A timeline for embedded Linux

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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

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

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