

Buildroot

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گروه کاربران لینوکس تهران
تابستان ۱۳۹۳

Buildroot

Buildroot is an embedded Linux build system to automate the process of building operating system from source

Cross Compilation

A **cross compiler** is a compiler capable of creating **executable** code for a platform **other than** the one on which the compiler is running.

Wikipedia

x86 Booting Process

- Power on the computer
- CPU runs BIOS
- BIOS does POST
- BIOS finds boot loader
- BIOS loads boot loader

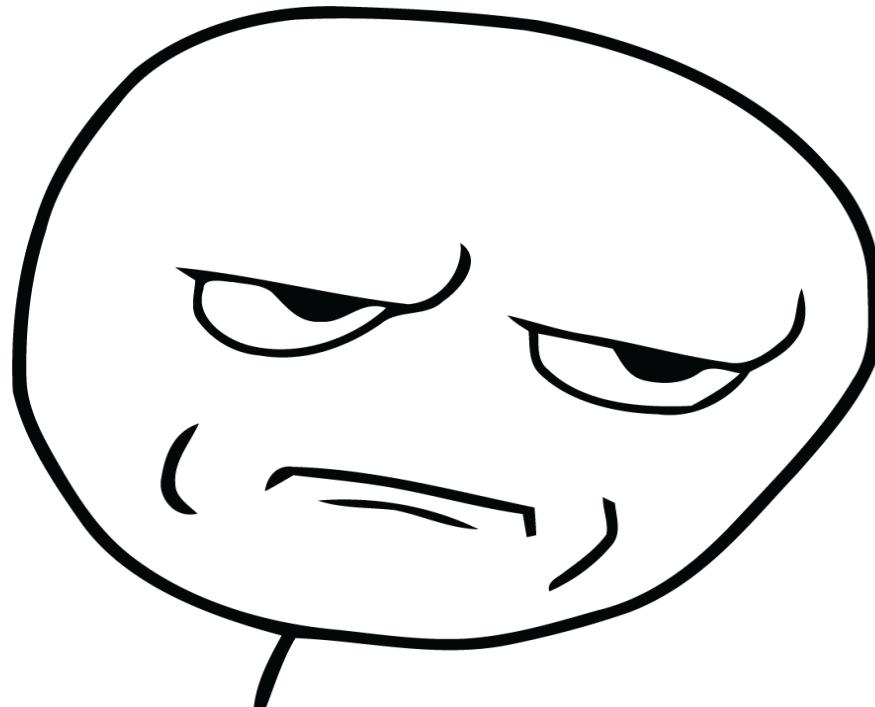
x86 Booting Process

- Bootloader loads Kernel and `initrd/initramfs`
- Kernel does initialization(load drivers)
- Kernel mounts main root file system
- Kernel executes init

chiken-and-egg problem

- Kernel needs root fs to load drivers
- Root fs has not been mounted yet

ARE YOU FUCKING KIDDING ME



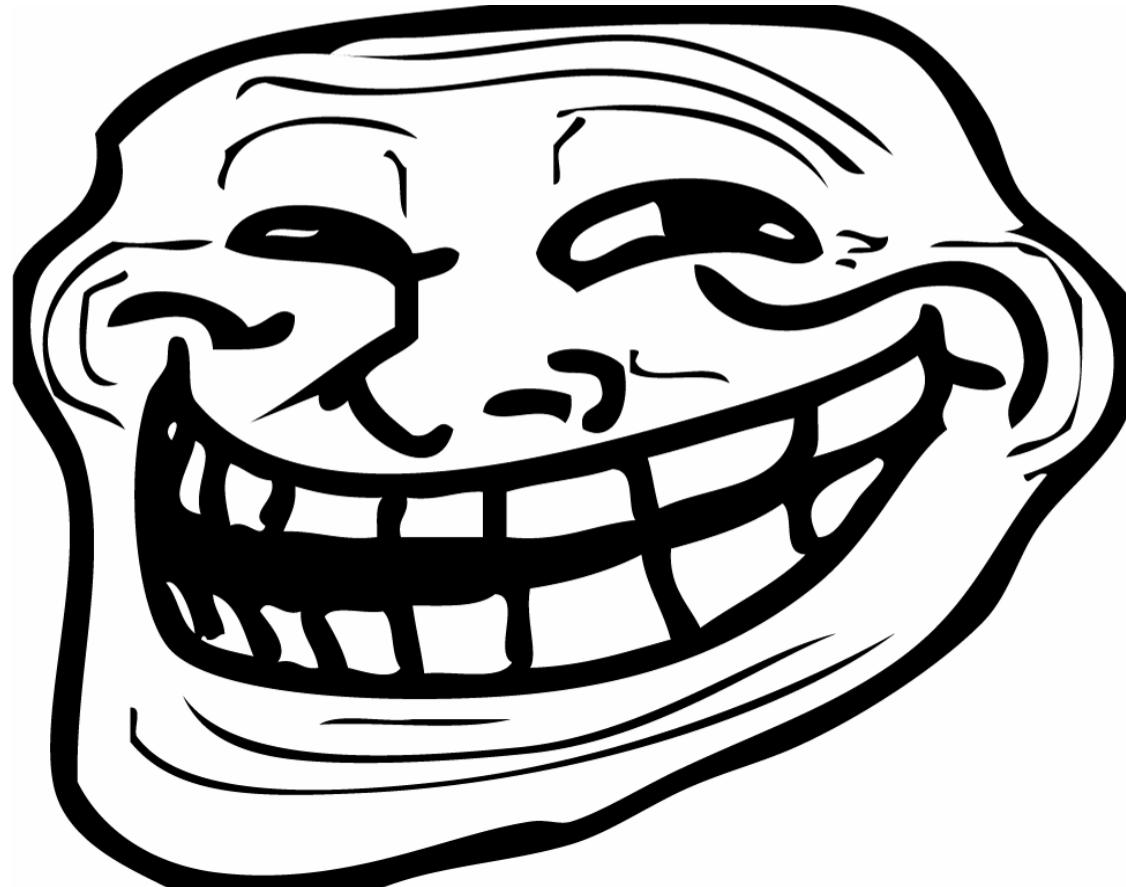
initrd / initramfs

Temporary root file system that is loaded in to memory in boot process.

initrd / initramfs

- **initrd**
 - Kernel run `/linuxrc`
 - `/linuxrc` mounts main root file system
 - `/linuxrc` executes **init** process
- **initramfs**
 - Kernel directly runs **init**
 - **init** process loads whatever is needed

ARM Boot Process



Where is God Damn BIOS?

ARM Boot Process

- BootRom is an internal loader of BootStrap
- BootStrap initializes external RAM and loads Bootloader
- Bootloader loads Kernel and provides boot arguments
- Kernel mounts RootFS
- Kernel starts init process

Buildroot

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Buildroot

- Cross compile tool chain
- Boot loader / Kernel / RootFS generator
- User space libraries or applications
- Completely written in **make**

OS Components

- Boot loader
- Kernel
- Root File System
 - C library
 - Basic tools
 - Libraries and applications

Kernel: Which board?

- Official Kernel support
- BSP (Board Support Package)
- Patch
- Custom vendor supplied Kernel

Board Support Package

Implementation of **specific support code**
for given **motherboard**, commonly built
into **bootloader**

defconfig

A text file containing which feature has been selected:

CONFIG_64BIT=y

CONFIG_X86_64=y

CONFIG_X86=y

CONFIG_INSTRUCTION_DECODER=y

CONFIG_OUTPUT_FORMAT="elf64-x86-64"

CONFIG_ARCH_DEFCONFIG="arch/x86/configs/x86_6
4_defconfig"

CONFIG_LOCKDEP_SUPPORT=y

CONFIG_STACKTRACE_SUPPORT=y

C Library: glibc

- Large binaries
 - Smallest static C program is 662 KB
- Stable
- Maximum binary performance
- Maximum **POSIX** compliance
- Minimal configurable feature set
- No **atomic** upgrade
- Backward compatible

C Library: uClibc

- Small binaries
 - Smallest static C program is 7 KB
- Medium binary performance
- Normal **POSIX** compliance
- **Maximum** configurable feature set
- **No atomic** upgrade
- **NOT** backward compatible

C Library: musl libc

- Small binaries
 - Smallest static C program is 1.8 KB
- High binary performance
- Normal **POSIX** compliance
- **No** configurable feature set
- **Atomic** upgrade
- **Backward / Forward** compatible

C Library: dietlibc

- Smallest binaries
 - Smallest static C program is 0.2 KB
- Worst binary performance
- Worst POSIX compliance
- Minimal configurable feature set
- No Atomic upgrade
- Not backward / forward compatible

BusyBox

BusyBox provides several **stripped-down**
Unix tools in a **single** executable file

`/bin/ls` ---> `/bin/busybox ls`

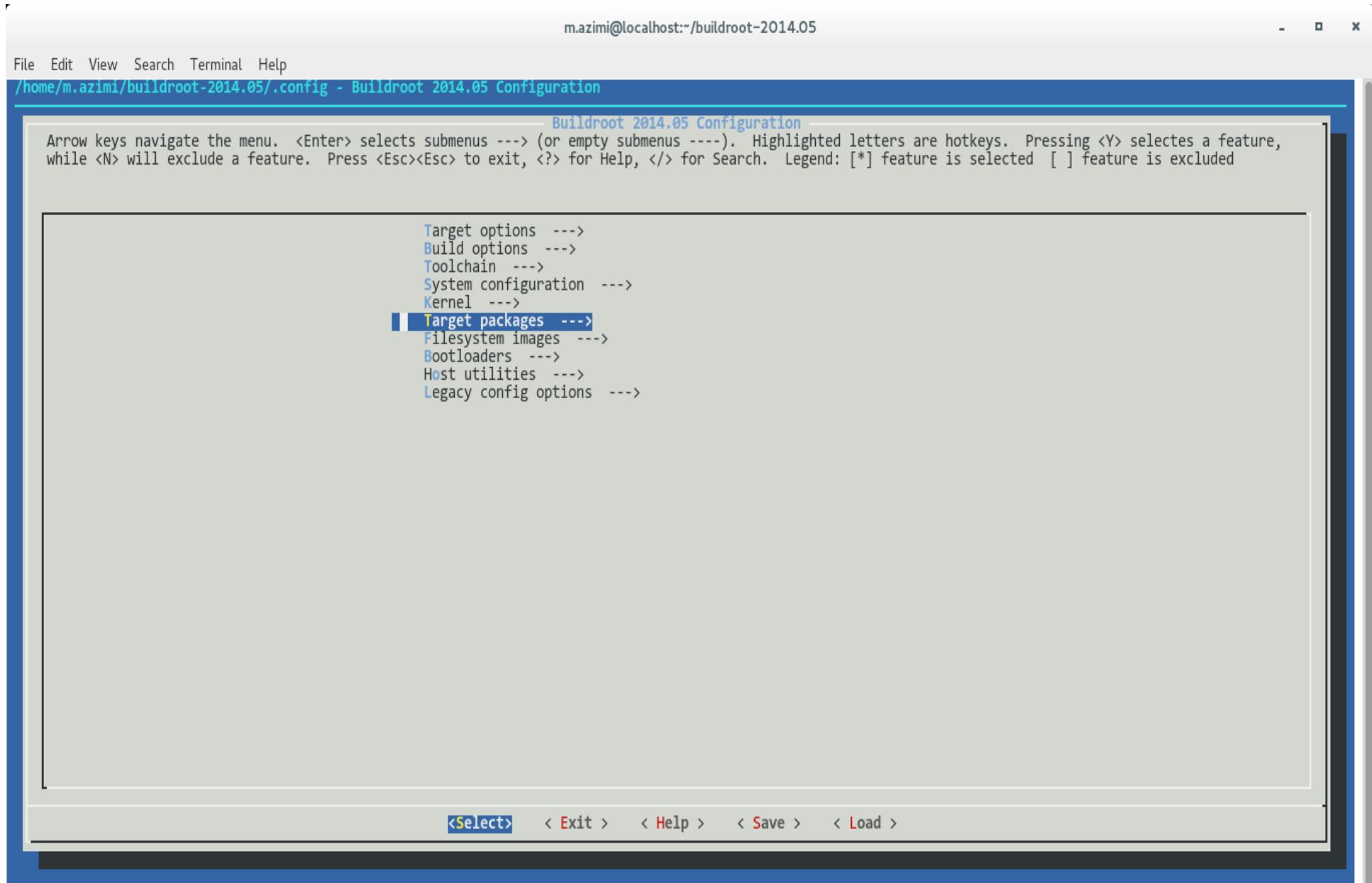
BusyBox

basename, bbconfig, beep, blkid, blockdev,
bootchartd, brctl, bunzip2, bzcat, bzip2, cal,
cat, catv, chat, chattr, chgrp, chmod, chown,
chpasswd, chpst, chroot, chrt, chvt, cksum, clear,
cmp, comm, conspy, cp, cpio, **crond**, crontab,
cryptpw, cttyhack, cut, date, dc, dd, deallocvt,
delgroup, deluser, depmod, devfsd, devmem, df,
dhcprelay, diff, dirname, dmesg, **dnsd**,
dnsdomainname, dos2unix, dpkg, dpkg-deb, du,
dumpkmap, dumpleases, echo, ed, egrep, eject, env,
envdir, envuidgid, ether-wake, expand, expr,
fakeidentd, false, fbset, fbsplash, fdflush,
fdformat, fdisk, fgconsole, fgrep, **find**, findfs,
flash_eraseall, flash_lock, flash_unlock, flashcp,
flock, fold, free, freeramdisk, **fsck**, fsck.minix,
fsync, **ftpd**, ft

BuildRoot

- make menuconfig
- make linux-menuconfig
- make uclibc-menuconfig
- make busybox-menuconfig
- make

make menuconfig



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