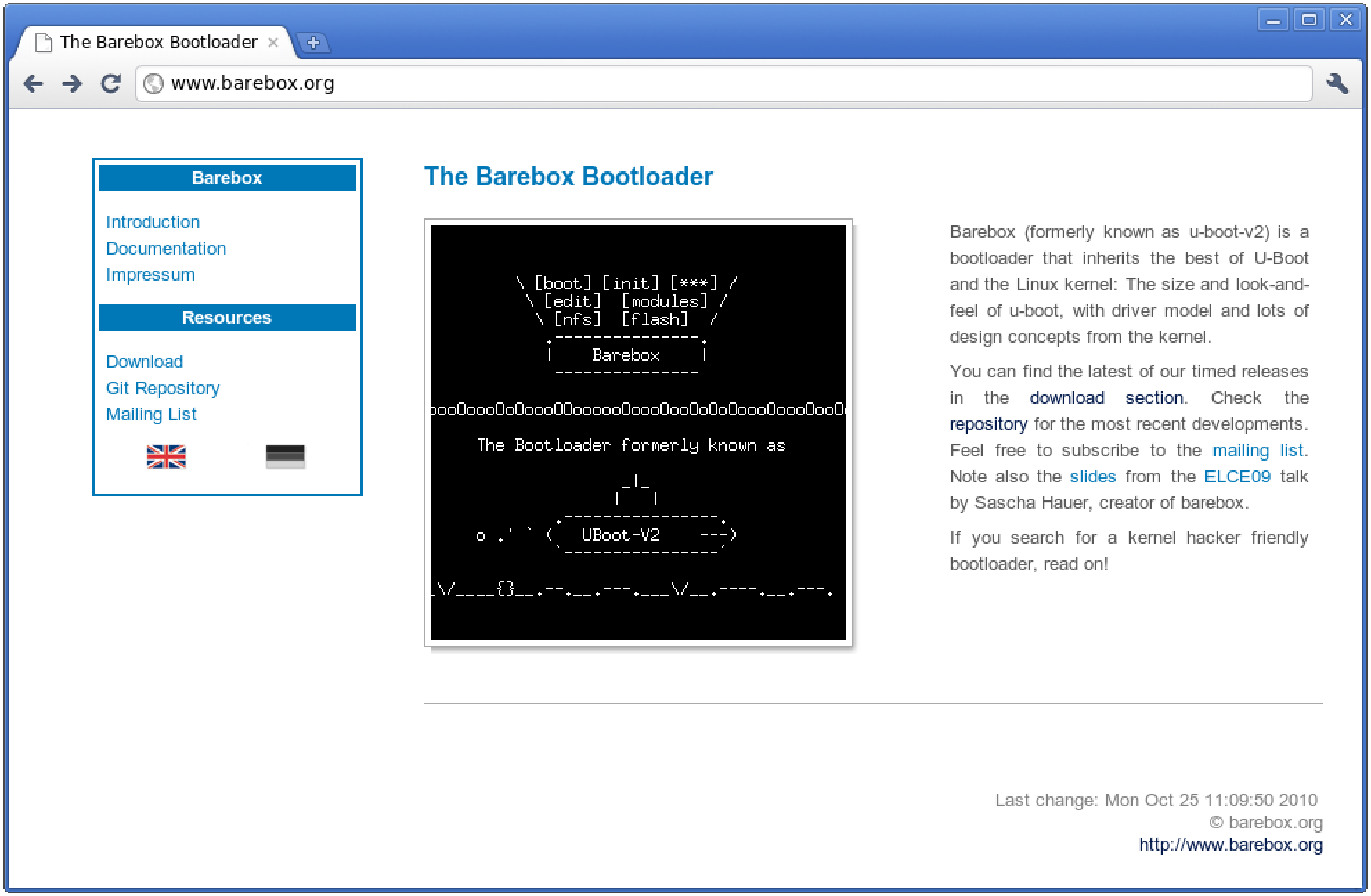
Booting Linux Fast & Fancy



The Barebox Bootloader

```
 \ [boot] [init] [***] /
  \ [edit]  [modules] /
   \ [nfs]  [flash]  /
    .---------------.
    |    Barebox    |
     ---------------

ooo0ooo0o0ooo00ooooo0ooo0oo0o0o0ooo0ooo0oo0

   The Bootloader formerly known as

              _|_
             |   |
         .---------------.
 o .' ` (   UBoot-V2    ---)
         `---------------'

_\/____{}__.--.__.---.___\/__.----.__.---.
```

Barebox (formerly known as u-boot-v2) is a bootloader that inherits the best of U-Boot and the Linux kernel: The size and look-and-feel of u-boot, with driver model and lots of design concepts from the kernel.

You can find the latest of our timed releases in the download section. Check the repository for the most recent developments. Feel free to subscribe to the mailing list. Note also the slides from the ELCE09 talk by Sascha Hauer, creator of barebox.

If you search for a kernel hacker friendly bootloader, read on!

Last change: Mon Oct 25 11:09:50 2010
© barebox.org
http://www.barebox.org

Embedded Linux Conference Europe
Cambridge, 2010-10-28
Robert Schwebel <r.schwebel@pengutronix.de>

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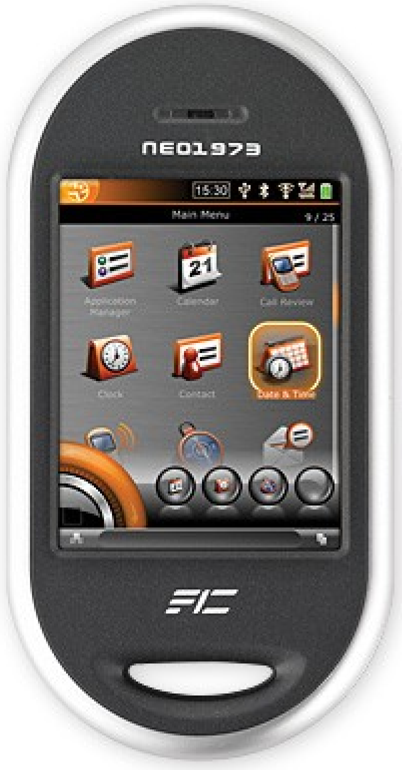
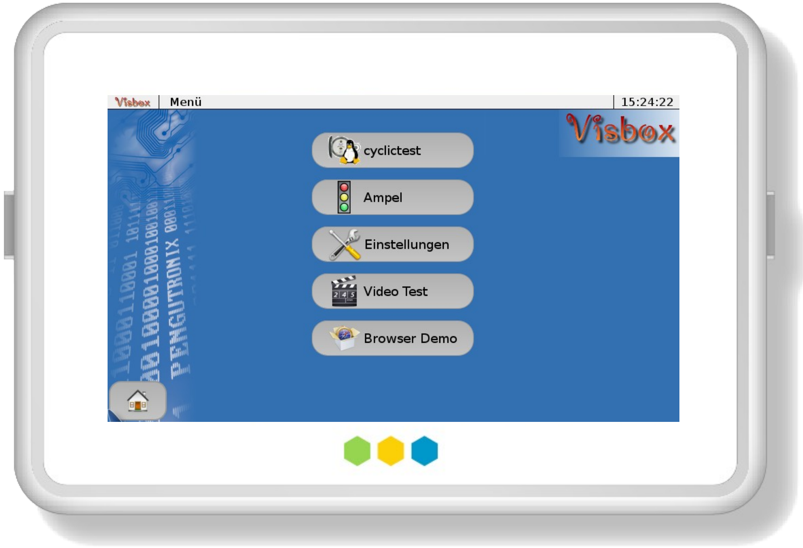
Motivation: Booting Linux Fast & Fancy I

- User experience becomes more important:



Motivation: Booting Linux Fast & Fancy II

- Industrial devices don't look like computers



- And the shouldn't boot slowly like computers...

Motivation: Booting Linux Fast & Fancy III

- Automotive devices have fast-boot requirements
- Example from a project:

  Anwering CAN messages in
  < 200 ms after power-on!

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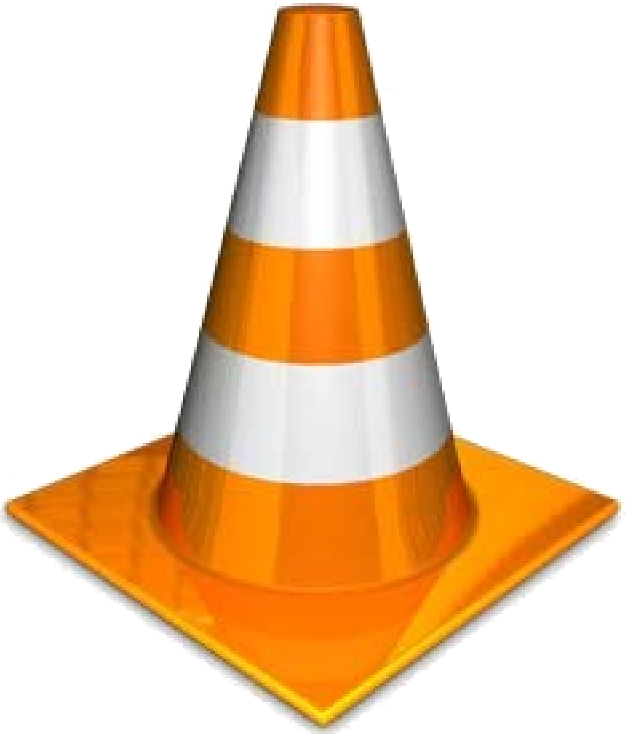
Motivation: Booting Linux Fast & Fancy IV

- Video: Start sequence on Vortex DX (800 MHz x86)



What can we do to avoid this?

Barebox: Project History

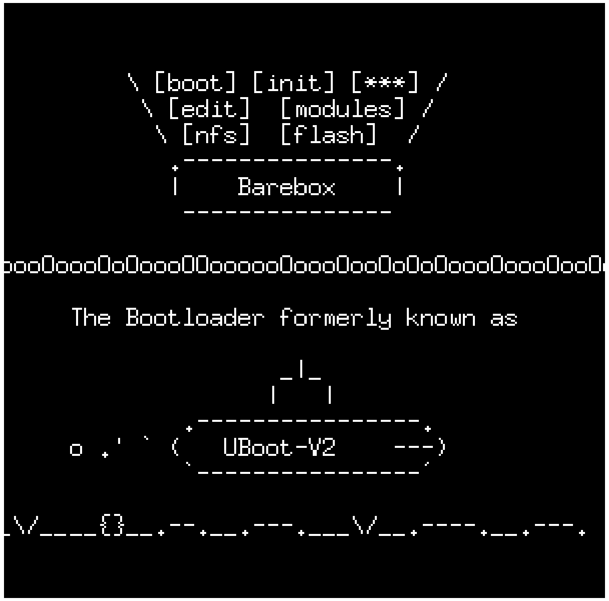
- 2007 / u-boot-v2-rc1:
  Forked from U-Boot,
  as a technology study
  under the “U-Boot-v2” name

- 2009 / barebox-2009.12.0:
  Renamed to barebox, with
  it's own infrastructure

- 2010 / barebox-2010.10.0
  20 releases up to now

- Timed releases:
  about once per month

- Maintenance releases:
  on demand



```
              \ [boot] [init] [***] /
               \ [edit]  [modules] /
                \ [nfs]  [flash]  /
                 .---------------.
                 |    Barebox    |
                  ---------------

oooOoooOoOoooOOoooooOoooOooOoOoOoooOoooOoooO

       The Bootloader formerly known as

                    _|_
                   |   |
                .----------------.
       o .' ` (   UBoot-V2    ---)
                `----------------'

_\/____{}__.--.__.---.___\/__.----.__.---.
```

Barebox: Development Resources

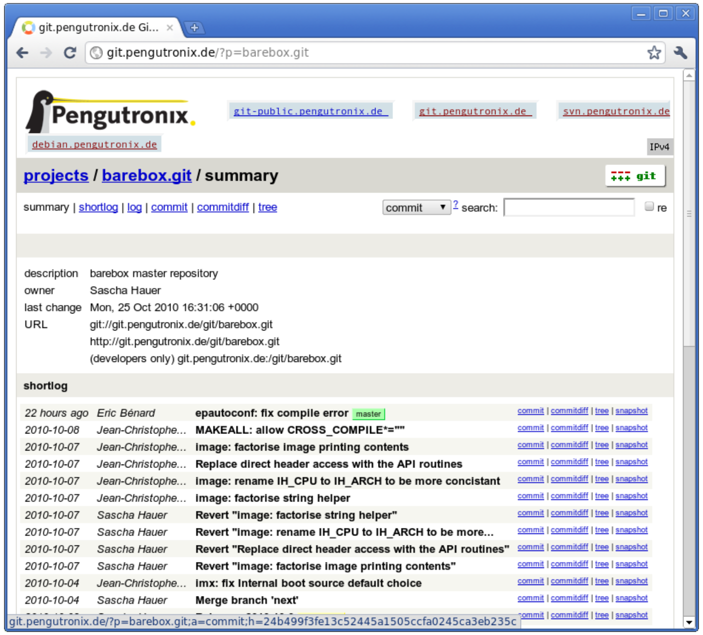
- Website:
  http://www.barebox.org

- GIT Server:
  http://git.pengutronix.de/?p=barebox.git

  next branch:
  accumulates new features

  master branch:
  next is merged into master after release

- Mailing List:
  http://lists.infradead.org/mailman/listinfo/barebox/



projects / barebox.git / summary

summary | shortlog | log | commit | commitdiff | tree

commit ▾ ? search: □ re

description	barebox master repository
owner	Sascha Hauer
last change	Mon, 25 Oct 2010 16:31:06 +0000
URL	git://git.pengutronix.de/git/barebox.git http://git.pengutronix.de/git/barebox.git (developers only) git.pengutronix.de:/git/barebox.git

shortlog

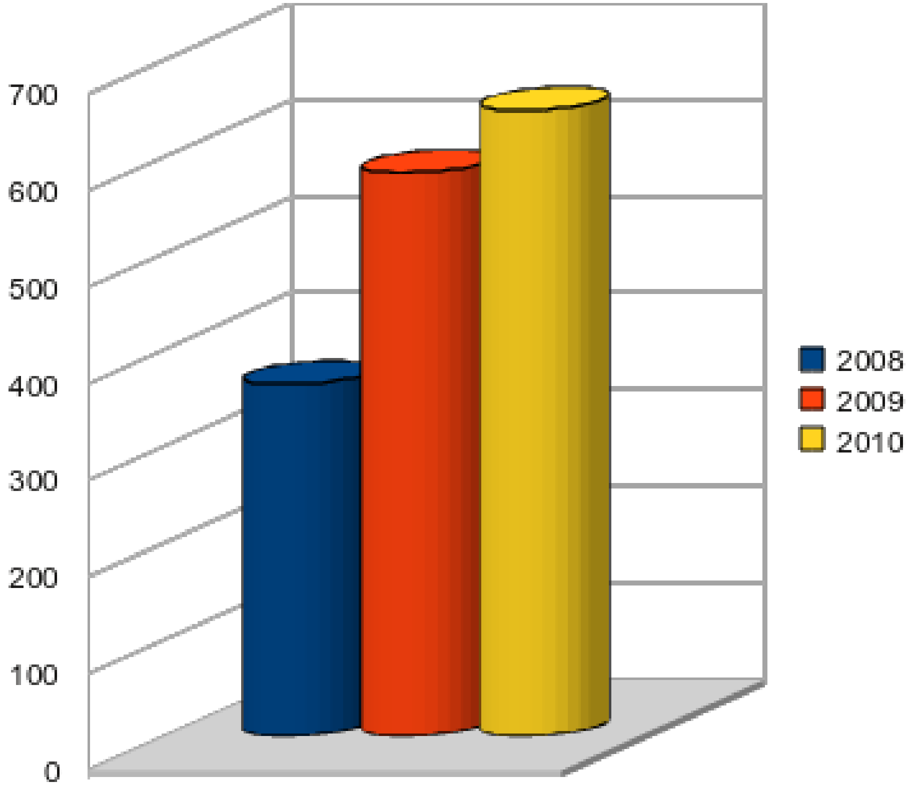
22 hours ago	*Eric Bénard*	**epautoconf: fix compile error** master	commit | commitdiff | tree | snapshot
2010-10-08	*Jean-Christophe...*	**MAKEALL: allow CROSS_COMPILE*=""**	commit | commitdiff | tree | snapshot
2010-10-07	*Jean-Christophe...*	**image: factorise image printing contents**	commit | commitdiff | tree | snapshot
2010-10-07	*Jean-Christophe...*	**Replace direct header access with the API routines**	commit | commitdiff | tree | snapshot
2010-10-07	*Jean-Christophe...*	**image: rename IH_CPU to IH_ARCH to be more concistant**	commit | commitdiff | tree | snapshot
2010-10-07	*Jean-Christophe...*	**image: factorise string helper**	commit | commitdiff | tree | snapshot
2010-10-07	*Sascha Hauer*	**Revert "image: factorise string helper"**	commit | commitdiff | tree | snapshot
2010-10-07	*Sascha Hauer*	**Revert "image: rename IH_CPU to IH_ARCH to be more...**	commit | commitdiff | tree | snapshot
2010-10-07	*Sascha Hauer*	**Revert "Replace direct header access with the API routines"**	commit | commitdiff | tree | snapshot
2010-10-07	*Sascha Hauer*	**Revert "image: factorise image printing contents"**	commit | commitdiff | tree | snapshot
2010-10-04	*Jean-Christophe...*	**imx: fix Internal boot source default choice**	commit | commitdiff | tree | snapshot
2010-10-04	*Sascha Hauer*	**Merge branch 'next'**	commit | commitdiff | tree | snapshot
			commit | commitdiff | tree | snapshot

git.pengutronix.de/?p=barebox.git;a=commit;h=24b499f3fe13c52445a1505ccfa0245ca3eb235c

Barebox: Development Speed

- Commit History:

2008	364
2009	583
2010	648 (until now)



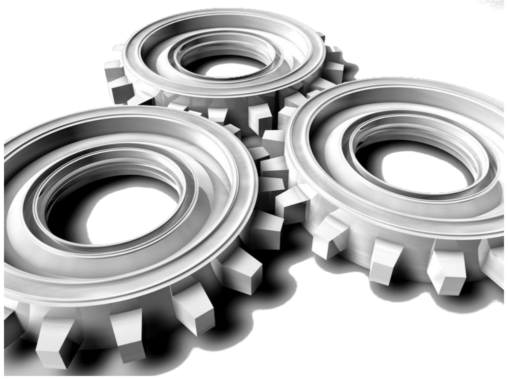
Barebox: CPU Architectures

- Supported Hardware:

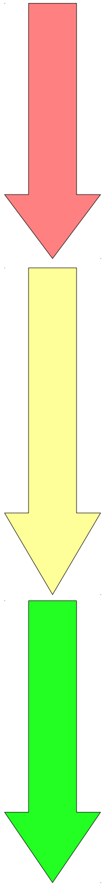
arm	at91, ep93, i.MX, netX, nomadik, omap, s3c24xx, stm
blackfin	
m68k	mcfv4e
ppc	mpc5xxx
sandbox	linux
x86	bios based

Barebox - All Features on One Slide

Build system:	Kconfig, Kbuild
Boot media:	linux16, nand, ubi, sd
Data Transport:	DFU, Kermit, X,/Y/Z-Modem, tftp
Graphics:	Framebuffer, splash screen
Filesystem:	cd, ls, cp, saveenv/loadenv, mount, partitions
Tools:	crc, edit, gpio, unlzo
User interaction:	login, menu
Drivers:	i2c, mfd, flash, serial, spi, usb host+device
Modules:	insmod, lsmod
Memory:	meminfo, memtest, md, mw
Network:	ipv4, dhcp, netconsole, tftp, rarp, ping, nfs, dns



Booting Linux Fast



Power-controller releases reset line

ROM bootloader starts running

Fetch boot block from NAND / SD card

Execute first boot code

Initialize hardware

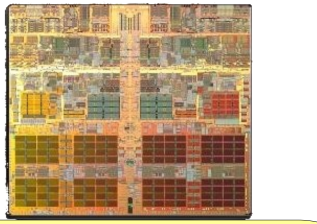
Fetch Linux kernel from NAND / SD card

Execute Linux

Extract compressed image

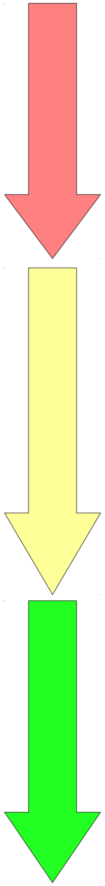
Kernel boots, initializes hardware

/sbin/init



Optimize Hardware
(Electronics)

Booting Linux Fast



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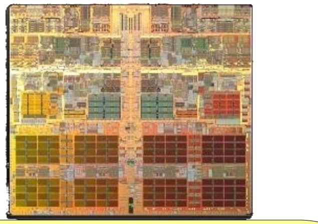
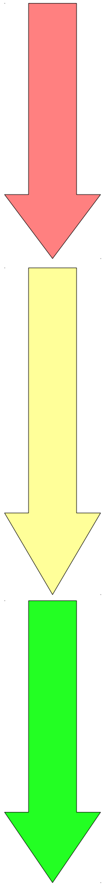


Select CPUs optimized for fastboot (i.e. MX25)

Booting Linux Fast



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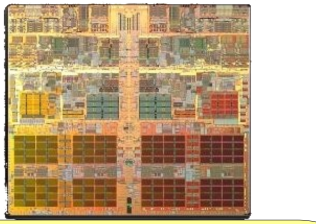
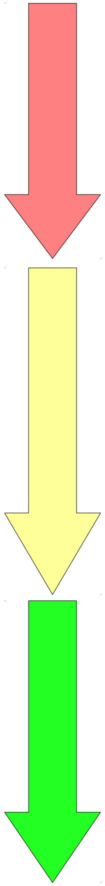


Done by firmware, cannot be tuned, usually.

Booting Linux Fast



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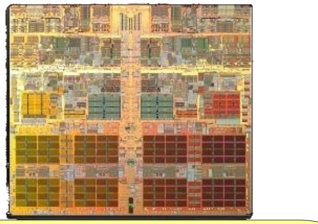
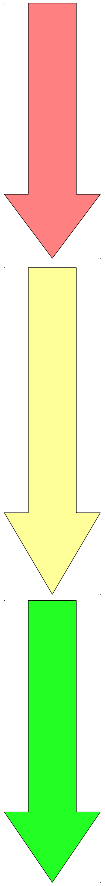


First place we can
do something
in software

Booting Linux Fast



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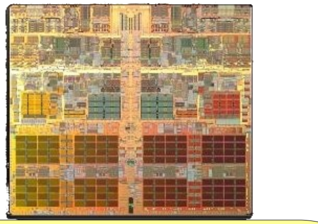
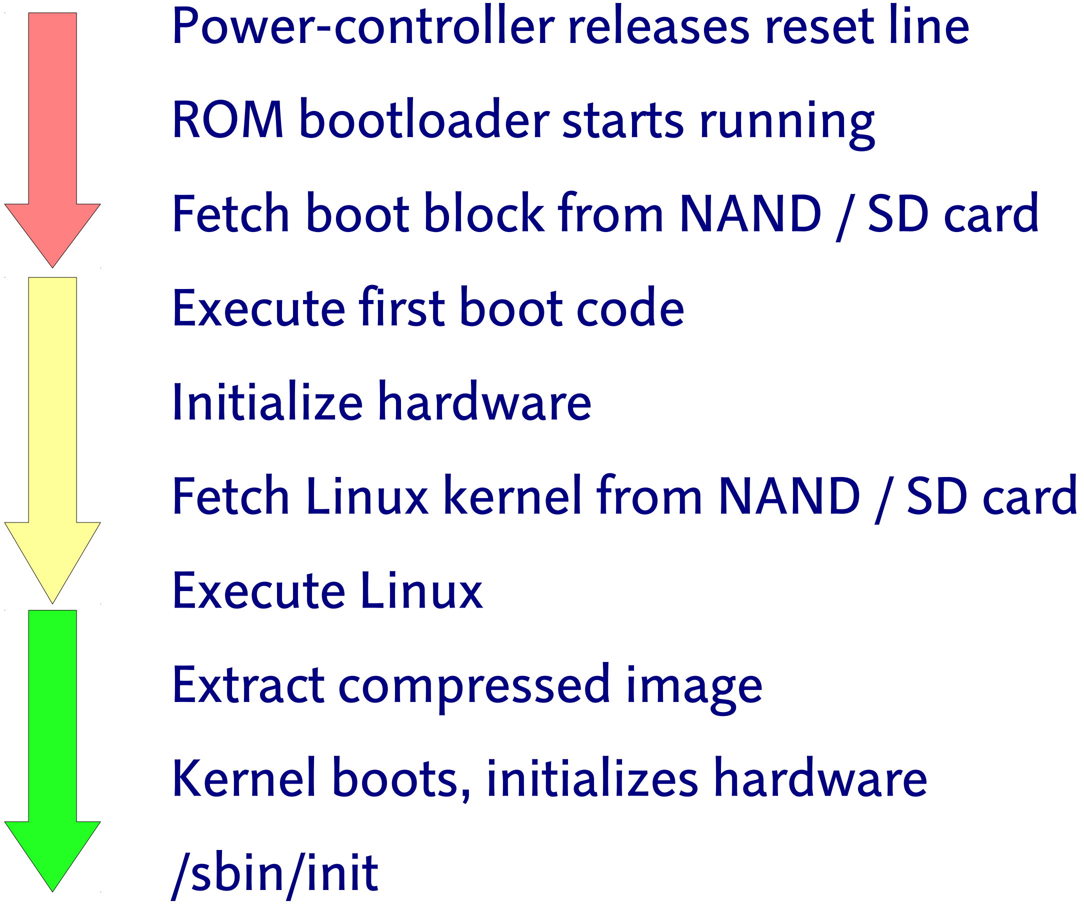


Do only what's absolutely necessary.

Tune clocks & timings.

Booting Linux Fast



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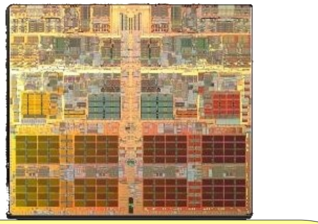
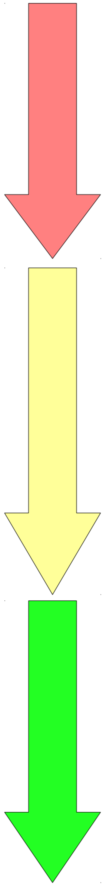


Async read and decompression tricks

Booting Linux Fast



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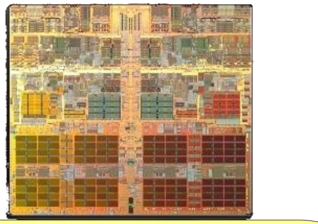
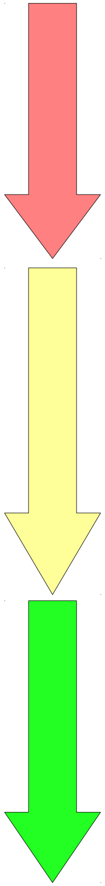


Depending on CPU, use uncompressed Image or zImage

Booting Linux Fast



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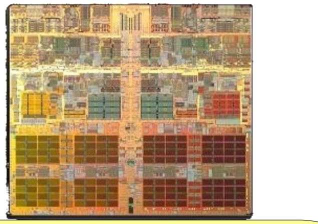

Minimized kernel, all the tricks from elinux.org wiki

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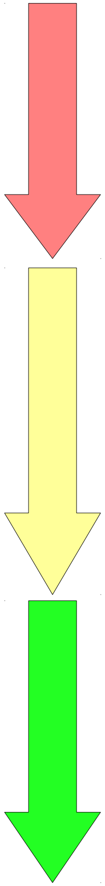
Booting Linux Fast



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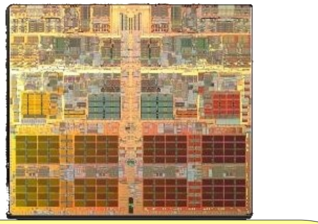
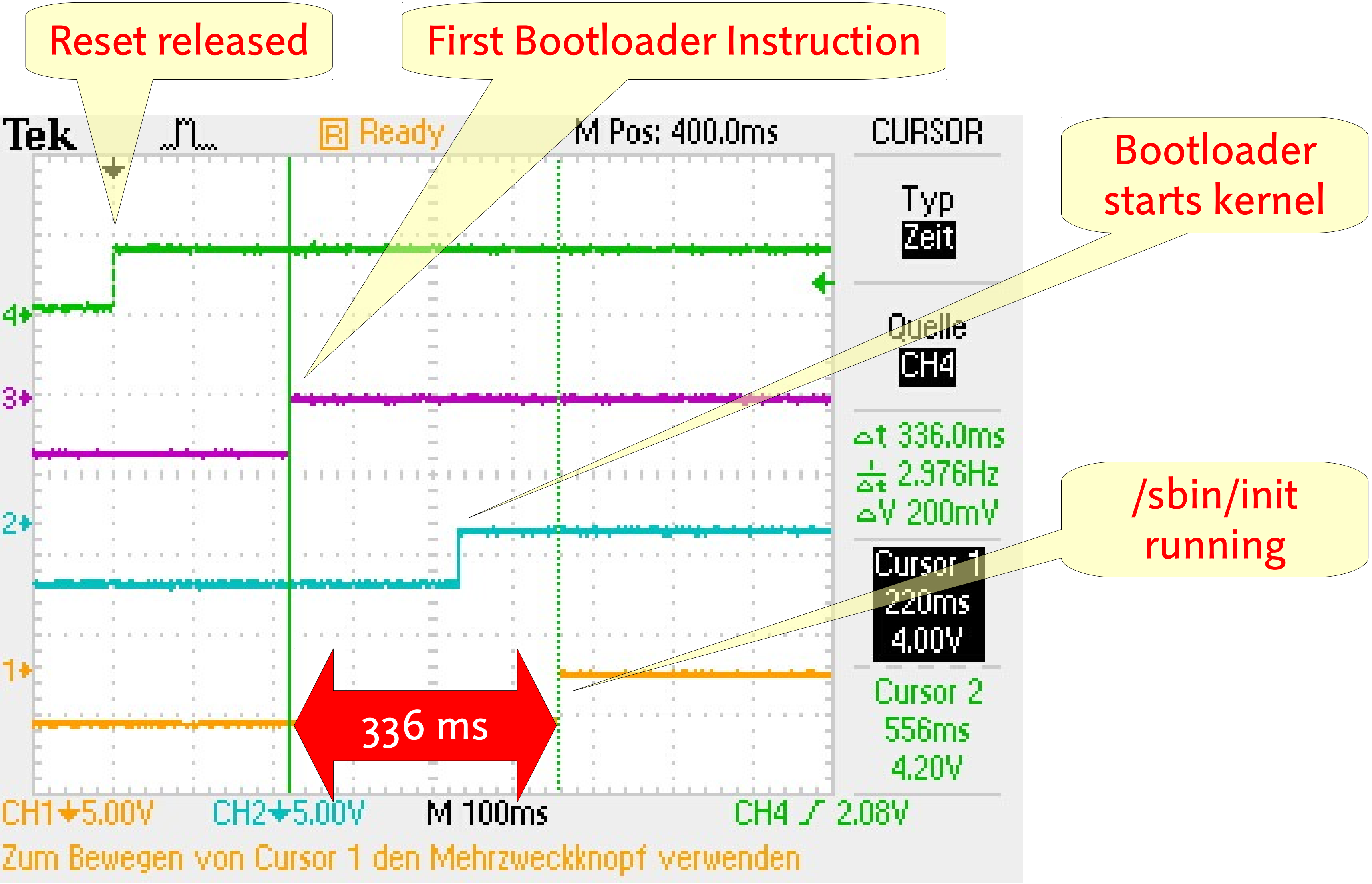


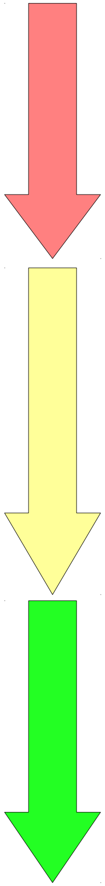
Depending on use case, use initramfs or real rootfs (slower)

Booting Linux Fast



Example: Freescale i.MX35, ARM1136EJ-S, 532 MHz

Booting Linux Fancy



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Fetch boot block from NAND / SD card

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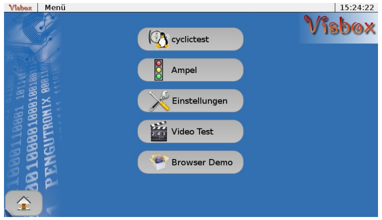
Execute Linux

Extract compressed image

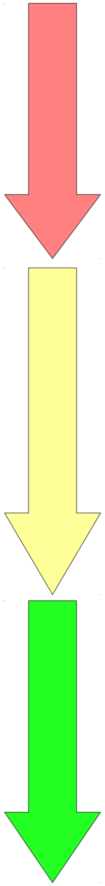
Kernel boots, initializes hardware

/sbin/init

Backlight off
Load splash
Show splash
Backlight on



Booting Linux Fancy



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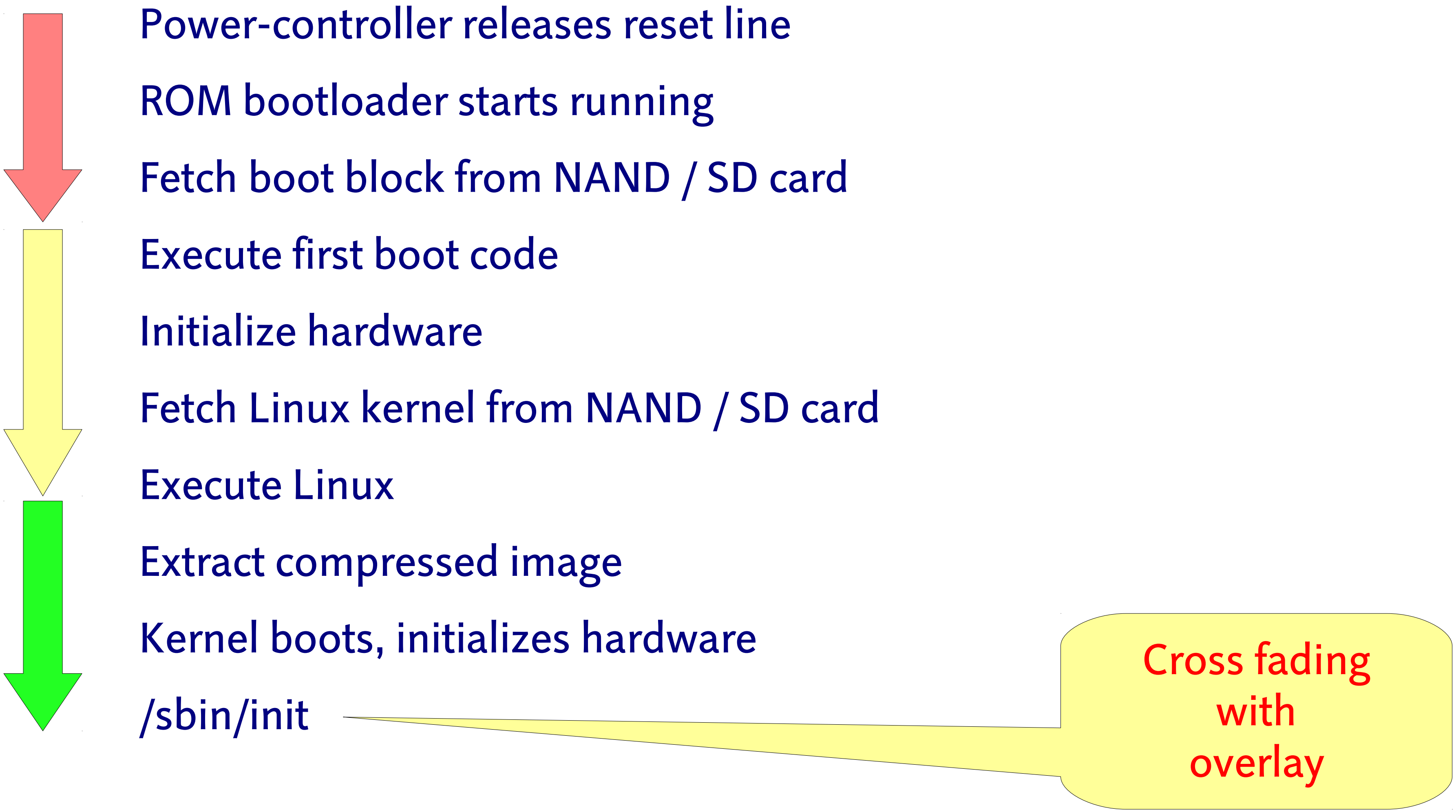
Kernel boots, initializes hardware

/sbin/init

Make sure Framebuffer has fixed address between bootloader and kernel.

No re-init!

Booting Linux Fancy



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Kernel boots, initializes hardware

/sbin/init

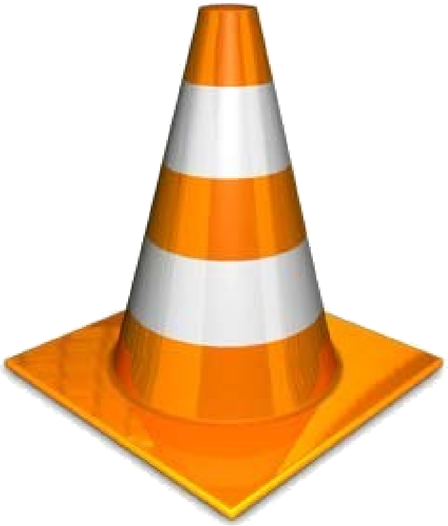
Cross fading
with
overlay

Booting Linux Fancy

- Video: Start sequence on phyCORE-i.MX27
  http://www.youtube.com/watch?v=F5Cbu1sO4D8

- Video: Start sequence on NESO (MX27, ARM926, 400 MHz)
  http://www.youtube.com/watch?v=2FZl_7u9nBE

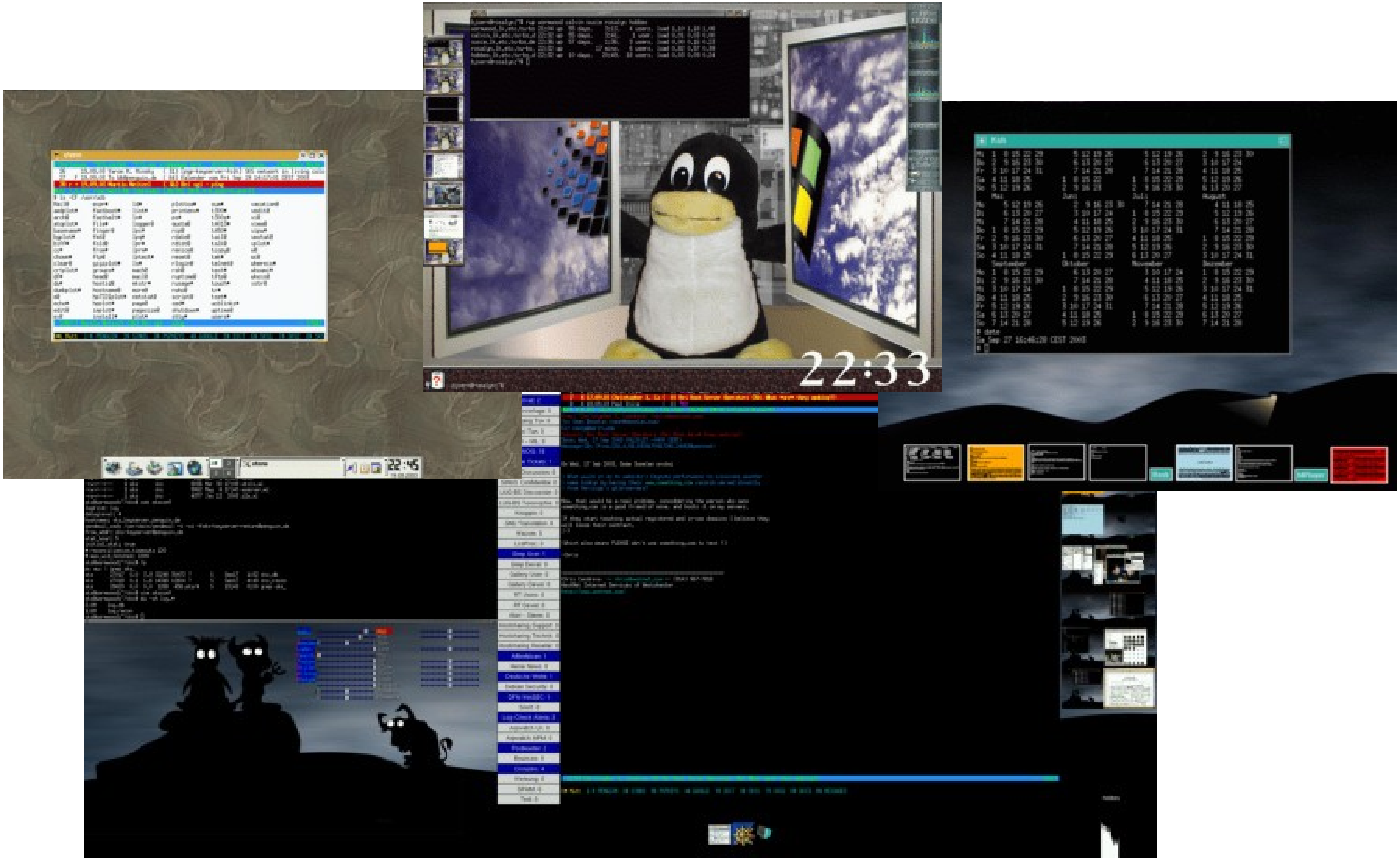
- Demo: Start sequence on CUPID (MX35, ARM1136, 532 MHz)



If fast is not fast enough ...

- We do not reach the 200 ms limit of the automotive guys
- BTCS: Boot Time Critical Services
  (originally inspired by Freescale, now implemented with mainline focus)
- Idea:
  - Set aside some memory
  - Register a “poller” in Barebox
  - Make sure memory is handed over to Linux
  - Poller ends up as a normal interrupt service routine in Linux
- We estimate to have CAN ready after about < 100 ms
- No numbers yet, measurement hardware is still under construction...
- Downside: “bare metal” stack

Thanks for Listening - Questions?



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Do we need a Bootloader at all?

- Alternative: use Linux to boot Linux (less code duplication) (See John's talk yesterday)
- Booting from NAND: we need at least a pre-loader dealing with Bad Blocks / UBI
- ROM access routines to NAND and SD are unoptimized
- Barebox offers a (to kernel developers) well-known structure, where to put code in *if* it is necessary.
- Minimal porting effort, no parallel running code
- Even if we have linux-only booting in the future, Barebox can be scaled down to the minimum, for the first stage

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