

Ch4 Introduction of Linux System



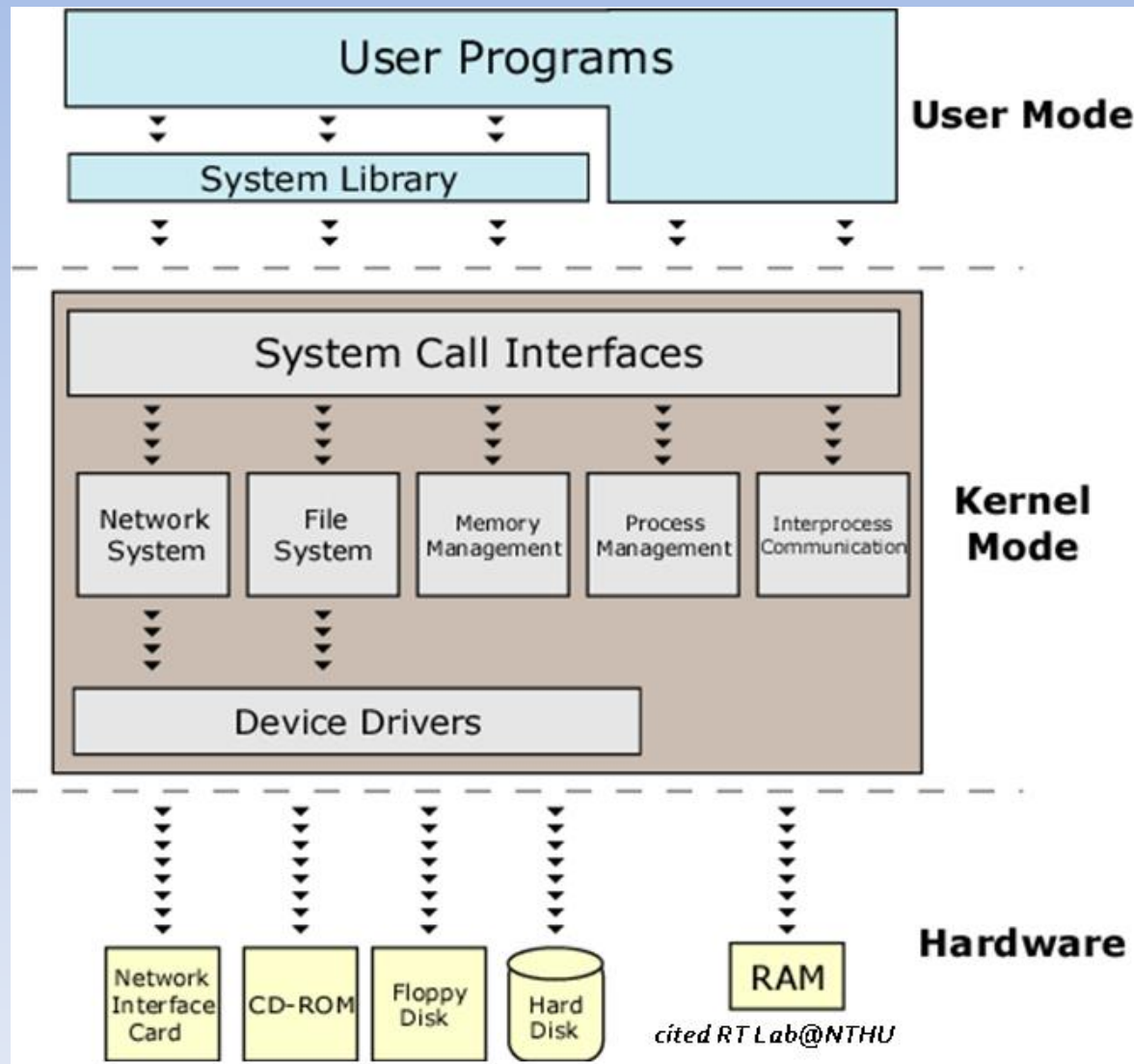
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謝明志(Jimin Hsieh)

Agenda

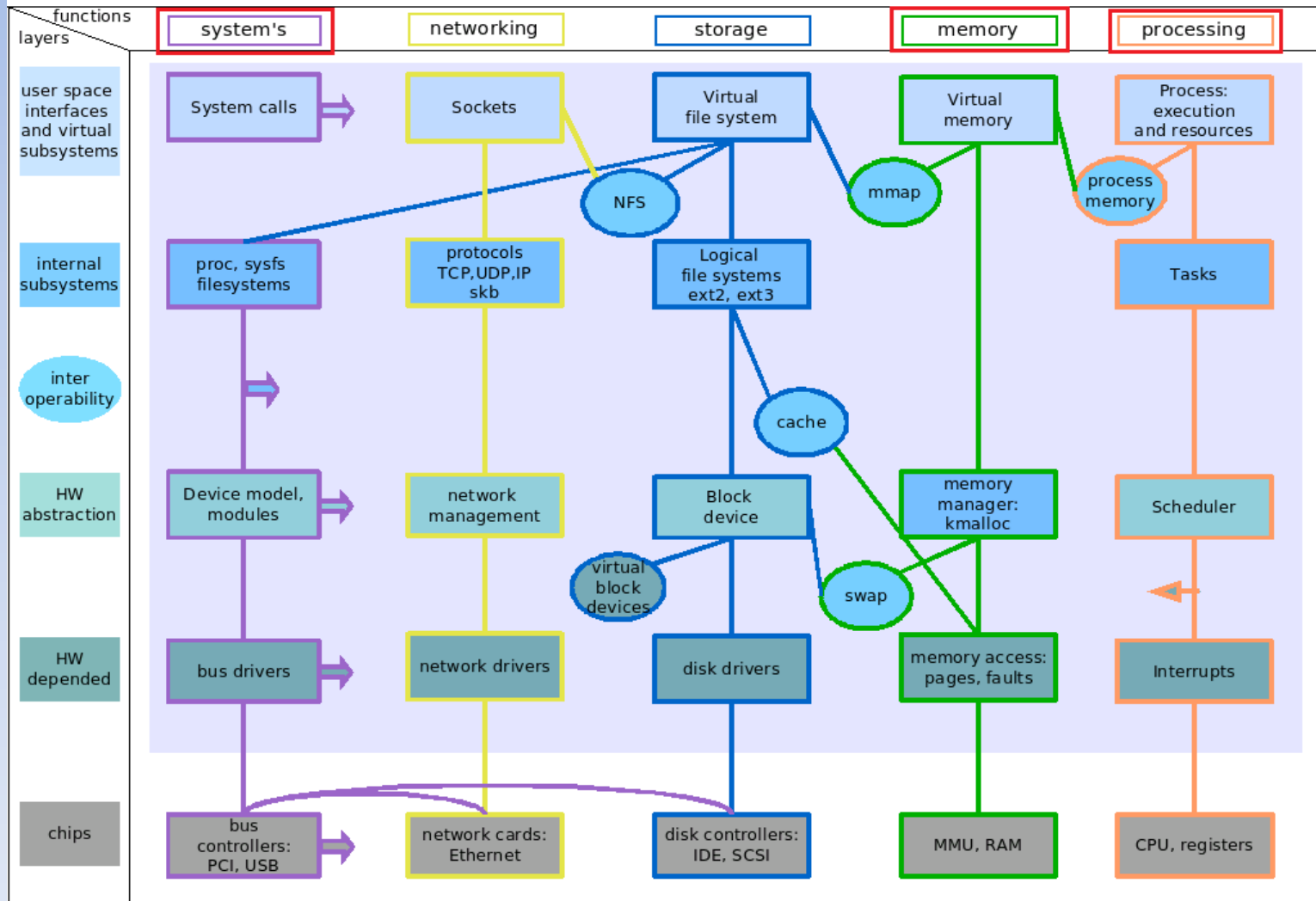
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Linux System Architecture

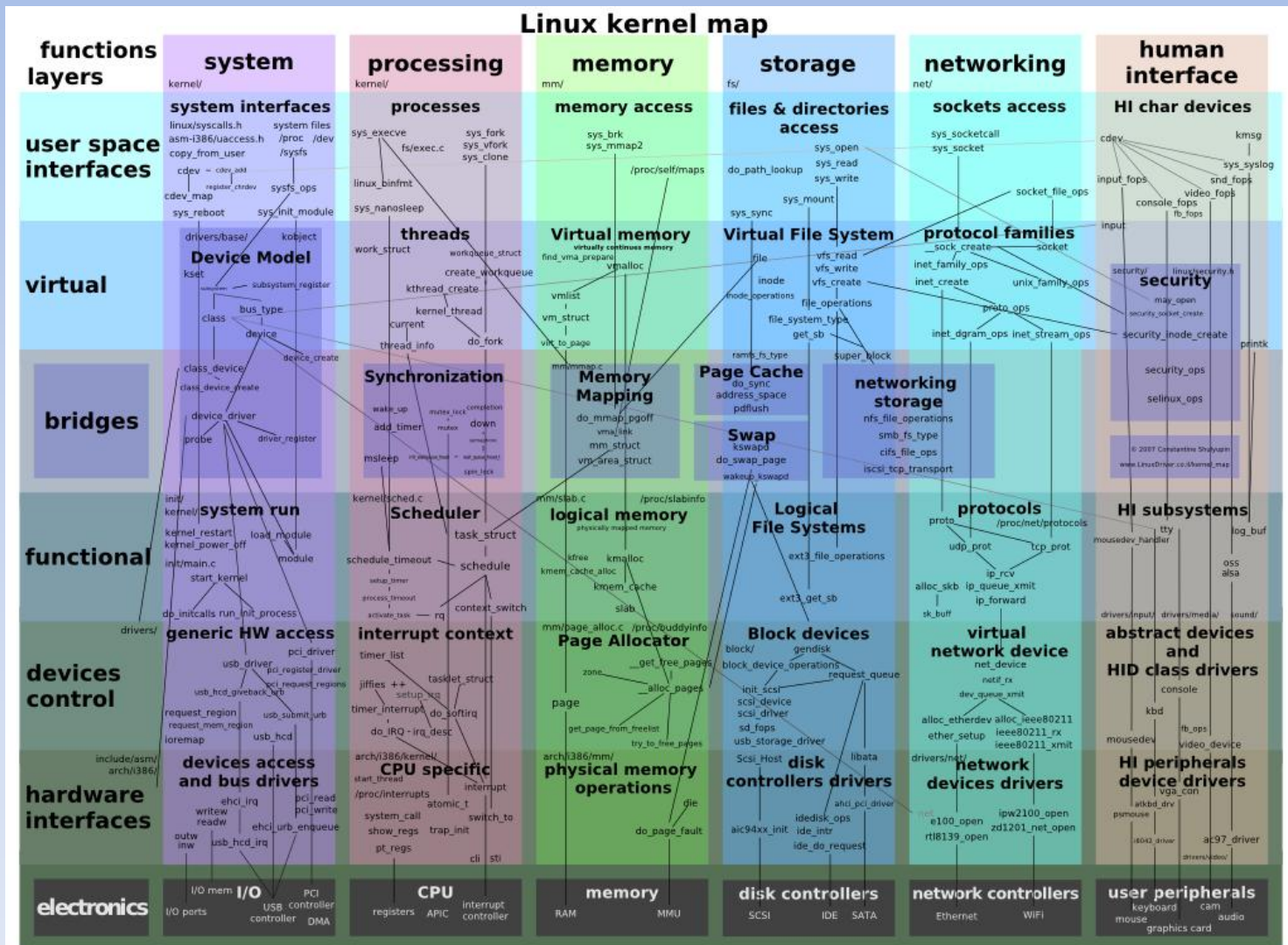


Linux Kernel Diagram

Simplified Linux kernel diagram in form of a matrix map



Linux Kernel Map



top

top : display Linux processes

```
top - 12:58:36 up 2 days, 20:00, 2 users, load average: 0.04, 0.03, 0.05
Tasks: 161 total, 1 running, 159 sleeping, 0 stopped, 1 zombie
%Cpu(s): 0.0 us, 0.0 sy, 0.0 ni, 100.0 id, 0.0 wa, 0.0 hi, 0.0 si, 0.0 st
KiB Mem: 6096668 total, 1079616 used, 5017052 free, 126308 buffers
KiB Swap: 5105660 total, 0 used, 5105660 free, 607972 cached
```

PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+	COMMAND
20174	jimin	20	0	30420	1744	1184	R	0.3	0.0	0:00.26	top
1	root	20	0	10644	820	684	S	0.0	0.0	0:01.23	init
2	root	20	0	0	0	0	S	0.0	0.0	0:00.00	kthreadd
3	root	20	0	0	0	0	S	0.0	0.0	0:00.81	ksoftirqd/0
6	root	rt	0	0	0	0	S	0.0	0.0	0:00.00	migration/0
7	root	rt	0	0	0	0	S	0.0	0.0	0:00.20	watchdog/0
21	root	0	-20	0	0	0	S	0.0	0.0	0:00.00	cpuset
22	root	0	-20	0	0	0	S	0.0	0.0	0:00.00	khelper
23	root	20	0	0	0	0	S	0.0	0.0	0:00.00	kdevtmpfs
24	root	0	-20	0	0	0	S	0.0	0.0	0:00.00	netns
25	root	20	0	0	0	0	S	0.0	0.0	0:00.20	sync_supers
26	root	20	0	0	0	0	S	0.0	0.0	0:00.00	bdi-default
27	root	0	-20	0	0	0	S	0.0	0.0	0:00.00	kintegrityd
28	root	0	-20	0	0	0	S	0.0	0.0	0:00.00	kblockd

top

- us: user space process
- sy: kernel space process
- Id: idle time
- hi: hardware interrupt
- si: software interrupt

top

top -H -p [PID]

Option “-H” thread mode

Option “-p [PID]” specific Process

```
top - 14:40:43 up 2:01, 4 users, load average: 0.21, 0.42, 0.63
Threads: 4 total, 0 running, 4 sleeping, 0 stopped, 0 zombie
%Cpu(s): 6.2 us, 5.5 sy, 0.0 ni, 88.3 id, 0.0 wa, 0.0 hi, 0.0 si, 0.0 st
KiB Mem: 10180276 total, 8355508 used, 1824768 free, 237192 buffers
KiB Swap: 4105212 total, 0 used, 4105212 free, 1713144 cached
```

PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+	COMMAND
4909	jimin	20	0	975m	85m	23m	S	0.0	0.9	0:28.44	chrome
4911	jimin	20	0	975m	85m	23m	S	0.0	0.9	0:01.54	Chrome_ChildIoT
4912	jimin	20	0	975m	85m	23m	S	0.0	0.9	0:00.00	VC manager
4928	jimin	20	0	975m	85m	23m	S	0.0	0.9	0:00.00	HTMLParserThrea

ps

ps

Option "aux"

```
jimin@JiminLab:~$ ps aux
```

USER	PID	%CPU	%MEM	VSZ	RSS	TTY	STAT	START	TIME	COMMAND
root	1	0.0	0.0	10644	820	?	Ss	Nov04	0:01	init [2]
root	2	0.0	0.0	0	0	?	S	Nov04	0:00	[kthreadd]
root	3	0.0	0.0	0	0	?	S	Nov04	0:00	[ksoftirqd/0]
root	6	0.0	0.0	0	0	?	S	Nov04	0:00	[migration/0]
root	7	0.0	0.0	0	0	?	S	Nov04	0:00	[watchdog/0]
root	21	0.0	0.0	0	0	?	S<	Nov04	0:00	[cpuset]
root	22	0.0	0.0	0	0	?	S<	Nov04	0:00	[khelper]
root	23	0.0	0.0	0	0	?	S	Nov04	0:00	[kdevtmpfs]
root	24	0.0	0.0	0	0	?	S<	Nov04	0:00	[netns]
root	25	0.0	0.0	0	0	?	S	Nov04	0:00	[sync_supers]
root	26	0.0	0.0	0	0	?	S	Nov04	0:00	[bdi-default]
root	27	0.0	0.0	0	0	?	S<	Nov04	0:00	[kintegrityd]

```
jimin 20054 0.0 0.0 98420 2028 ? S 12:43 0:00 sshd: jimin@pts/0
jimin 20055 0.0 0.0 29464 5264 pts/0 Ss 12:43 0:00 -bash
root 20462 0.0 0.0 69536 1788 pts/0 S 14:20 0:00 su
root 20469 0.0 0.0 26560 2168 pts/0 S 14:20 0:00 bash
root 20498 0.0 0.4 59188 25872 pts/0 S+ 14:20 0:00 apt-get upgrade
root 20503 0.0 0.0 40556 2244 pts/0 S+ 14:21 0:00 /usr/lib/apt/methods/http
root 20558 0.0 0.0 0 0 ? Z 14:38 0:00 [date] <defunct>
root 20570 0.0 0.0 98420 4180 ? Ss 14:39 0:00 sshd: jimin [priv]
jimin 20575 0.0 0.0 98420 2024 ? S 14:39 0:00 sshd: jimin@pts/2
jimin 20576 0.2 0.0 29396 5068 pts/2 Ss 14:39 0:00 -bash
jimin 20668 0.0 0.0 23944 1280 pts/2 R+ 14:40 0:00 ps aux
```

pstree

```

init-Manager
├── NetworkManager──{NetworkManager}
├── accounts-daemon──{accounts-daemon}
├── acpid
├── apache2
│   └── apache2
│       └── 2*[apache2──26*[{apache2}]]
├── at-spi-bus-laun──dbus-daemon
│   └── 3*[{at-spi-bus-laun}]
├── at-spi2-registr──{at-spi2-registr}
├── atd
├── avahi-daemon──avahi-daemon
├── bluetoothd
├── console-kit-dae──64*[{console-kit-dae}]
├── cron
├── 3*[dbus-daemon]
├── dbus-launch
├── dconf-service──2*[{dconf-service}]
├── exim4
├── gconfd-2
├── gdm3
│   ├── gdm-simple-slav
│   │   ├── Xorg
│   │   ├── gdm-session-wor
│   │   │   ├── gnome-session
│   │   │   │   ├── gdm-simple-gree──2*[{gdm-simple-gree}]
│   │   │   │   ├── gnome-settings──2*[{gnome-settings-}]
│   │   │   │   ├── metacity──2*[{metacity}]
│   │   │   │   ├── polkit-gnome-au──{polkit-gnome-au}
│   │   │   │   └── 3*[{gnome-session}]
│   │   │   └── 2*[{gdm-session-wor}]
│   │   ├── gdm-session-wor──{gdm-session-wor}
│   │   └── {gdm-simple-slav}
│   └── {gdm3}

```

/proc

/proc: Virtual File System

- /proc/cpuinfo
- /proc/meminfo
- /proc/version

cpuinfo

- /proc/cpuinfo
- flags infor: linux/arch/x86/include/asm/cpufeature.h

```
processor       : 0
vendor_id      : GenuineIntel
cpu family     : 6
model          : 23
model name     : Intel(R) Core(TM)2 Quad CPU    Q8400  @ 2.66GHz
stepping       : 10
microcode      : 0xa07
cpu MHz        : 2003.000
cache size     : 2048 KB
physical id    : 0
siblings       : 4
core id        : 0
cpu cores      : 4
apicid         : 0
initial apicid : 0
fpu            : yes
fpu_exception  : yes
cpuid level    : 13
wp             : yes
flags          : fpu vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov pa
t pse36 clflush dts acpi mmx fxsr sse sse2 ss ht tm pbe syscall nx lm constant_tsc
arch_perfmon pebs bts rep_good nopl aperfmperf pni dtes64 monitor ds_cpl vmx est
tm2 ssse3 cx16 xtpr pdcm sse4_1 xsave lahf_lm dtherm tpr_shadow vnmi flexpriority
bogomips      : 5320.05
clflush size   : 64
cache_alignment : 64
address sizes   : 36 bits physical, 48 bits virtual
power management:
```

meminfo

- /proc/meminfo

```
MemTotal:      12204744 kB
MemFree:       4988984 kB
Buffers:        220208 kB
Cached:        1352572 kB
SwapCached:          0 kB
Active:        1810772 kB
Inactive:      1279632 kB
Active(anon):  1087820 kB
Inactive(anon): 457204 kB
Active(file):   722952 kB
Inactive(file): 822428 kB
Unevictable:    16 kB
Mlocked:        16 kB
SwapTotal:     1316860 kB
SwapFree:      1316292 kB
Dirty:          132 kB
Writeback:       4 kB
AnonPages:     1517688 kB
Mapped:        4037068 kB
Shmem:          27388 kB
Slab:          142880 kB
SReclaimable:   67712 kB
SUnreclaim:    75168 kB
KernelStack:    4696 kB
```

free

- # free

```
      total        used        free      shared    buffers     cached
Mem:   12204744    7488672    4716072          0     225012    1370332
-/+ buffers/cache:    5893328    6311416
Swap:   1316860         568     1316292
```

version

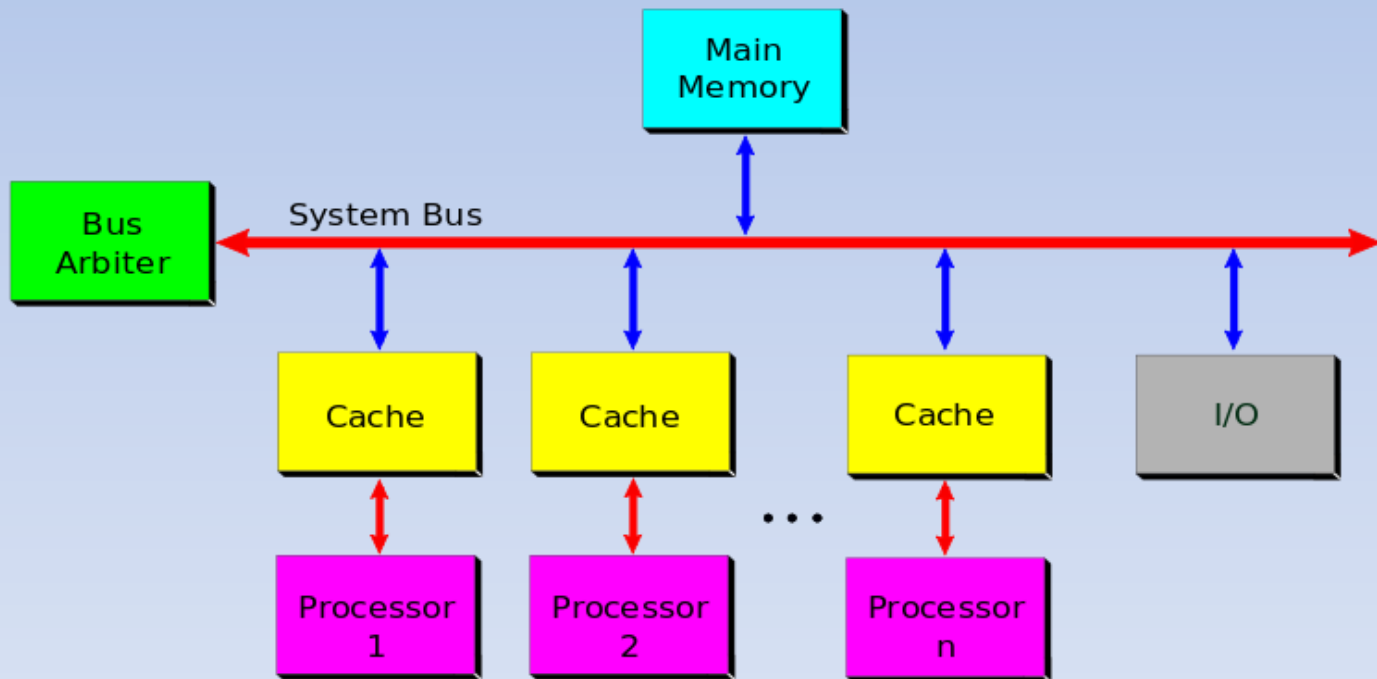
- /proc/version
- # uname -a

```
Linux version 3.2.0-4-amd64 (debian-kernel@lists.debian.org) (gcc version 4.6.3 (Debian 4.6.3-14) ) #1 SMP Debian 3.2.51-1
```

- 3.2.51-1
- 3: Kernel version
- 2: Major revision,
even number: stable
odd number: develop
- 51: Minor revision
- 1: corrections- patches and bug fixes

What is SMP?

SMP - Symmetric Multiprocessor System



By Ferruccio Zulian - Milan, Italy

System Messages

- # dmesg : debug message in kernel space
- /var/log/messages

```
[ 1344.031116] usb 1-1.2: USB disconnect, device number 3
[ 1395.126474] CPUM: APIC 01 at 00000000fee00000 (mapped at ffffc9000186e000) - ver 0x0
[ 1395.126490] CPUM: APIC 00 at 00000000fee00000 (mapped at ffffc90017960000) - ver 0x0
[ 1395.126504] CPUM: APIC 03 at 00000000fee00000 (mapped at ffffc90006616000) - ver 0x0
[ 1395.126541] CPUM: APIC 02 at 00000000fee00000 (mapped at ffffc9000187e000) - ver 0x0
[ 1395.340767] device eth0 entered promiscuous mode
[ 1461.697425] ADDRCONF(NETDEV_UP): wlan0: link is not ready
[ 1463.622647] wlan0: authenticate with 78:54:2e:5c:47:8e (try 1)
[ 1463.626473] wlan0: authenticated
[ 1463.660837] wlan0: associate with 78:54:2e:5c:47:8e (try 1)
[ 1463.666914] wlan0: RX AssocResp from 78:54:2e:5c:47:8e (capab=0x431 status=0 aid=5)
[ 1463.666919] wlan0: associated
[ 1463.677556] ADDRCONF(NETDEV_CHANGE): wlan0: link becomes ready
[ 1473.972581] wlan0: no IPv6 routers present
[ 1649.792077] CPU3: Package power limit notification (total events = 771)
[ 1649.792081] CPU2: Package power limit notification (total events = 771)
[ 1649.792100] CPU0: Package power limit notification (total events = 771)
[ 1649.792104] CPU1: Package power limit notification (total events = 770)
[ 1649.794065] CPU2: Package power limit normal
[ 1649.794073] CPU3: Package power limit normal
[ 1649.794083] CPU0: Package power limit normal
[ 1649.794092] CPU1: Package power limit normal
```

lsmod

- # lsmod: show kernel module

```
iptables_nat      12928  1
nf_nat            18242  2 iptables_nat,ipt_MASQUERADE
nf_conntrack_ipv4 14078  4 nf_nat,iptables_nat
nf_defrag_ipv4    12483  1 nf_conntrack_ipv4
xt_state          12503  1
nf_conntrack      52720  5 xt_state,nf_conntrack_ipv4,nf_nat,iptables_nat,ipt_MASQUERADE
```

Q&A

Thanks for you attentions!