

A timeline for embedded Linux

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30th April 2014

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The originals are at <http://2net.co.uk/slides/>

About Chris Simmonds



- Consultant and trainer
- Working with embedded Linux since 1999
- Android since 2009
- Speaker at many conferences and workshops

"Looking after the Inner Penguin" blog at <http://2net.co.uk/>



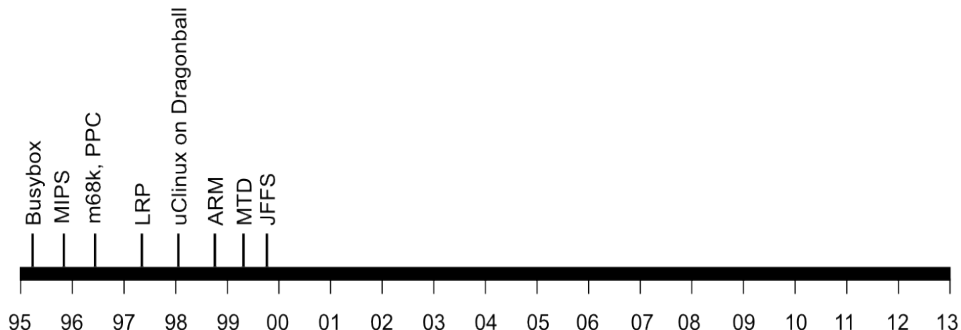
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<https://google.com/+chrissimmonds>

The early days: 1995 to 1999

- By 1995 Linux was already attracting attention beyond desktop and server
- It just needed a few more steps to make it a real contender...



Making Linux small

1995

Busybox: a collection of command-line utilities

Created by Bruce Perens so that he could put the Debian installer on to a single 1.44 MiB floppy disk

Also ideal for embedded devices with limited storage

The Linux Router Project

1997

The Linux Router Project (LRP): Dave Cinege used Busybox to create a Linux distribution on a floppy disk that turns a PC into a router

1998

*David Täht and Greg Retkowski publish the "Arlan Wireless Howto"
The first embedded Linux wireless router*

Making the Linux code portable

1995: MIPS

1996: m68k, ppc

1998: uClinux for m68k Dragonball on 3Com Palm Pilot

1999: ARM

Flash memory

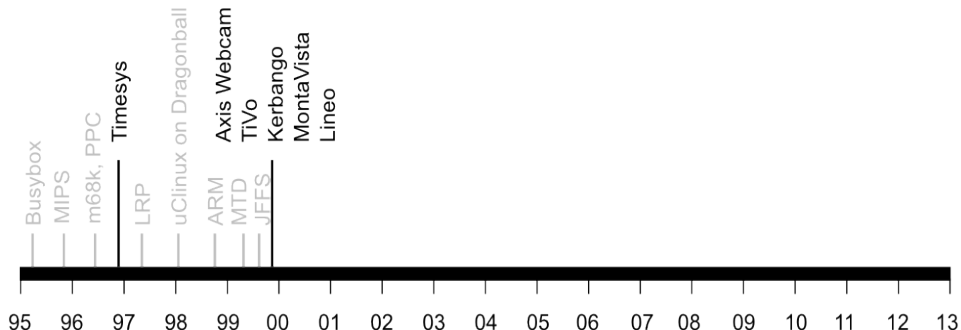
1999

David Woodhouse begins work on the Memory Technology Devices (MTD) layer

Axis create a robust file system for the flash memory in the AXIS 2100 Network Camera. It was called JFFS (Journaling Flash File System)

Things start to happen: 1999

- The first products based on Embedded Linux appear
- Embedded Linux software companies emerge



Things start to happen: 1999



AXIS 2100 Network
Camera



TiVo DVR



Kerbango Internet
radio

Professional help

1996: Timesys

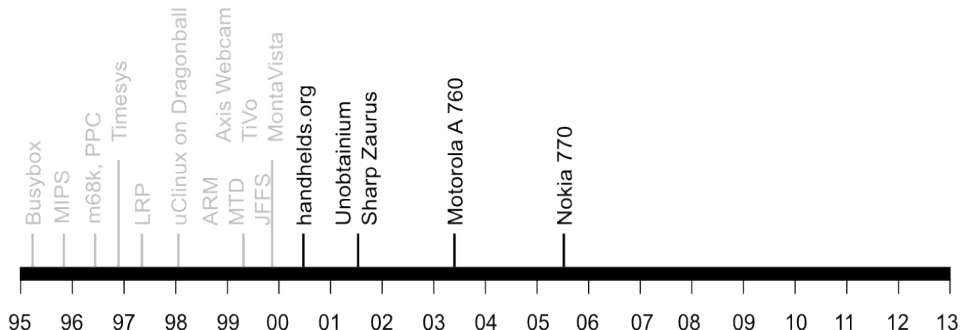
1999: MontaVista

1999: Lineo

1999: Denx

Linux goes mobile: 2000 to 2005

- From early beginnings hacking on mobile hardware to a full mobile operating system

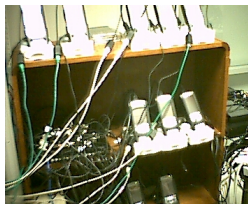


2000

handhelds.org was a focus for porting Linux to a variety of portable devices, starting with the Compaq iPAQ H3600



iPaq running X11



The build cluster

The unobtainium

2001

Project Mercury at Compaq put together a prototype mobile handset nicknamed the "Unobtainium"

iPaq 3600

GSM/CDMA/802.11b/Bluetooth

640x480 camera

1 GiB of storage on an IBM Microdrive



Zaurus

2001

*Sharp create the Zaurus SL-5000D PDA running Linux 2.4.10
(provided by Lineo)*



Motorola handsets

2003

Motorola A 760 handset (MontaVista Linux)



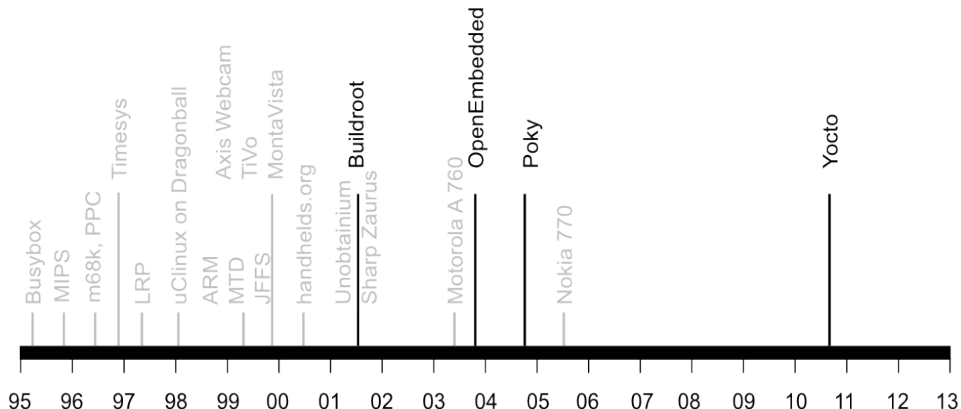
2005

Nokia 770 Internet Tablet running Maemo Linux



Embedded Linux gets easier: 2001 onwards

- Move away from RYO (Roll Your Own) embedded Linux distributions



Embedded Linux build tools

2001

Buildroot emerges from the uClinux/uClibc project

2003

OpenEmbedded Project is born, creating a common build system and code base for Familiar Linux, OpenZaurus and OpenSIMpad

2004

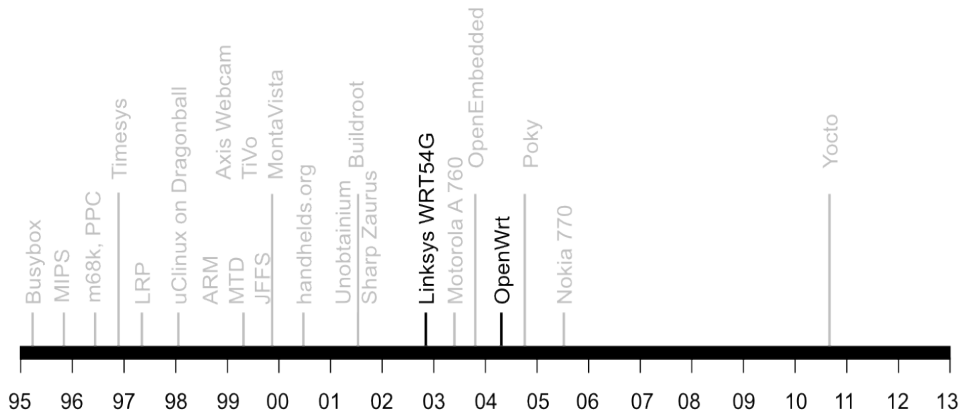
OpenedHand employee Richard Purdie creates Poky Linux based on OpenEmbedded

2010

Intel spin off Poky Linux, acquired as part of OpenedHand, as the Yocto Project

Continuing the router story: 2002 onwards

- Linux becomes accepted in consumer WiFi routers



The WRG54G and OpenWrt

2002: December: Linksys release the WRT54G

2003: July Linksys post GPL source components of the WRT54G firmware

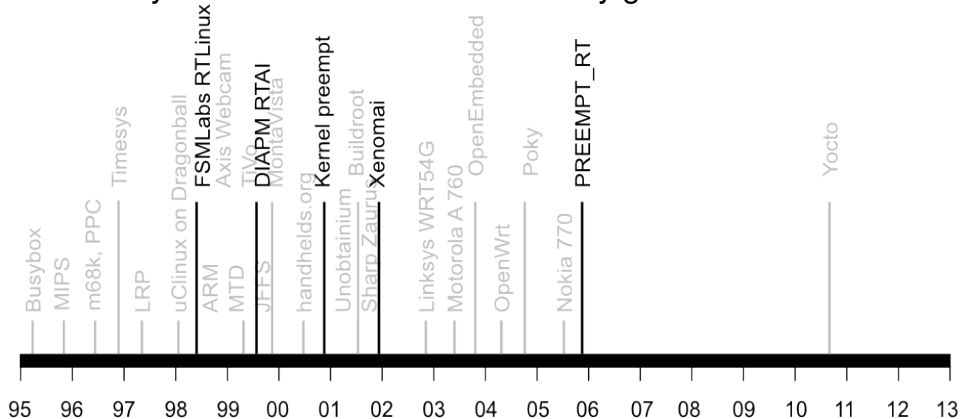
2004: OpenWRT project starts

2004 onwards: a large proportion of WiFi routers run Linux



Real-time: 1998 to present day

- Sometimes, real-world events require a deterministic response
- Early versions of Linux were not very good at real-time



Sub-kernels

1998: FSMLabs RTLinux

1999: DIAPM RTAI

2001: Xenomai

2002: DIAPM Adeos/RTAI

Patents

*FSMLabs patented techniques used in both RTLinux and RTAI
(associated with interrupt dispatching)*

*Adeos "nano kernel" implemented a different method, resolving
the patent issue (probably)*

Native real-time

2000: Timesys launch Linux/RT 1.0

2000: voluntary preempt patch (Ingo Molnar and Andrew Morton)

2001: kernel preemption patch (Robert Love)

2003: Linux 2.6 includes voluntary preempt and kernel preemption patches

2005: PREEMPT_RT kernel patch (Ingo Molnar, Thomas Gleixner and others) 2013: PREEMPT_RT still not in mainline kernel

Where are we today?

Android has 1.5 million activations per day, installed base 900 million

250 million set top boxes and smart TVs per annum

200 million WiFi routers per annum

Embedded Linux is the default OS

- Any questions?