openSUSE for ARM

On Your Device
ARM Booting
ARM Booting

Boot Loader
ARM Booting

Boot Loader

Kernel
ARM Booting

Boot Loader → Kernel → User Space
ARM Booting

Boot Loader → Kernel → User Space → Appliance
Boot Loader

U-Boot

built-in  external

Others
U-Boot

- Default way of booting on ARM developer boards
- Command line
- Scripting
- GPL, so we can modify it to our needs
U-Boot
Built-in
U-Boot
Built-in
U-Boot

Built-in

CuBox

** LOADER **

U-Boot 2009.08 (Jan 15 2012 - 00:43:32) Marvell version: 5.4.4 NQ

BootROM:
  Version on chip: 2.33
  Status: OK
  Retries #: 0
Board: CuBox
SoC: 88AP510 (A1)
CPU: Marvell Sheeva (Rev 5)
  CPU @ 800Mhz, L2 @ 400Mhz
  DDR3 @ 400Mhz, TClock @ 166Mhz
PEX 0: interface detected no Link.
PEX 1: interface detected no Link.
DRAM: 1 GB
  CS 0: base 0x00000000 size 512 MB
  CS 1: base 0x20000000 size 512 MB
  Addresses 12M - 0M are saved for the U-Boot usage.
SF: Detected M25P32 with page size 64 kB, total 4 MB

Streaming disabled
L2 Cache Prefetch disabled
L2 Cache ECC disabled
Modifying CPU/CORE/DDR power rails to 1.0(-2.5%) / 1.0(-5%) / 1.5(-5%)
USB 0: Host Mode
USB 1: Host Mode
Setting VPU power OFF.
Setting GPU power ON.
MMC: MV_SDHCI: 0, MV_SDHCI: 1
Net: egiga0 [PRIME]
Hit any key to stop autoboot: 0
U-Boot
Built-in

printenv kerneladdr || setenv kerneladdr \${kernel_addr_r}
printenv ramdiskaddr || setenv ramdiskaddr \${ramdisk_addr_r}
setenv bootcmd "ext2load mmc 0:1 \${kerneladdr} boot/linux.vmx; \
ext2load mmc 0:1 \${ramdiskaddr} boot/initrd; \
bootm \${kerneladdr} \${ramdiskaddr}";

boot

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U-Boot

Built-in

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boot

boot.scr

linux.vmx

initrd
U-Boot
Built-in
Starting kernel ...

Uncompressing Linux... done, booting the kernel.
[ 0.000000] Booting Linux on physical CPU 0
[ 0.000000] Initializing cgroup subsys cpuset
[ 0.000000] Initializing cgroup subsys cpu
[ 0.000000] Linux version 3.6.0-rc7-17-cubox (abuild@build14) (gcc version 4.7.1 20120723 [gcc-4_7-branch revision 189773] (SUSE Linux) ) #2 Mon Oct 1 02:19:54 UTC 2012
[ 0.000000] CPU: ARMv7 Processor [560f5815] revision 5
(ARMv7), cr=10c53c7d
[ 0.000000] CPU: PIPT / VIPT nonaliasing data cache, PIPT instruction cache
[ 0.000000] Machine: SolidRun CuBox
[ 0.000000] Ignoring unrecognised tag 0x41000403
[ 0.000000] Ignoring unrecognised tag 0x41000404
[ 0.000000] Memory policy: ECC disabled, Data cache writeback
[ 0.000000] Built 1 zonelists in Zone order, mobility grouping on. Total pages: 260096
[ 0.000000] Kernel command line: loader=uboot disk=/dev/disk/by-id/mmc-SU04G_0x0509b5dc resume=openSUSE-Factory-ARM-cubox console=ttys0,115200n8
[...]

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Starting kernel ...

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[...]
U-Boot

External
U-Boot
External
U-Boot

External
U-Boot
External
U-Boot
External
U-Boot

External

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U-Boot
External

SPL
/boot
U-Boot 2012.04.01 (Oct 18 2012 - 10:24:59) for ORIGEN

CPU:    S5PC210@1000MHz
Board:   ORIGEN
DRAM:   1 GiB
WARNING: Caches not enabled
MMC:    SAMSUNG SD/MMC: 0
*** Warning - bad CRC, using default environment

In:    serial
Out:   serial
Err:   serial
Hit any key to stop autoboot: 0
U-Boot

External

- Rest of boot identical to built-in u-boot
Other bootloaders
Other bootloaders

- Some OSes have special bootloaders
- Load specific format straight on
- Bad for openSUSE
- Best bet: Get u-boot running
Boot Loader

Kernel

User Space
Kernel
Kernel

Upstream
Kernel

Upstream

Downstream
Kernel

Upstream

Downstream

Proprietary
Upstream Kernel

- Code is in Linus’ git tree
- Automatically pulled in by openSUSE
- Doesn’t support all devices usually
- Different kernels have different targets
- Getting unified in ‘single zImage’ effort
Upstream Kernel

- OMAP3-5
- Beagle Board
- Panda Board
- Highbank
- i.MX 51,53,6 (no gfx)
- Samsung Exynos 4,5
- ...

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Downstream Kernel

• Some kernel tree on the internet
• Open Source, but not mainline
• Not picked up by openSUSE
• “Normal” case in the ARM world
• Supports a board/SoC completely
Downstream Kernel

- Raspberry Pi
- Efika MX (2.6.31)
- NVidia Tegra AC100
Kernel
Kernel

Proprietary
Proprietary Kernel

• Can not be downloaded anywhere
• Does not adhere to the GPL
• Ask / sue your device manufacturer
http://download.opensuse.org/repositories/openSUSE:12.2:/ARM/images/openSUSE-12.2-ARM-JeOS.armv7l-*.tbz
SUSE Rootfs

- Download .tbz
- Extract to a partition
- Boot from it!
Starting Command Scheduler...
Started Command Scheduler
[ OK ]
Starting LSB: Configure the remote-fs depending network interfaces...
Starting OpenSSH Daemon...
Starting /etc/init.d/boot.local Compatibility...
Started /etc/init.d/boot.local Compatibility
[ OK ]
Starting Wait for Plymouth Boot Screen to Quit...
Starting Terminate Plymouth Boot Screen...

Welcome to openSUSE 12.3 "Mantis" - Kernel 3.6.0-rc7-17-cubox (ttyS0).

linux login:
Done, are we?
openSUSE way

- Packaging
- Appliance building
• Create your own repo in your home directory for your target

• copy meta prj and meta prjconf from openSUSE:12.2:Contrib:* to your project

• Adjust them for your target
U-boot

- Boot from ext2/3, no FAT
- Provide $kerneladdr and $ramdiskaddr
- Default openSUSE boot.scr on SD card
- Package it as rpm to /boot/u-boot.bin
Kernel

Upstream

Downstream
Kernel

Upstream
Upstream

- Fetch openSUSE kernel git
- Add config for your SoC / board
- Update your config for openSUSE kernel
- Package it up as rpm source
- Build it
$ git clone git://kernel.opensuse.org/kernel-source.git
Initialized empty Git repository in /dev/shm/kernel-source/.git/
remote: Counting objects: 213374, done.
remote: Compressing objects: 100% (69607/69607), done.
remote: Total 213374 (delta 144761), reused 208009 (delta 141278)
Receiving objects: 100% (213374/213374), 861.77 MiB | 11600 KiB/s, done.
Resolving deltas: 100% (144761/144761), done.
Upstream

• Add config for your SoC / board

$ cd kernel-source
$ cp /working_kernel/.config config/armv7hl/<your target>
$ vi config.conf
<add your target to +armv7hl list>
Update your config for openSUSE kernel

$ ./scripts/sequence-patch.sh
./scripts/sequence-patch.sh
WARNING: You should run ./scripts/install-git-hooks to enable pre-commit checks.
SCRATCH_AREA not defined (defaulting to "tmp")
Creating tree in /dev/shm/kernel-source/tmp/linux-3.6-master
Cleaning up from previous run (background)
Linking from /dev/shm/kernel-source/tmp/linux-3.6.orig
 [ patches.kernel.org/patch-3.6.1 ]
 [ patches.kernel.org/patch-3.6.1-2 ]
 [ ... ]
$ cd tmp/linux-3.6-master/
$ ./run-oldconfig.sh --arch armv7hl --flavor <your target>
Upstream

- Package it up as rpm source

$ ./scripts/tar-up.sh
WARNING: You should run ./scripts/install-git-hooks to enable pre-commit checks.
linux-3.6.tar.bz2
config.tar.bz2
patches.apparmor.tar.bz2
patches.arch.tar.bz2
patches.drivers.tar.bz2
patches.fixes.tar.bz2
patches.kernel.org.tar.bz2
patches.rpmify.tar.bz2
[...]
$ cd kernel-source
$ osc build --alternative-project openSUSE:12.2:ARM standard armv7l kernel-<target>.spec
WARNING: package is not existing on server yet
WARNING: source service from package or project will not be executed. This may not be the same build as on server!
Building kernel-omap2plus.spec for standard/armv7l
Getting buildinfo from server and store to /dev/shm/kernel-source/kernel-source/_buildinfo-standard-armv7l.xml
Getting buildconfig from server and store to /dev/shm/kernel-source/kernel-source/_buildconfig-standard-armv7l
Updating cache of required packages
[...]
Kernel

Upstream

Downstream
Kernel

Downstream
• Good luck :)

Downstream
• Check out the Raspberry Pi kernel image

Kiwi
Kiwi

- Easy framework to create your own image
- Create JeOS description in your repo
- Change config according to your target
- Fine tune U-boot setup scripts
Kiwi

• Create JeOS description in your repo

$ osc copypac openSUSE:12.2:ARM:Contrib:Highbank JeOS-highbank
<your repo> JeOS-<target>
$ osc co <your repo> JeOS-<target>
$ cd <your repo>/JeOS-<target>
$ mv JeOS-highbank.kiwi JeOS-<target>.kiwi
$ vi JeOS-<target>.kiwi
Kiwi

• Change config according to your target

```xml
<image schemaversion="5.5" name="openSUSE-12.2-ARM-JeOS-highbank">
  <preferences>
    <type image="oem" filesystem="ext3" boot="oemboot/suse-12.2" bootloader="uboot" kernelcmdline="console=ttYAMA0" editbootconfig="uboot-image-setup" editbootinstall="uboot-image-install" />
  </type>
  <repository type="rpm-md">
    <source path="obs://openSUSE:12.2:ARM/standard"/>
  </repository>
  <repository type="rpm-md">
  </repository>
  <packages type="bootstrap">
    <package name="kernel-highbank" bootinclude="true"/>
  </packages>
</image>
```
Kiwi

• Build it

$ osc build *.kiwi images armv7l
Building JeOS-panda.kiwi for images/armv7l
Overriding config value for packagecachedir='/var/tmp/osbuild-packagecache'
with '/studio/arm/pkgs/'
Getting buildinfo from server and store to /studio/arm/openSUSE:12.2:ARM/
JeOS/.osc/_buildinfo-images-armv7l.xml
Getting buildconfig from server and store to /studio/arm/openSUSE:12.2:ARM/
JeOS/.osc/_buildconfig-images-armv7l
Updating cache of required packages
0.0% cache miss. 1440/1440 dependencies cached.
[...]

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Boot up and debug!