

# Linux: Not just for PCs (2015 edition)

Revisiting a talk from June 1999:

0 1 2 3 4 5 6 7 8 9 10 11 12 13 next

**It's Linux Jim.....but not as we know it.....**

**Linux most popular on PCs**

**Actually quite portable**

**\* Most architecture dependent sections separated out**

**Lots of choice - you don't have to use PCs!**

# What is a PC?

## A computer with:

- An x86 processor (32 or 64bit)
- A standard BIOS or EFI firmware
- Standard basic support
  - *All in a standard location/address (or small choice)*
  - Interrupt controllers
  - Timers
  - Ways to get to busses with devices on
- **Special x86 systems without these aren't quite PCs**
  - e.g. SGI Ultraviolet supercomputers, Intel Quark

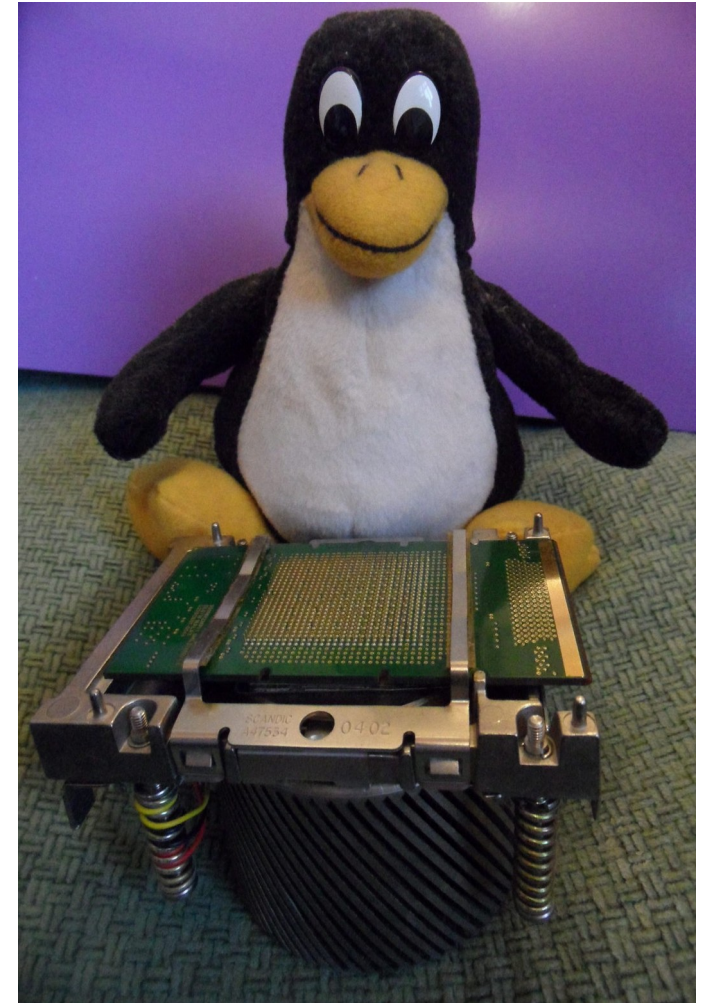
# Some (modern) non-PCs that run Linux

- **Raspberry Pi, Beagle Board, MIPS Creator C120**
- **Most phones/Tablets (but some are PCs!)**
- **Wireless/Cable/DSL router**
- **Some Supercomputers (e.g. **K computer**); (most supercomputers run Linux, but a lot are PCs now)**
- **64bit ARM servers, IBM Mainframes, Itanium, Power**
- **Wireless SD card for camera** (Transcend and others)
- **Some Smart TVs (Sony Bravia)**
- **Kitchen blender (Thermomix)**
- **Or with some hacking:**
  - [Canon DSLR cameras](#), anything with an accessible CPU!

# Modern kernel and distro arch list

2428	alpha	584	nios2
972	arc	524	openrisc
31356	arm	2324	parisc
2136	arm64	15648	powerpc
1312	avr32	3280	s390
6012	blackfin	640	score
640	c6x	5092	sh
4876	cris	4792	sparc
1324	frv	2772	tile
632	hexagon	1284	um
4028	ia64	820	unicore32
1404	m32r	12112	x86
6448	m68k	1424	xtensa

- Just CPU architectures listed
- Some common (x86, ARM, etc)
- Some obsolete (alpha, parisc)
- Some obscure (m32r, mn10300)
- Some upcoming (arm64)
- Some very open (openrisc)



# **The Linux world (1999)**

- **Plenty of home users running it on PCs**
- **Some people running it on weirder stuff**
- **Red Hat Linux on i386, SPARC and Alpha**
- **Yellow Dog on PPC**
- **Debian 2.1 on i386, Alpha, SPARC and 680x0**
- **Kernel at 2.2**

# Linux on non-PCs in '99

- **PowerPC Macs**
- **Mostly workstations**
  - SPARC workstations very common 2<sup>nd</sup> hand/out of skips
  - MIPS SGI box (SGI Indy especially), Cobalt Qube
  - Alpha both workstations and motherboards
  - ARM Archimedes, Netwinder
  - Old 680x0 (Sun3, Amiga etc)
  - Also HP-PA
- **Starting to be some embedded**
  - Empeg car audio system

# Booting

**PC: BIOS loads 1st sector→Loads 2<sup>nd</sup> stage GRUB (using BIOS calls)→Loads Linux+Initramfs (using BIOS calls)**

**PC: EFI+GPT Partitions→Loads shim/GRUB→Loads Linux+initramfs (using EFI calls)**

**PowerPC: OpenFirmware→Yaboot→Loads Linux+initramfs**

**ARM (some): uBoot→Loads Linux+initramfs**

**Each architecture has different boot processes, and sometimes vary per board not just by CPU type**

GRUB2 now not just on PC

Updating boot process can be different



# Integration & standardisation made things easier

## Workstations were all different

Proprietary busses

Some shared chips –  
but all wired differently

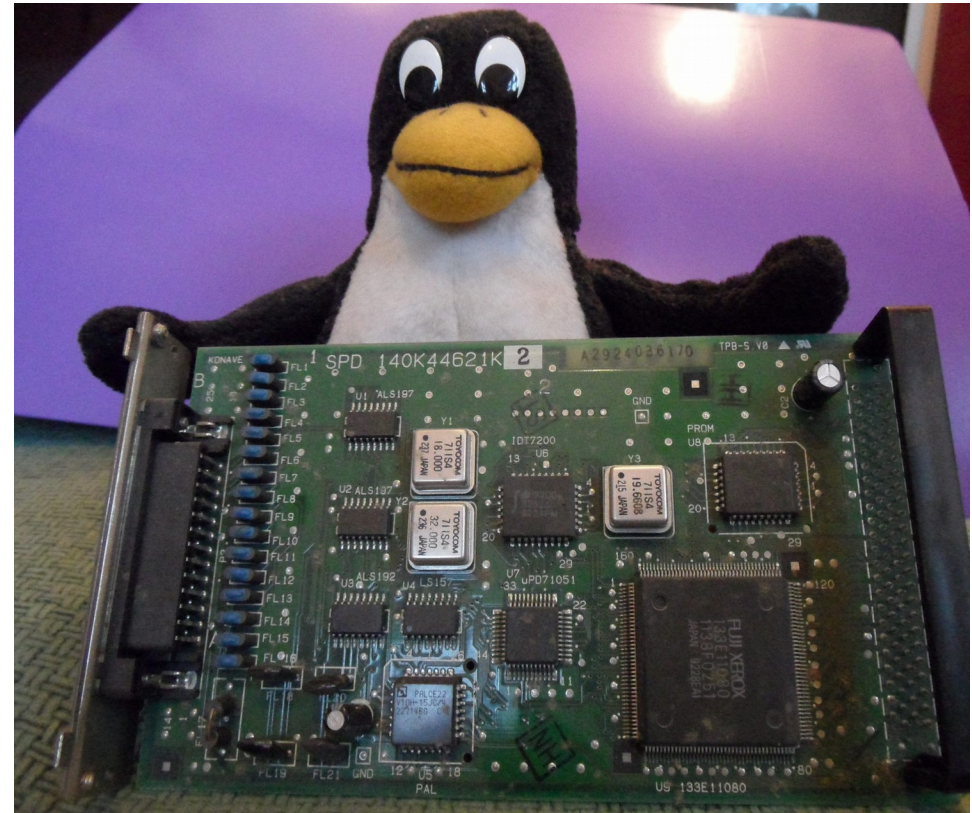
## PCI & PCIe & USB helped

Share the same network/IO and  
maybe video cards with PCs  
(some boot problems)

## Integration simplified

Mostly one chip/IO card

Most of the time if a card has that chip it's now likely to work.

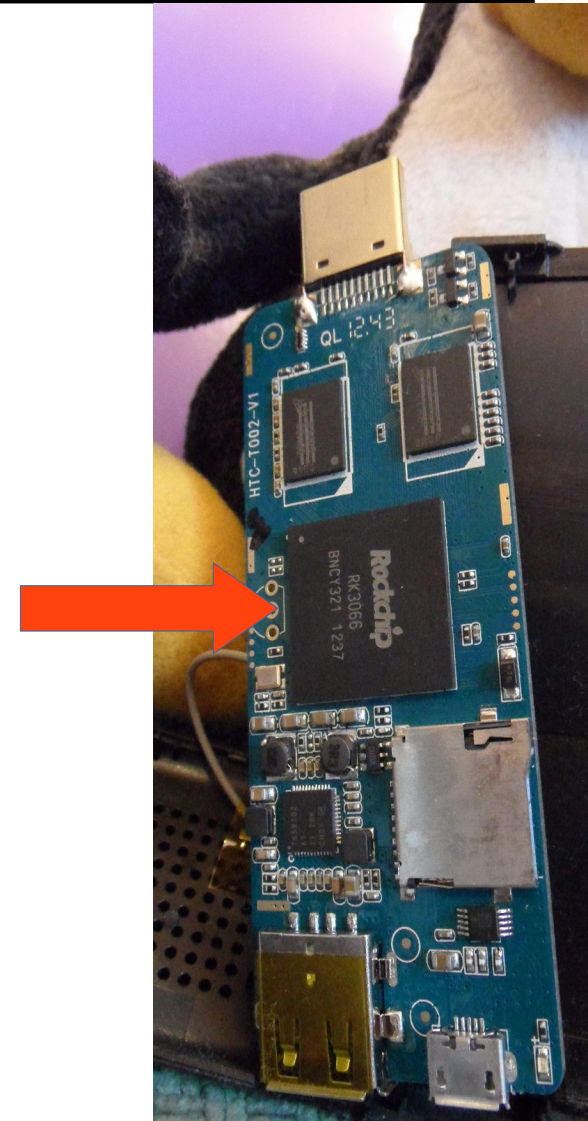




# Rise of the SoCs aka why Integration made it harder

**System on Chip** - most stuff on a single chip, specialised for a class of applications

- Even sometimes the RAM in the same package
- Maybe no external 'bus'
- Not much commonality
  - e.g. common to have specialised ways to access the main flash memory
  - Sometimes need drivers for each chip type just to boot
  - Specific bootloader types



# More SoCs

- **Very varied**

- Some short lifespan
  - Next one being designed/built before this one is being sold
- Badly documented
- No upstream/distro support

- **Some well documented/supported**

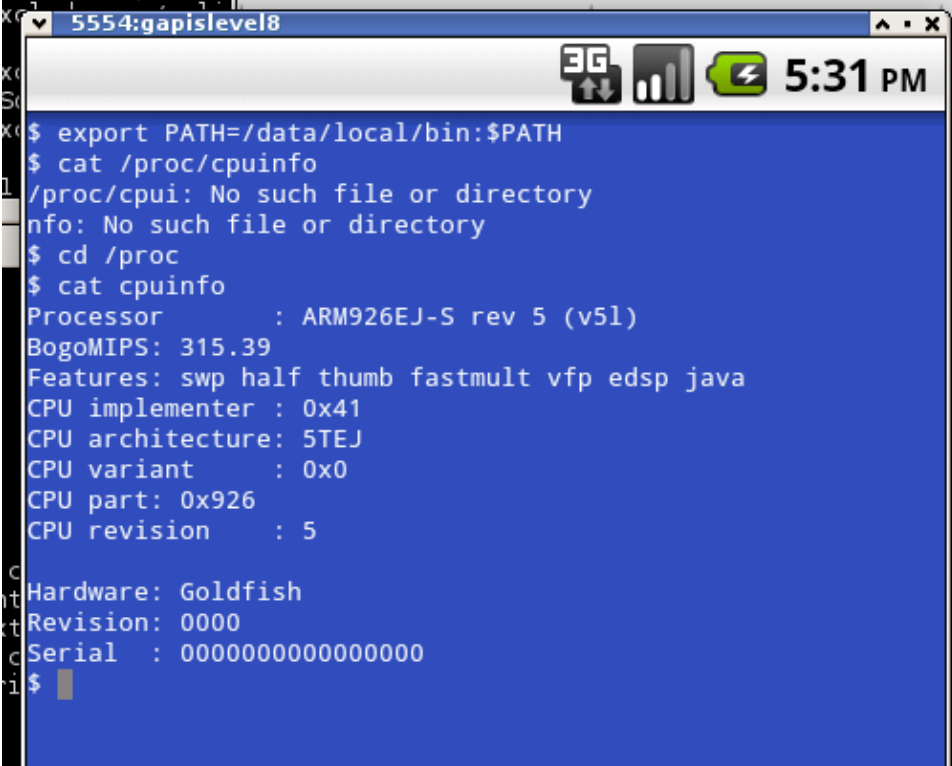
- Much easier to work with
- Often normal kernels with special build

- **Attempts to define SoCs**

- 'device tree'

# Emulation

- QEMU for most architectures
  - special versions in Android devkits
- Individual emulators for popular micros



```
$ export PATH=/data/local/bin:$PATH
$ cat /proc/cpuinfo
/proc/cpui: No such file or directory
nfo: No such file or directory
$ cd /proc
$ cat cpuinfo
Processor       : ARM926EJ-S rev 5 (v5l)
BogoMIPS: 315.39
Features: swp half thumb fastmult vfp edsp java
CPU implementer : 0x41
CPU architecture: 5TEJ
CPU variant     : 0x0
CPU part: 0x926
CPU revision    : 5

Hardware: Goldfish
Revision: 0000
Serial : 0000000000000000
$
```

# Installations

## **Modular/PC like setups**

- **Traditional distro**
- **Check the distro install notes to make sure that hardware is supported**
- **After boot very similar**

## **Embedded/SoCs**

- **Typically special instructions**
- **Prebuilt images**
- **Userspace of other distros+kernel+bootloader+update scripts**
- **Often critical binary blobs**

# Programming on something else

- **Endianness: 0123 vs 3210**

- X86 is 'little endian', 680x0 is 'big endian'
- PowerPC used to be BE but now moving towards LE
- ARM mostly LE, some BE uses

- **Alignment**

- X86 'anything goes' – most others are fussy

- **Memory ordering**

- X86 mostly does what you ask – ARM,PPC reorder a lot

- **FP formats**

- **Function descriptors (rare)**

- **Don't assume PCI, SCSI discs, a lot of RAM, the boot process**

# Now & the future?

- **Linux is everywhere on non-PCs**
  - The PCs are fighting back a bit! (phones, tablets etc)
- **Servers/workstations mostly PCs**
  - The old technical workstations have gone
  - Still none-PC servers, but rarer – almost all now explicitly support Linux
  - 64-bit ARM just arriving