Linux File System

For Flash

- JFFS2
  - Journalling Flash FileSystem, for Nor
- Yaffs
  - Yet Another Flash File System, for Nand
- Cramfs
  - Compressed ROM File System
- Ubifs
  - Unsorted Block Image File System, UBIFS
  - for Nand

For RAM

- Ramdisk
  - initrd
- ramfs/tmpfs
- NFS
  - Network File System

For Disk

- Ext/2/3
- FAT32
- NTFS

YAFFS/YAFFS2

Description	Yet Another Flash FileSystem. Works, in principle, much like JFFS2, but designed specifically for NAND flash devices, which are a bit different than MTD flash devices.
When to Use	NAND flash devices
Capacity and Limitations	2^{32} GB, 2^{32} files Complete POSIX metadata No compression
How to Use	Filesystems created using user space tool, much like JFFS2. The resulting file can then be written directly to a flash partition.
Home Page More Info	http://www.aleph1.co.uk/taxonomy/term/31 http://www.aleph1.co.uk/node/40 http://lldn.timesys.com/docs/tiny_flash

JFFS2

Description	Read/Write filesystem designed specifically for MTD/Flash based devices. Handles wear leveling and compresses data during creation and subsequent writes
When to Use	Flash-based storage hardware
Capacity and Limitations	2^{32} GB, 2^{32} files, Page size from 2^{12} to 2^{18} Complete POSIX meta data Mounts slowly (improved lately); at capacity, writes can be slow
How to Use	`$ mkfs.jffs2 -o ../<bsp_name>-flash.jffs2 -e 00040000` Full details at: http://lldn.timesys.com/docs/jffs2 rootfstype=jffs2 on the command line, mounting the /dev/mtdblock device as the root device.
Home Page More Info	http://sourceware.org/jffs2 http://sourceware.org/jffs2/jffs2-html/jffs2-html.html http://lldn.timesys.com/tag/jffs2

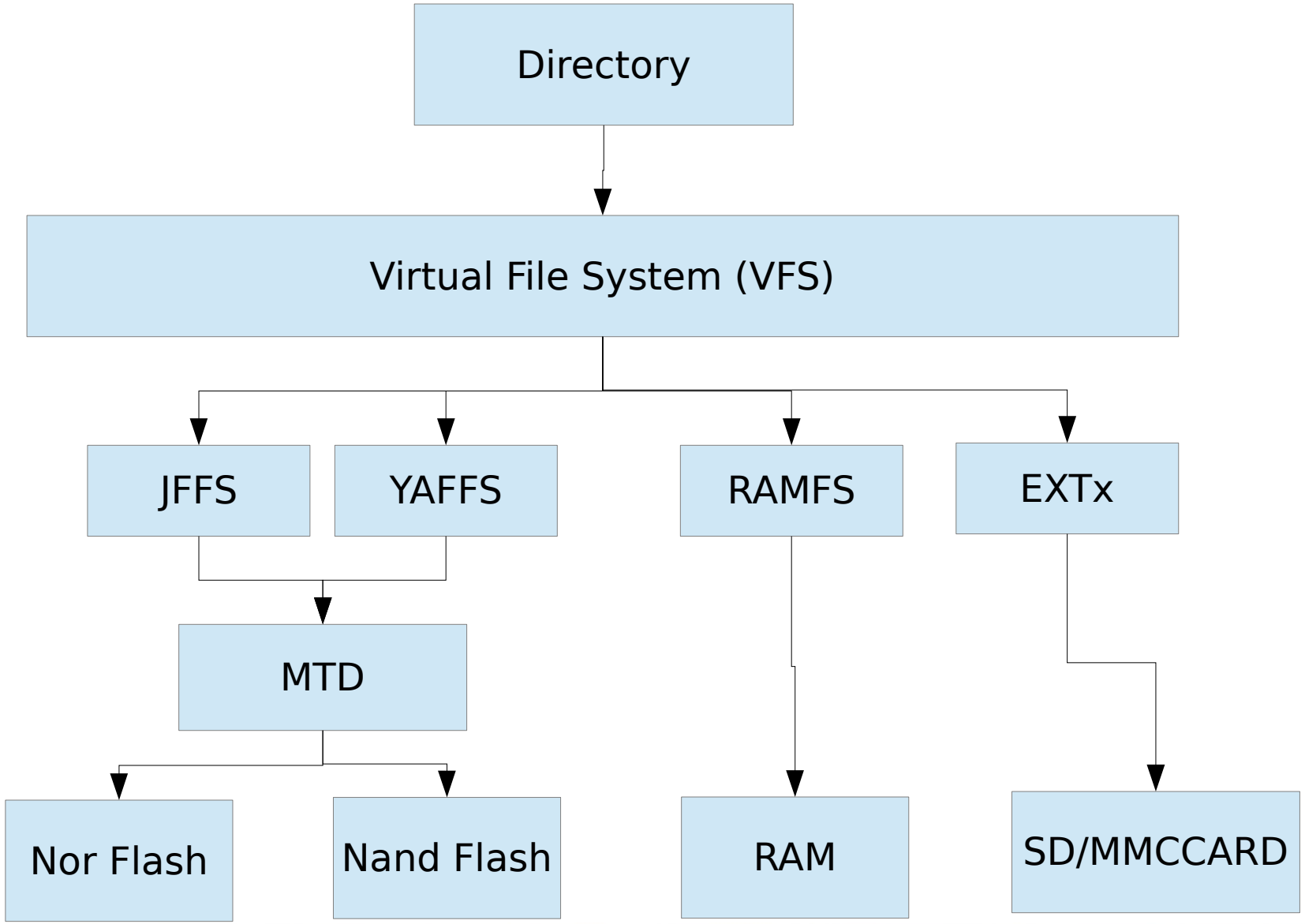
CRAMFS

Description	Compressed ROM Filesystem. Read only filesystem widely used in the embedded space. Data stored in compressed format (zlib).
When to Use	▪ Low-memory systems ▪ Ensures RFS integrity ▪ Metadata not important (doesn't store full information)
Capacity and Limitations	256 MB, 2^{16} files Does not store all permissions, all files owned by root. No timestamps stored (inode overhead is just 12 bytes!)
How to Use	`$ mkcramfs -m dev.cramfs.txt <rfs_dir> rootfs.cramfs` Full details at: http://lldn.timesys.com/docs/cramfs
Home Page More Info	http://sourceforge.net/projects/cramfs http://lldn.timesys.com/tag/cramfs

Ext2/3

Description	Ext2 shipped with Linux from the start. Most systems today use the journaling cousin of ext2, named ext3.
When to Use	▪ Ramdisks ▪ Low-resource systems
Capacity and Limitations	2 TB, 10^{18} files Full complement of file ownership and permissions
How to Use	Most systems ship with ext2/3 drivers and utilities as part of the distribution. Typical usage pattern is to create a partition directly on a block device, or use a loopback block device that is bound to a file.
Home Page More Info	http://e2fsprogs.sourceforge.net/ext2.html http://lldn.timesys.com/tag/ext2

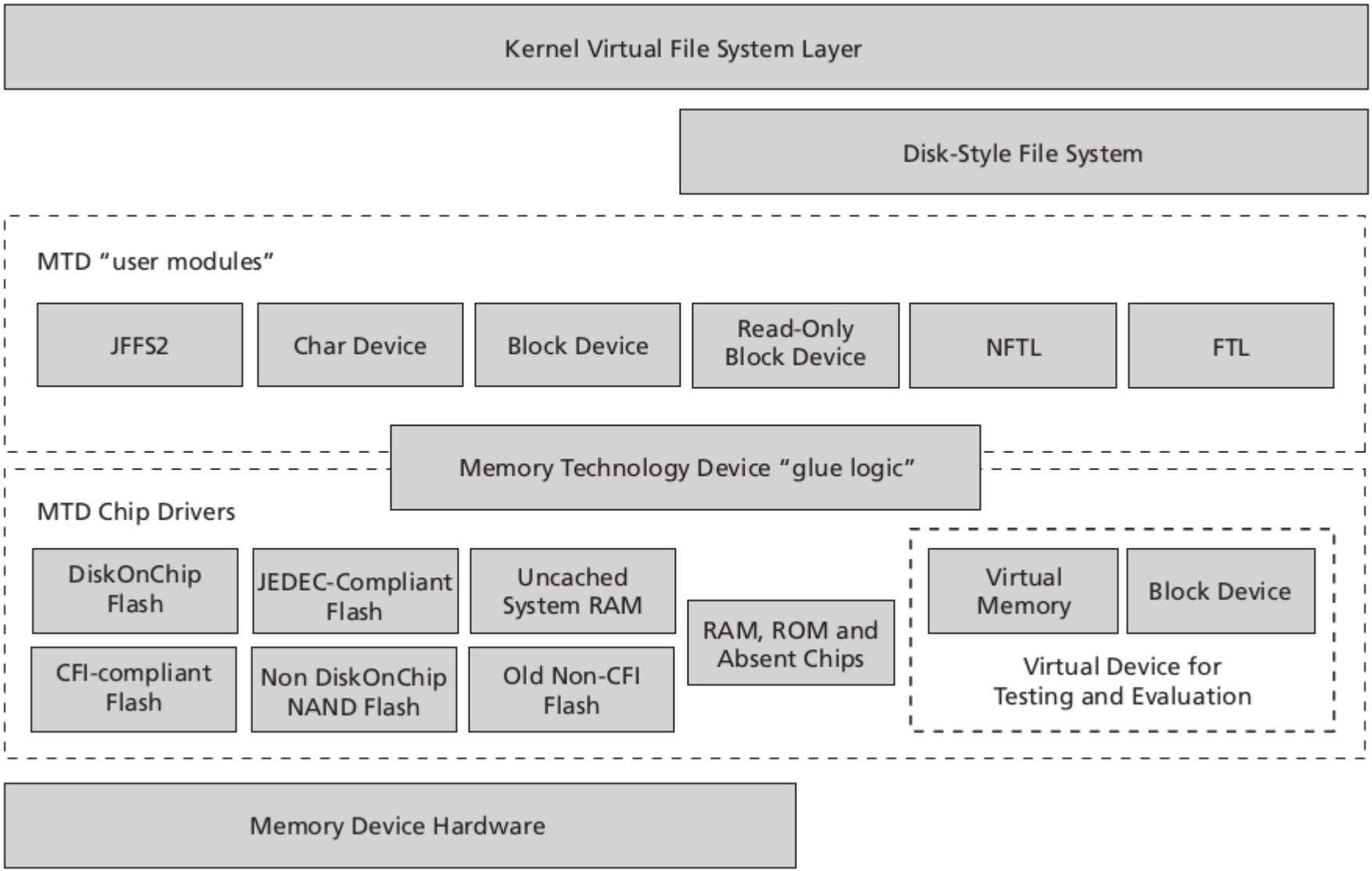
File System in Linux



MTD

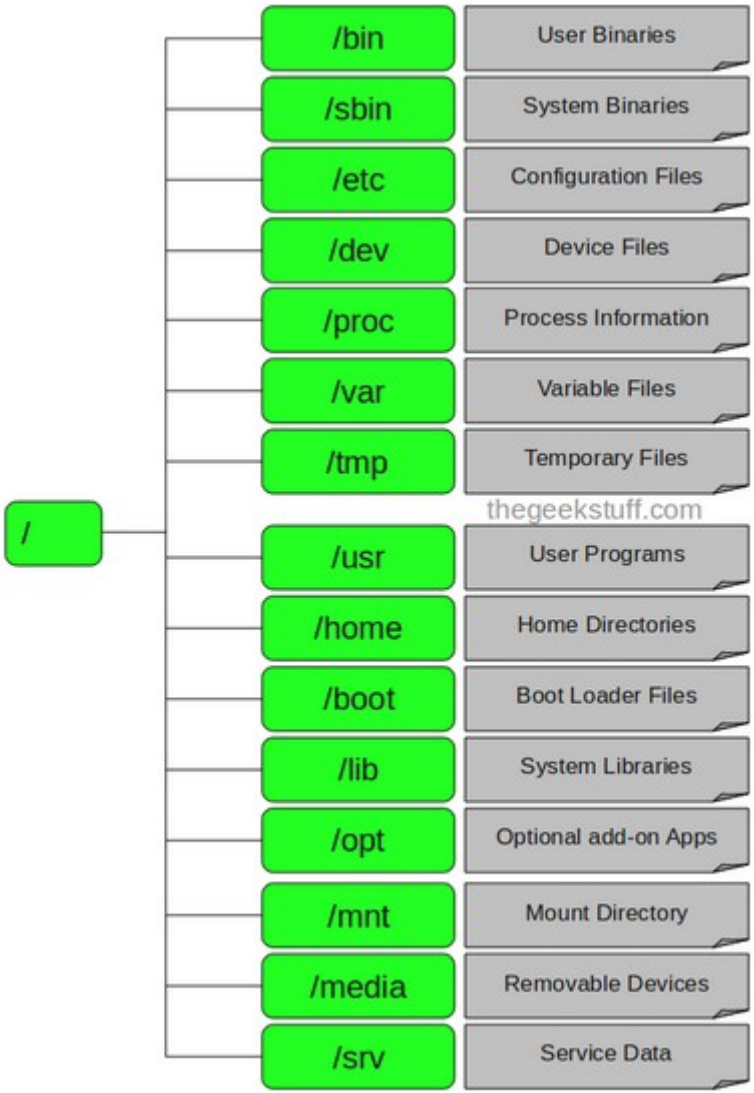
- MTD – Memory Technology Device
  - /dev/mtdblockx
  - Block driver
- For Flash device
  - NOR, NAND, OneNAND ...

MTD Subsystem Architecture



ROOTFS

Linux Directory Structure



Root

- Every single file and directory starts from the root directory
- Only root user has write privilege under this directory
- Please note that /root is root user's home directory, which is not same as /

/bin – User Binaries

- Contains binary executables.
- Common linux commands you need to use in single-user modes are located under this directory.
- Commands used by all the users of the system are located here.
- For example: ps, ls, ping, grep, cp.

/sbin – System Binaries

- Just like /bin, /sbin also contains binary executables.
- But, the linux commands located under this directory are used typically by system aministrator, for system maintenance purpose.
- For example: iptables, reboot, fdisk, ifconfig, swapon

/etc – Configuration Files

- Contains configuration files required by all programs.
- This also contains startup and shutdown shell scripts used to start/stop individual programs.
- For example: /etc/resolv.conf, /etc/logrotate.conf

/dev – Device Files

- Contains device files.
- These include terminal devices, usb, or any device attached to the system.
- For example: /dev/tty1, /dev/usbmon0

/proc – Process Information

- Contains information about system process.
- This is a pseudo filesystem contains information about running process. For example: /proc/{pid} directory contains information about the process with that particular pid.
- This is a virtual filesystem with text information about system resources. For example: /proc/uptime

/var – Variable Files

- var stands for variable files.
- Content of the files that are expected to grow can be found under this directory.
- This includes — system log files (/var/log); packages and database files (/var/lib); emails (/var/mail); print queues (/var/spool); lock files (/var/lock); temp files needed across reboots (/var/tmp);

/tmp – Temporary Files

- Directory that contains temporary files created by system and users.
- Files under this directory are deleted when system is rebooted.

/usr – User Programs

- Contains binaries, libraries, documentation, and source-code for second level programs.
- /usr/bin contains binary files for user programs. If you can't find a user binary under /bin, look under /usr/bin. For example: at, awk, cc, less, scp
- /usr/sbin contains binary files for system administrators. If you can't find a system binary under /sbin, look under /usr/sbin. For example: atd, cron, sshd, useradd, userdel
- /usr/lib contains libraries for /usr/bin and /usr/sbin
- /usr/local contains users programs that you install from source. For example, when you install apache from source, it goes under /usr/local/apache2

/home – Home Directories

- Home directories for all users to store their personal files.
- For example: /home/john, /home/nikita

/boot – Boot Loader Files

- Contains boot loader related files.
- Kernel initrd, vmlinux, grub files are located under /boot

/lib – System Libraries

- Contains library files that supports the binaries located under /bin and /sbin
- Library filenames are either ld* or lib*.so.*

/opt – Optional add-on Applications

- opt stands for optional.
- Contains add-on applications from individual vendors.
- add-on applications should be installed under either /opt/ or /opt/ sub-directory.

/mnt – Mount Directory

- Temporary mount directory where sysadmins can mount filesystems.

/media – Removable Media Devices

- Temporary mount directory for removable devices.
- For examples, /media/cdrom for CD-ROM; /media/floppy for floppy drives; /media/cdrecorder for CD writer

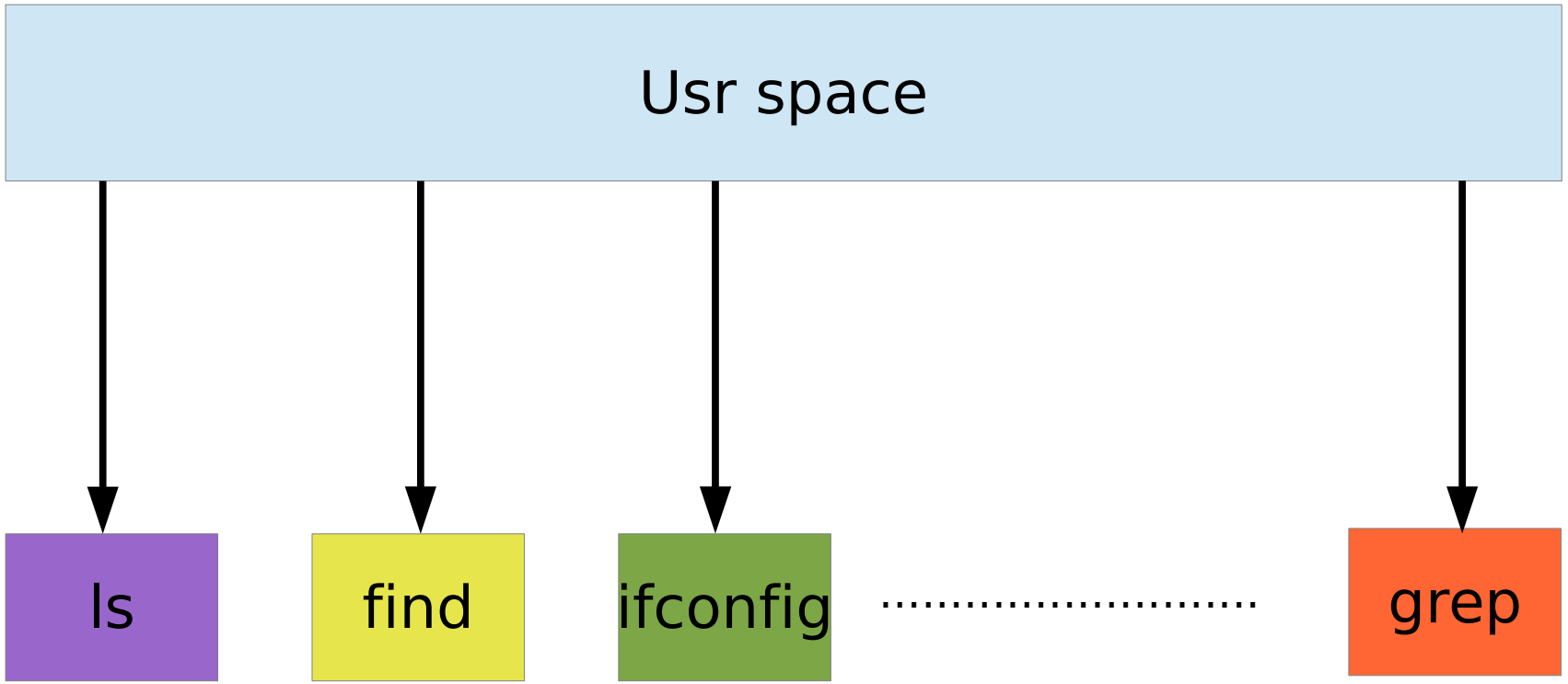
BusyBox

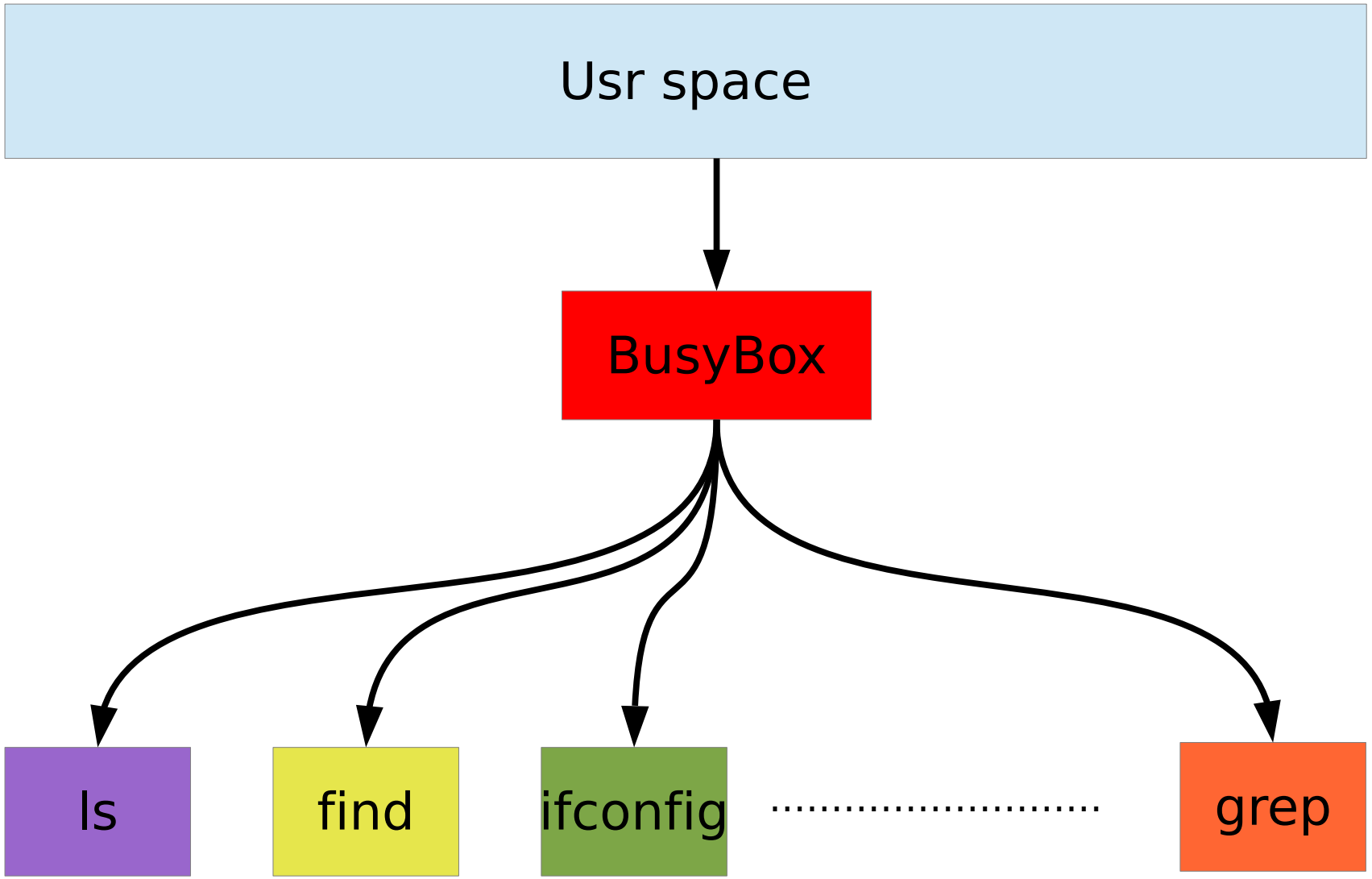
BusyBox

- Linux system needs a basic set of programs to work
  - Init program
  - shell
- In normal Linux systems, these programs are independent
  - Binary size large
- BusyBox down size these program

BusyBox

- Rewrite of many useful Unix command
  - Down size
- All the program are compiled into a single executable, /bin/busybox
- It can configure all command
- http://www.busybox.net/


Usr space
ls
find
ifconfig
.....
grep


Usr space
BusyBox
ls
find
ifconfig
.....
grep

Busybox init

- Busybox provides an implementation of an init program
- A single configuration file: /etc/inittab
  - Each line has the form <id>::<action>:<process>
- Check examples/inittab in Busybox for details on the configuration

Configuring BusyBox

- http://busybox.net
  - wget http://www.busybox.net/downloads/busybox-1.24.0.tar.bz2
- Configure BusyBox
  - make menuconfig
  - make defconfig
- Install it
  - Make install