSilicon	2.659M

表格来源： http://elinux.org/CE_Workgroup_Device_Mainlining_Project



Mess: LINUS IS ANGRY

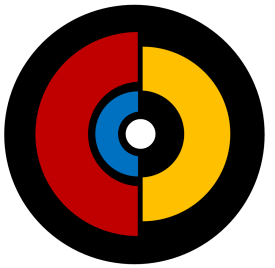
- https://lkml.org/lkml/2011/3/17/492
- “Gaah. Guys, this whole ARM thing is a f*cking pain in the ass.”

Solution: Device Tree

- Originated from Sun Open Firmware, then abstracted by Linux.
- Used by Embedded PowerPC with OF.
- Chosen to be used on ARM.

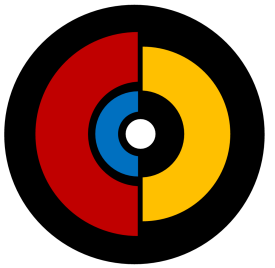
Solution: Device Tree

- What's Device Tree
  - Device description
  - Like a tree
  - Structured
  - Can be "flatten" to storage



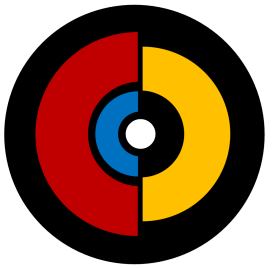
Solution: Device Tree

- Example of the opportunity of DT:
  - AOSC OS armel sunxi boot
    - Provided 2 kernels for more than 6 SoCs, 20 boards.
  - Raspberry Pi DT Overlay
    - Easy to adapt add-ons



Solution: Device Tree

- DT structure:
  - Really like a tree
  - Everything starts at a “/”
  - Device nodes can be embedded to bus nodes, when the device is connected to the bus.

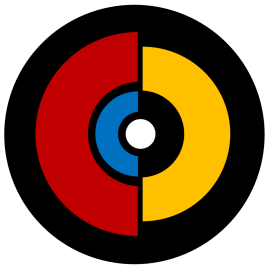


Solution by another kernel

- Windows NT on ARM
  - Force UEFI and ACPI
  - Use DSDT for device structure
  - Use HAL Extension for special devices

Future

- ARM officially choose UEFI
- Server standard is introduced
- Standard interface for communication between ARM kernel and firmware, for power, regulators, etc



Thanks!

Now you can point out problems

and wait for further improvement by us!