Sunbeam Institute of Information Technology
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Embedded Linux Device Driver

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Program : set of instructions to the CPU

Application / software : set of programs

e.g. GCC – Application

↳ cpp, cc, as, ld, gdb ……

Operating System = Core OS (kernel) + System Utilities + Application software

Compulsory

1. Process management
2. CPU scheduling
3. Memory management
4. File & IO management
5. Hardware Abstraction

Optional

1. User interfacing
2. Networking
3. Security & protection

Types of kernel :

1. Monolithic kernel :

UNIX
BSD UNIX – single kernel image (binary) is created.

2. Micro kernel :

Symbian
MACH – only important functionalities are kept in kernel and other functionalities are implemented as seperate user space processes. (srv)

3. Modular kernel :

Windows – only important functionalities are kept in kernel and other functionalities are implenented as dynamically loadable modules

4. Hybrid kernel :

- combination of two kernels

e.g. monolithic + micro

Darwin = BSD UNIX + MACH

5. nano kernel :

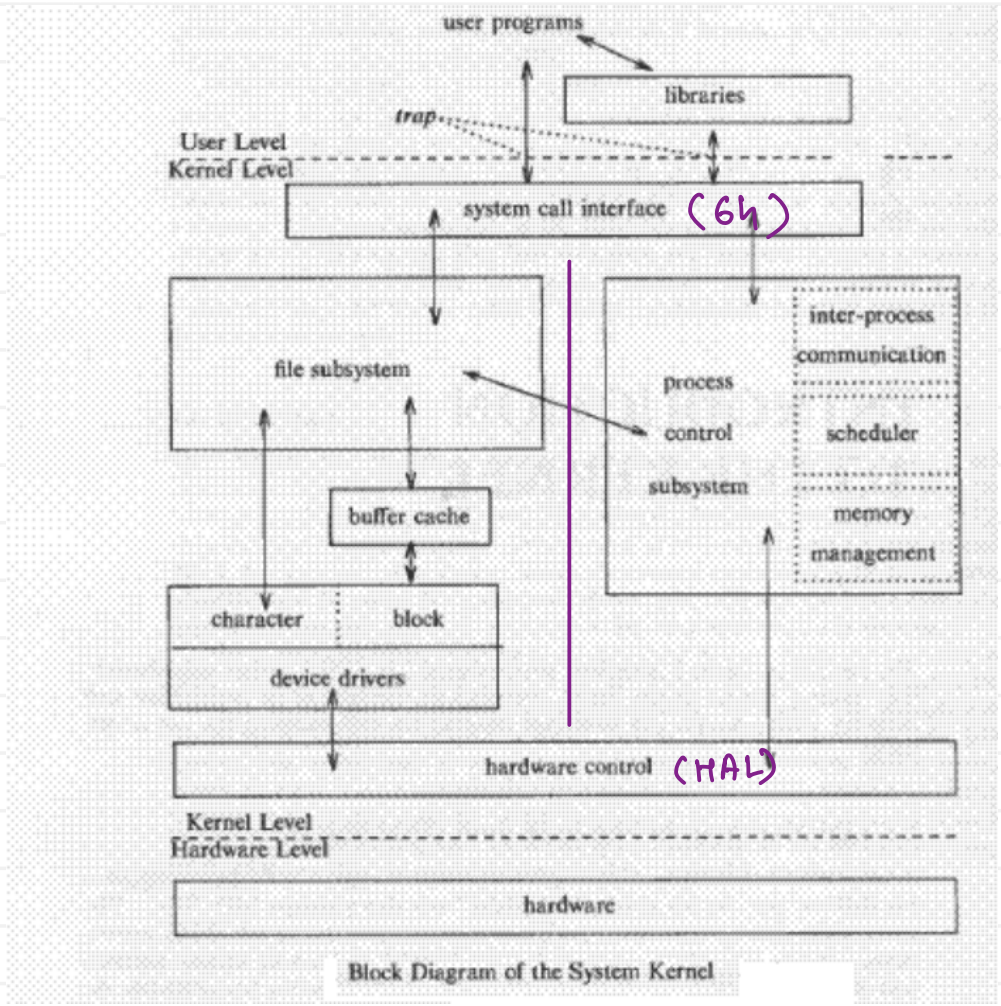
- size is very less. because only required functionalities are kept.

FreeRTOS

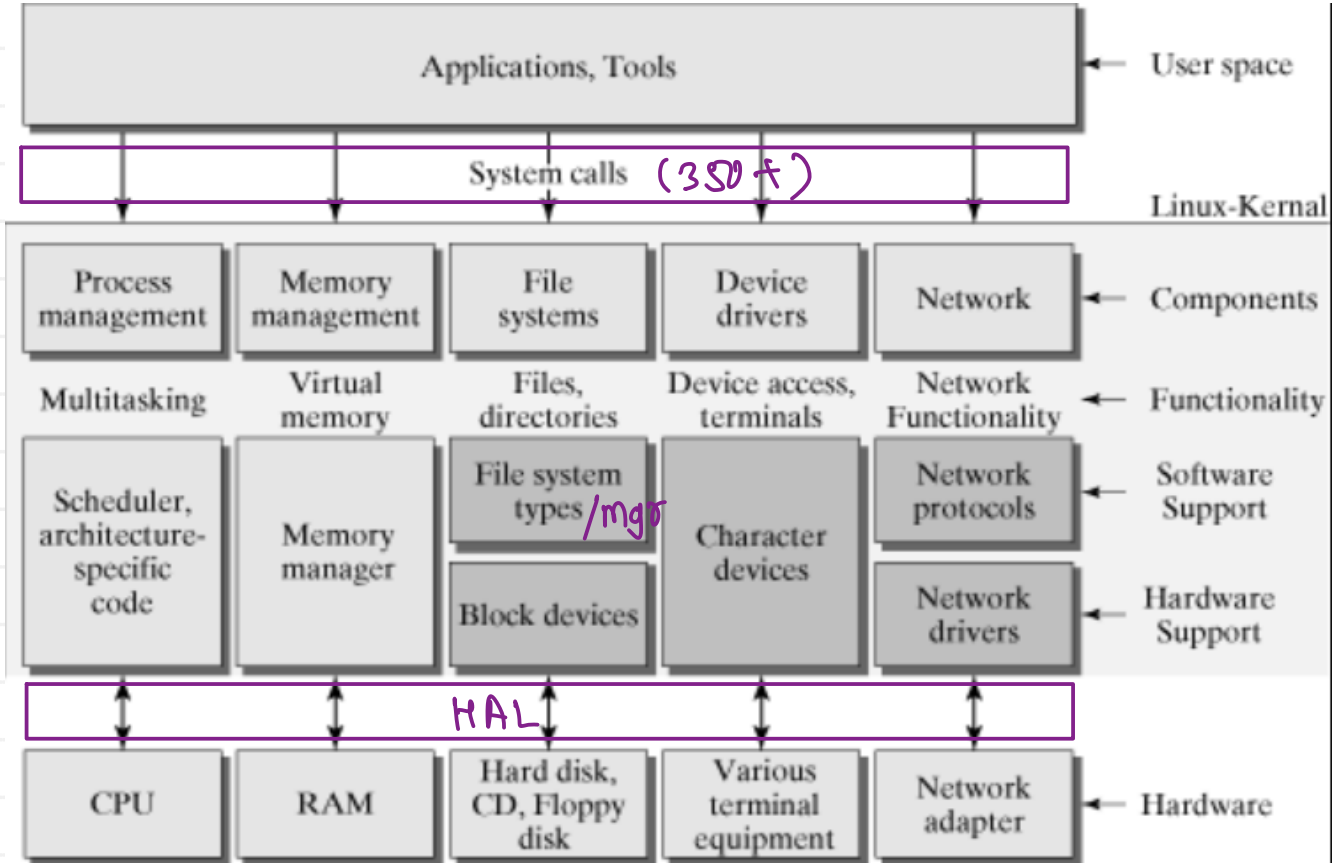
Everything is File

Types

1. Regular file
2. Directory file
3. Link file
4. Pipe file
5. Socket file
6. Char special file
7. Block special file



Block Diagram of the System Kernel



Linux Kernel = Monolithic + Modular + Micro

Monolithic
static Component

1. Process management
2. CPU scheduling
3. Memory management
4. IO subsystem
5. Hardware Abstraction layer
6. System calls
...

Kernel image = vmlinuz
location = /boot

Modular
Dynamic Component

1. file system managers
2. device drivers
...

dynamically loadable modules
(Kernel Objects - .ko)

locations = /lib/modules/`uname -r`

Micro
UI
xServer

process server

kernel.org

linux-6.8.2.tar.gz ← vanila kernel

linux-x.y.z.tar.gz - gnu zip
.xz - extended zip
.bz2 - binary zip

-z
-J
-j
} optional

x - major revision
- arch (x86/ARM) specific change/addition
- no backward compatibility

y - minor revision
- change/addition of any subsystems
- backward compatibility

z - revision
- error/bug fixing

linux-6.8.2
major revision = 6
minor revision = 8
revision = 2

uname -r

linux-6.8.0-57-generic
major revision = 6
minor revision = 8
revision = 0
Local version = -57-generic

tar -xvf linux-6.8.2.tar.gz
-x : extract
-v : verbose
-f : filename


x86/ARM...
Arch specific code
Kernel : arch/x86/kernel
arch
Block layer
block
Security /other certificates
certs
encryption/ decryption
crypto
Documentation
Kernel objects
drivers
File system managers
fs
Header files
include
initialization code startup files
init
IO
io_uring
ipc
Core OS
kernel
lib
LICENSES
memory management
mm
Networking
net
rust
Sample codes
samples
configuration/ automation/ kernel scripts
scripts
security
sound
tools
usr
virt

Linux kernel compilation

- Linux kernel is monolithic.
- But it exhibits modular and micro-kernel nature as well.
  - Monolithic kernel image: vmlinuz (/boot)
  - Kernel modules: .ko (/lib/modules/<kernel-version>)
- Kernel source tree contains source code corresponding to kernel & modules.
  - arch, init, kernel, ipc, crypto, include, lib, mm, net, block, fs, drivers, sound, usr, scripts, ...
- Kernel release tree contains compiled kernel image & modules in root file system.
  - boot, lib, bin, sbin, home, usr, home, etc, ...

1. copy preconfigured .config file into source tree
   ↳present in /boot directory
2. make menuconfig
   - do some changes like local version ...
3. make bzImage
   - compile static component of kernel
   - it will be created into arch/x86/boot
4. make modules
   - compile dynamic components of kernel into their respective directories.
5. sudo make modules_install
   - copies dynamic modules into destination directory (/lib/modules/`uname -r`)
6. sudo make install
   - bzImage is copied into /boot as vmlinuz
   - update GrUB and add entry for compiled kernel

more compressed ↑ self extracting binary image

1. make defconfig
   - creates default configuration file

2. make config
   - asks for multiple questions

3. make menuconfig
   - character base UI

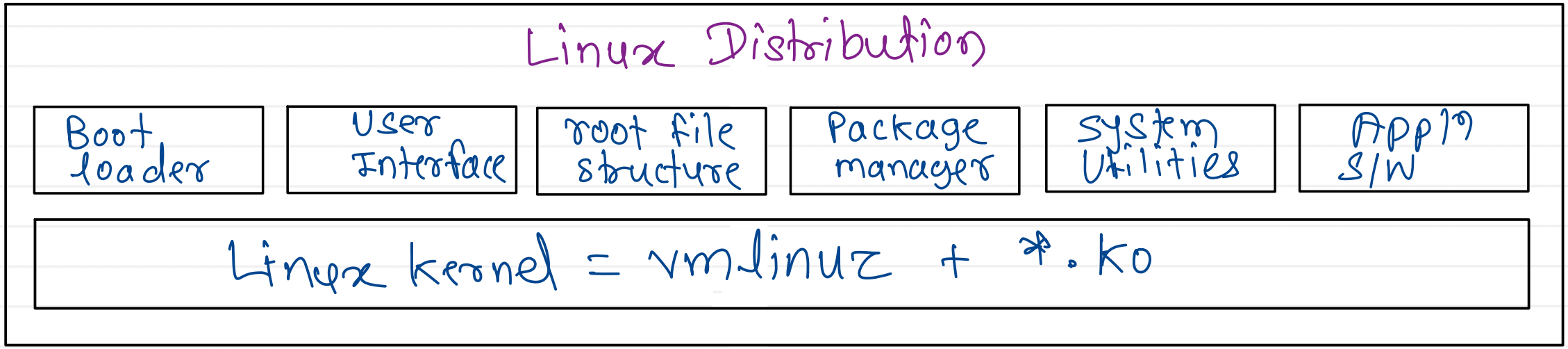
   make gconfig - GTK based UI
   make xconfig - Qt based UI

4. copy existing config file from boot

   cp /boot/config-6.8.0-57-generic .config

Linux Distribution

- Linux source code is available on www.kernel.org.
- Companies (like RedHat, Novell, ...) or individuals download source code, complie and integrate with other components like bootloader, user interface, package manager, root file system, libraries, system utilities & applications to develop Linux distributions.
- There are thousands of Linux distros available (www.distrowatch.com)
- Linux kernel compilation is compiling Linux source code only. It should be ensured that compiled kernel should work well with rest of the components.



Thank you!!!

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