

Buildroot

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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

chicken-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

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

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_64_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: musllibc

- 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, 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, dealloct, 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

m.azimi@localhost:~/buildroot-2014.05

File Edit View Search Terminal Help

/home/m.azimi/buildroot-2014.05/.config - Buildroot 2014.05 Configuration

Buildroot 2014.05 Configuration

Arrow keys navigate the menu. <Enter> selects submenus ---> (or empty submenus ----). Highlighted letters are hotkeys. Pressing <Y> selects a feature, while <N> will exclude a feature. Press <Esc><Esc> to exit, <?> for Help, </> for Search. Legend: [*] feature is selected [] feature is excluded

```
Target options --->
Build options --->
Toolchain --->
System configuration --->
Kernel --->
*Target packages --->
Filesystem images --->
Bootloaders --->
Host utilities --->
Legacy config options --->
```

<Select> < Exit > < Help > < Save > < Load >

?