

Exploring Linux Based Operating Systems

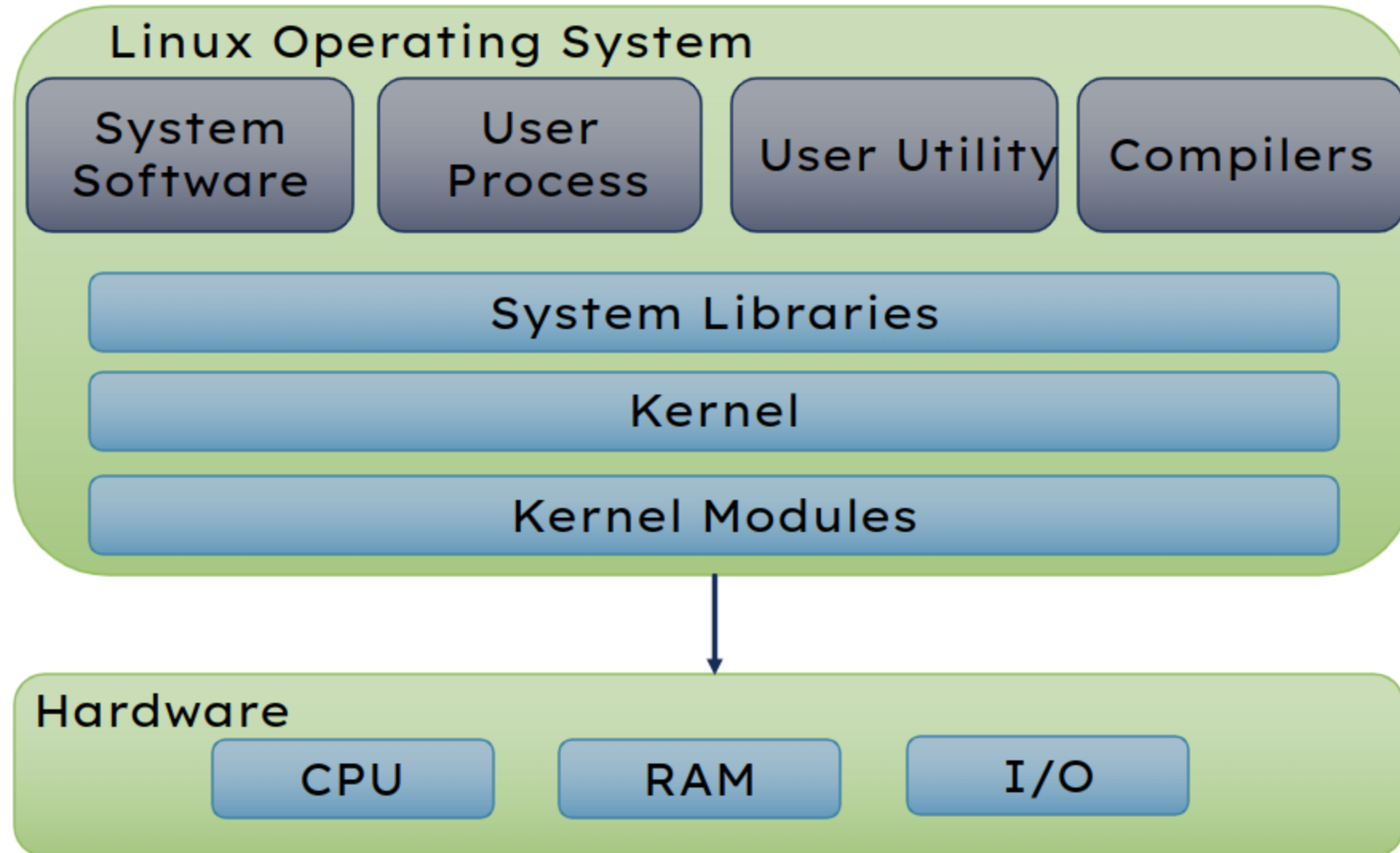
Course Code: ELEE1119

Course Name: Advanced Computer Engineering

Credits: 30

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Linux System: Diagrammatic View



Linux A version of UNIX

Linux OSs have these primary components

- Kernel
- System Library
- System Utility
- User Application
- Hardware Platform

System Library 1

System libraries are special functions or programs using which application programs or system utilities accesses Kernel's features.

Examples of file extensions for libraries files:

- *.a - These are statically linked libraries. Static libraries are linked into programs.
- *.bin - These libraries are binary files.
- *.fw - Firmware files are special libraries/drivers for hardware.
- *.o - Many loadable kernel modules/objects are object files.
- *.so - These files are dynamically-linked shared libraries that are not linked put into programs. Rather, programs reference this library and obtain functions/code from it.

System Library 2

`/lib/` - The important shared library files are kept in here. Mainly these are system libraries or low-level libraries.

The Linux kernel modules are kept under

`/lib/modules/` and firmware drivers are under `/lib/firmware/`.

```
/lib# via @ v17.1.0
> cd modules

/lib/modules#
> ls
5.15.4-arch1-1

/lib/modules#
> cd 5.15.4-arch1-1/

/lib/modules/5.15.4-arch1-1#
> ls
build          modules.builtin          modules.dep          modules.softdep      vmlinux
kernel         modules.builtin.alias.bin modules.dep.bin      modules.symbols
modules.alias  modules.builtin.bin      modules.devname      modules.symbols.bin
modules.alias.bin modules.builtin.modinfo  modules.order        pkgbase

/lib/modules/5.15.4-arch1-1#
> cd kernel/

modules/5.15.4-arch1-1/kernel#
> ls
arch  crypto  drivers  fs  kernel  lib  mm  net  security  sound  virt

modules/5.15.4-arch1-1/kernel#
> cd fs

5.15.4-arch1-1/kernel/fs#
> ls
9p          ceph      erofs     fuse      jffs2      netfs      ntfs3      quota      udf
affs        cifs     exfat     gfs2      jfs        nfs        ocfs2     reiserfs  ufs
afs         coda     ext4      hfs       ksmbd      nfs_common omfs       romfs     vboxsf
befs       cramfs   f2fs     hfsplus   lockd      nfsvd      orafefs   smbfs_common xfs
btrfs      dlm      fat       isofs     mbcache.ko.zst nilfs2    overlayfs squashfs  zonefs
cachefiles ecryptfs fscache  jbd2      minix      nls       pstore   ubifs
```

System Library 3

- `/usr/lib/` - Program libraries are stored here. These libraries are either multiarch or specific to the current system
- `/usr/libexec/` - These are application-specific executable libraries.
- `/usr/lib32/` - 32-bit specific application libraries are found here.
- `/usr/lib64/` - 64-bit specific application libraries are found here.

```
/usr
> ls lib
lib/  lib32/ lib64/

/usr
> cd lib64

/usr/lib64 via @ v17.1.0
> ls | wc -l
2664

/usr/lib64 via @ v17.1.0
> ls
accounts-daemon  libdw.a                libicutest.so
alsa-lib         libdw.so               libicutest.so.69
apparmor        libdw.so.1            libicutu.so
asb-plugins-5   libdwarves.so         libicutu.so.69
at-spi-bus-launcher  libdwarves.so.1      libicutu.so.69.1
at-spi2-registryd  libdwarves.so.1.0.0  libicuuc.so
atkmm-1.6       libdwarves_emit.so    libicuuc.so.69
audit           libdwarves_emit.so.1  libicuuc.so.69.1
avahi           libdwarves_emit.so.1.0.0  libid3tag.so
awk             libdwarves_reorganize.so  libid3tag.so.0
bash            libdwarves_reorganize.so.1  libid3tag.so.0.3
bellagio        libdwarves_reorganize.so.1.0.0  libidn.so
bfd-plugins     libe2p.so             libidn.so.12
binfmt.d        libe2p.so.2          libidn2.so
bluetooth       libebml.so            libidn2.so.0
brave-bin       libebml.so.5          libidn2.so.0.3.7
cairo           libebml.so.5.0.0     libiec61883.so
cairomm-1.0     libedit.so            libiec61883.so.0
ckport          libedit.so.0         libiec61883.so.0.68
cmake           libefiboot.so         libIex-3_1.so
code            libefiboot.so.1      libIex-3_1.so.30
coreutils       libefiboot.so.1.37   libIex.so
crt1.o          libefivar.so         libIex-0.35.so
crti.o          libefivar.so.1       libIexs.so
crtm.o          libefivar.so.1.37
cups            d3d
d3d
```

System Library 4

Users can see a list of libraries needed by an executable by running the `"ldd"` command

`cp` – uses dynamic libraries

`brave` – uses static libraries that are built in to the executable

```
> ldd --help
Usage: ldd [OPTION]... FILE...
  --help                print this help and exit
  --version              print version information and exit
  -d, --data-relocs      process data relocations
  -r, --function-relocs  process data and function relocations
  -u, --unused           print unused direct dependencies
  -v, --verbose          print all information

For bug reporting instructions, please see:
<https://bugs.archlinux.org/>.

~
> ldd `which cp`
    linux-vdso.so.1 (0x00007ffdbe4d3000)
    libacl.so.1 => /usr/lib/libacl.so.1 (0x00007fde890e9000)
    libattr.so.1 => /usr/lib/libattr.so.1 (0x00007fde890e1000)
    libc.so.6 => /usr/lib/libc.so.6 (0x00007fde88f15000)
    /lib64/ld-linux-x86-64.so.2 => /usr/lib64/ld-linux-x86-64.so.2 (0x00007fde8912a000)

~
> ldd `which brave`
    not a dynamic executable

~
>
```

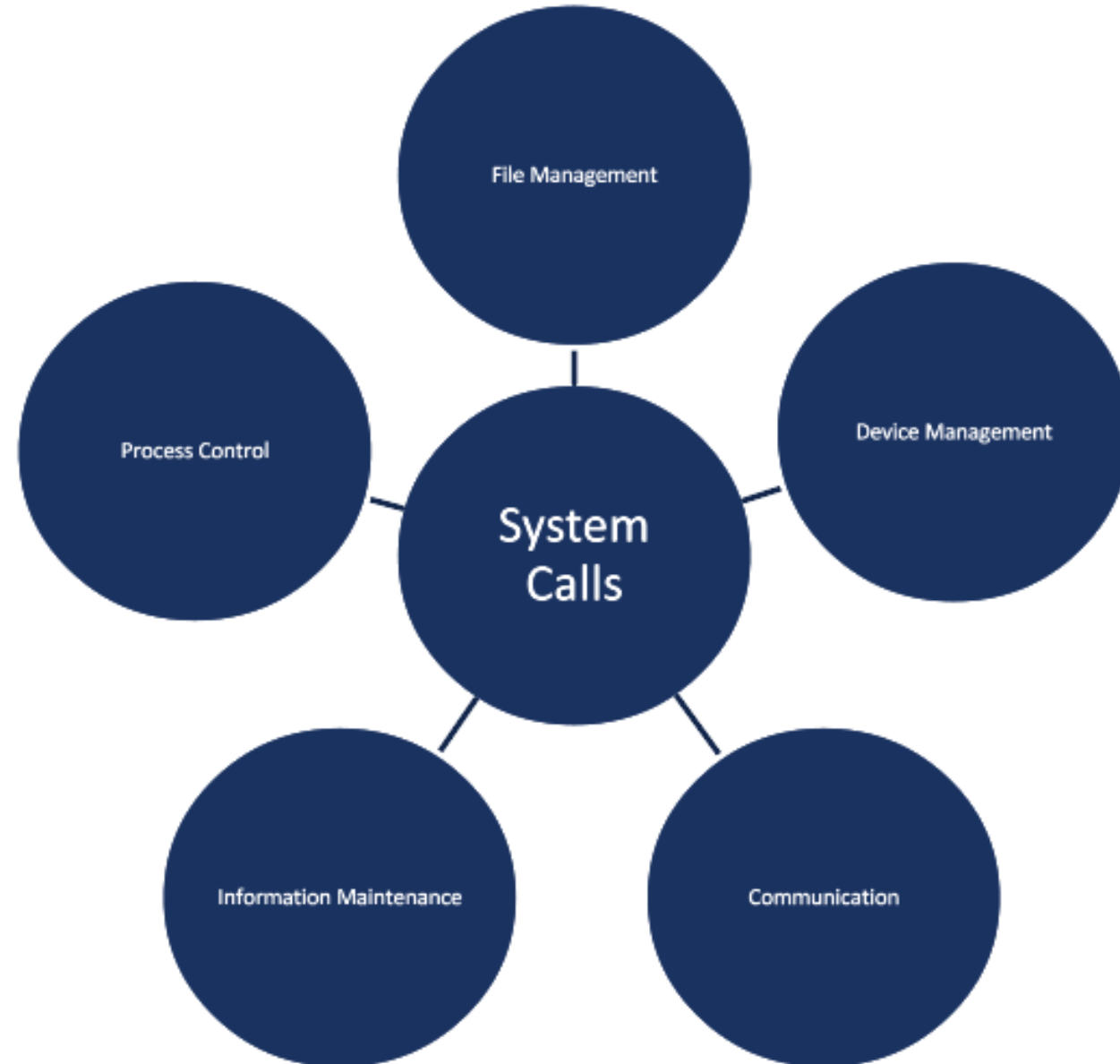
System Utility 1

System Utility programs are responsible to do specialized, individual level tasks.

The system utilities consist of various system interrupts and system calls which are to transfer the control for the user mode to the kernel mode containing the kernel and shell for further execution of the commands.

The control can be transferred using system calls.

System call is an interface between a process and the operating system



System Utility 2

File management system calls handle file manipulation jobs like creating a file, reading, and writing, etc.

The Linux System calls under this are:

`open()` : It is the system call to open a file.

`read()` : This system call opens the file in reading mode. Multiple processes can execute the `read()` system call on the same file simultaneously.

`write()` : This system call opens the file in writing mode. Multiple processes can not execute the `write()` system call on the same file simultaneously.

`close()` : This system call closes the opened file.

System Utility 3

Device management does the job of device manipulation like reading from device buffers, writing into device buffers, etc.

The Linux System calls under this is `ioctl()`.

`ioctl()` : is referred to as Input and Output Control.

It is a system call for device-specific input/output operations and other operations which cannot be expressed by regular system calls.

System Utility 4

Information Maintenance handles information and its transfer between the OS and the user program. In addition, OS keeps the information about all its processes and system calls are used to access this information.

`getpid()` : `getpid()` stands for Get the Process ID.

The function shall return the process ID of the calling process..

`alarm()` : This system call sets an alarm clock for the delivery of a signal that when it has to be reached.

`sleep()` : This System call suspends the execution of the currently running process for some interval of time.

System Utility 5

These types of system calls are specially used for inter-process communications.

- **Message Passing**(processes exchange messages with one another)
- **Shared memory** (processes share memory region to communicate)
- `pipe()` : System call is used to communicate between different Linux processes.
- `shmget()` : Stands for shared memory segment. It is mainly used for Shared memory communication.
- `mmap()` : This function call is used to map or unmap files or devices into memory.

System Utility 6

Process Control system calls perform the task of process creation, process termination, etc.

`fork()` : A new process is created by this system call. A new process may be created with `fork()` without a new program being run-the new sub-process simply continues to execute exactly the same program that the first (parent) process was running.

`exit()` : system call is used by a program to terminate its execution.

`exec()` : A new program will start executing after a call to `exec()` . Running a new program does not require that a new process be created first.

System Utility 7

`ps` is a system utility program for snapshotting of the current processes.

ISO/IEC 9945-1:2000

“Defines a standard operating system interface and environment, including a command interpreter (or "shell"), and common utility programs to support applications portability at the source code level.”

```
> ps -aux
USER          PID  %CPU  %MEM    VSZ   RSS TTY      STAT START   TIME COMMAND
root             1   0.0   0.0 165300 11156 ?        Ss   Jan03   0:08 /sbin/init
root             2   0.0   0.0      0      0 ?        S    Jan03   0:00 [kthreadd]
root             3   0.0   0.0      0      0 ?        I<   Jan03   0:00 [rcu_gp]
root             4   0.0   0.0      0      0 ?        I<   Jan03   0:00 [rcu_par_gp]
root             8   0.0   0.0      0      0 ?        I<   Jan03   0:00 [mm_percpu_wq]
root            10   0.0   0.0      0      0 ?        S    Jan03   0:00 [rcu_tasks_kthre]
root            11   0.0   0.0      0      0 ?        S    Jan03   0:00 [rcu_tasks_rude_]
root            12   0.0   0.0      0      0 ?        S    Jan03   0:00 [rcu_tasks_trace]
root            13   0.0   0.0      0      0 ?        S    Jan03   1:49 [ksoftirqd/0]
root            14   0.0   0.0      0      0 ?        I    Jan03   3:04 [rcu_preempt]
root            15   0.0   0.0      0      0 ?        S    Jan03   0:00 [rcub/0]
root            16   0.0   0.0      0      0 ?        S    Jan03   0:00 [rcuc/0]
root            17   0.0   0.0      0      0 ?        S    Jan03   0:01 [migration/0]
root            18   0.0   0.0      0      0 ?        S    Jan03   0:00 [idle_inject/0]
root            20   0.0   0.0      0      0 ?        S    Jan03   0:00 [cpuhp/0]
root            21   0.0   0.0      0      0 ?        S    Jan03   0:00 [cpuhp/1]
root            22   0.0   0.0      0      0 ?        S    Jan03   0:00 [idle_inject/1]
root            23   0.0   0.0      0      0 ?        S    Jan03   0:01 [migration/1]
root            24   0.0   0.0      0      0 ?        S    Jan03   0:00 [rcuc/1]
root            25   0.0   0.0      0      0 ?        S    Jan03   0:44 [ksoftirqd/1]
root            27   0.0   0.0      0      0 ?        I<   Jan03   0:00 [kworker/1:0H-kblockd]
root            28   0.0   0.0      0      0 ?        S    Jan03   0:00 [cpuhp/2]
root            29   0.0   0.0      0      0 ?        S    Jan03   0:00 [idle_inject/2]
root            30   0.0   0.0      0      0 ?        S    Jan03   0:01 [migration/2]
root            31   0.0   0.0      0      0 ?        S    Jan03   0:00 [rcuc/2]
root            32   0.0   0.0      0      0 ?        S    Jan03   0:55 [ksoftirqd/2]
root            34   0.0   0.0      0      0 ?        I<   Jan03   0:00 [kworker/2:0H-kblockd]
root            35   0.0   0.0      0      0 ?        S    Jan03   0:00 [cpuhp/3]
```

User Application

The application which user required to perform its task. example – office suites, VSCode, gcc, brave, etc



Hardware Platform

The resources of the system such as keyword, Monitor, Printer etc with which a user can input/output the request are supported by the Linux.

<https://linux-hardware.org/>

Select your Linux distro: Debian



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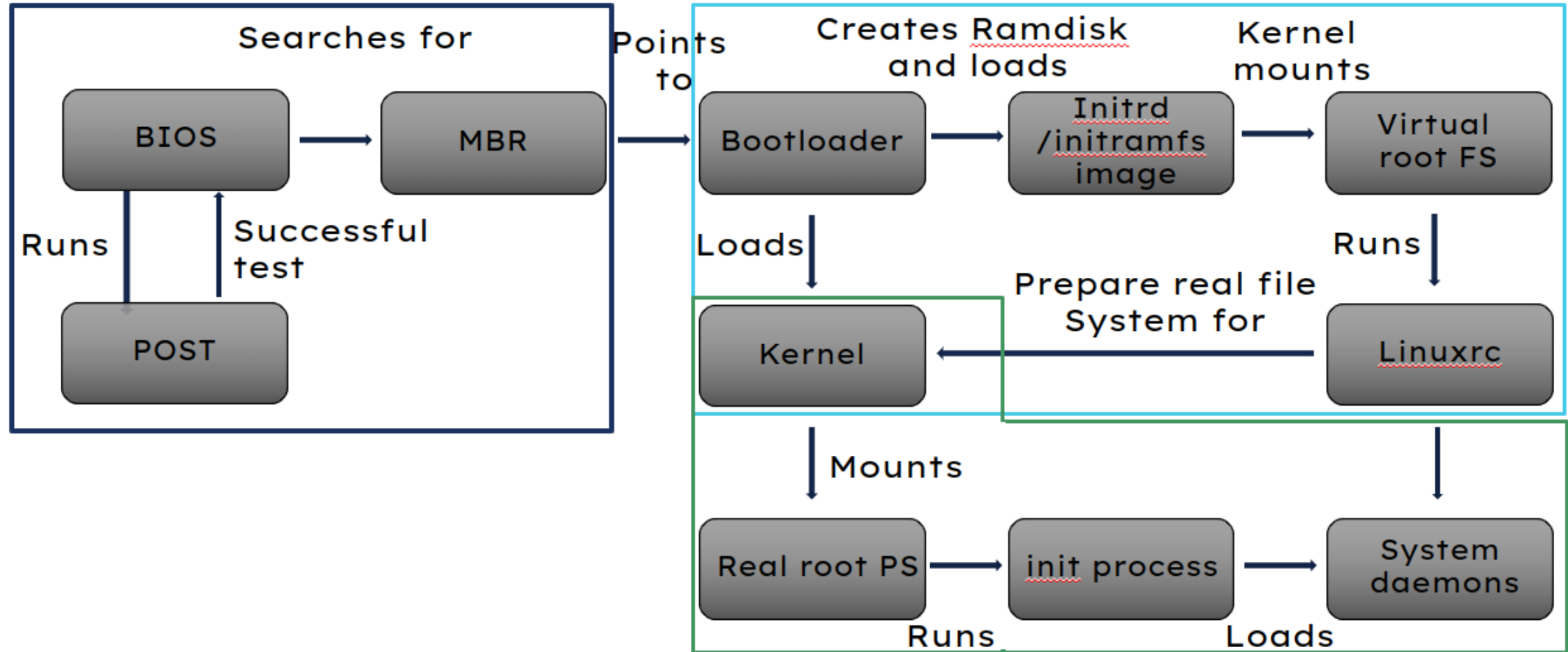


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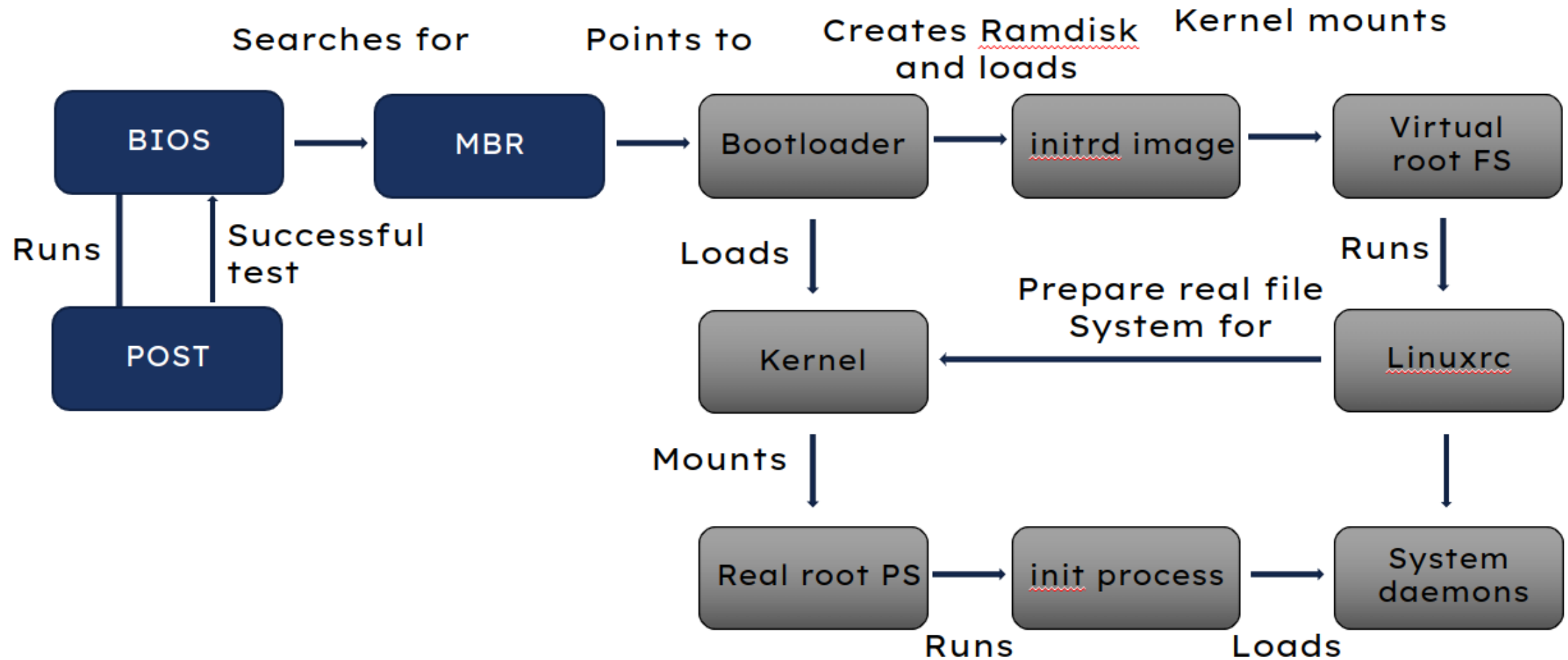


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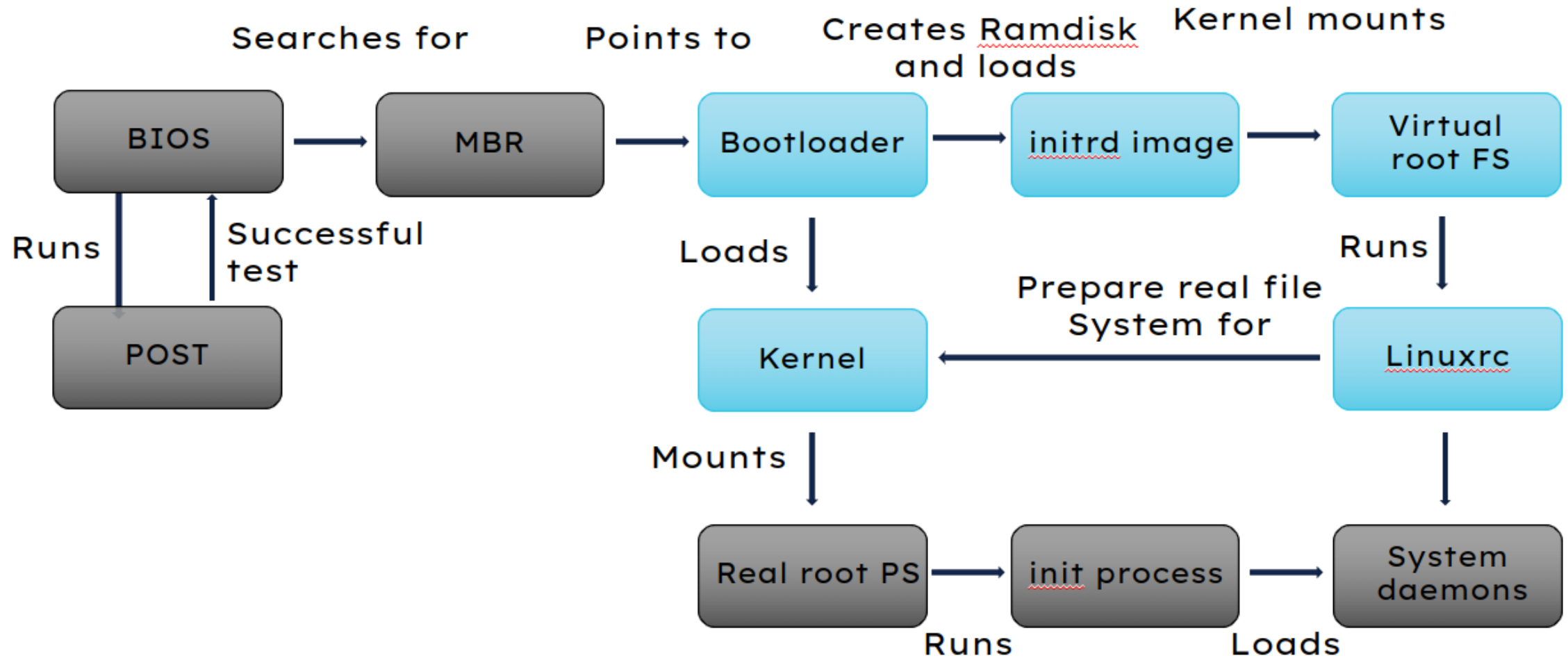
Boot Process



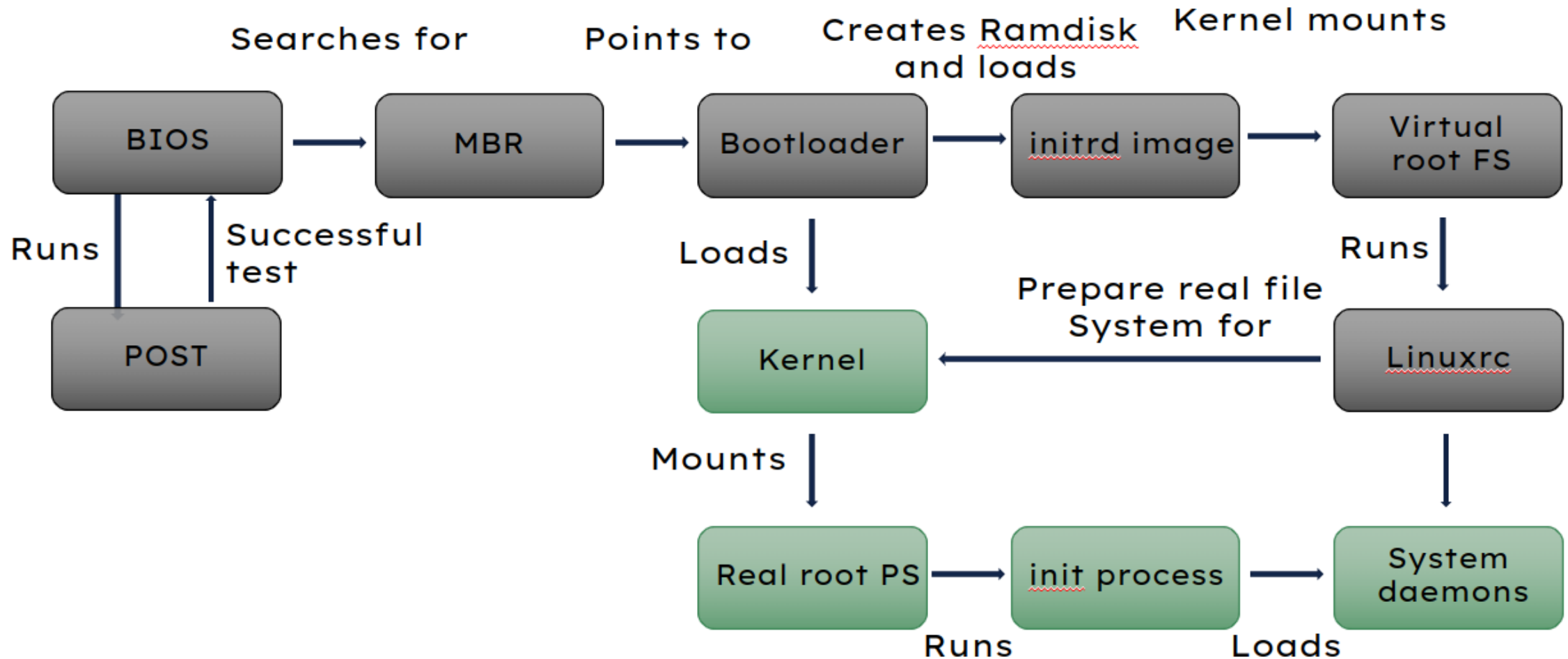
BIOS Stage



Bootloader Stage



Kernel Stage



Boot Process Log

```
Jan 12 10:13:06 nyx kernel: sd 0:0:0:0: [sda] Write Protect is off
Jan 12 10:13:06 nyx kernel: sd 0:0:0:0: [sda] Mode Sense: 00 3a 00 00
Jan 12 10:13:06 nyx kernel: sd 0:0:0:0: [sda] Write cache: enabled, read cache: enabled, doesn't support DPO or FUA
Jan 12 10:13:06 nyx kernel: sd 0:0:0:0: [sda] Attached SCSI disk
Jan 12 10:13:06 nyx kernel: Freeing unused decrypted memory: 2036K
Jan 12 10:13:06 nyx kernel: Freeing unused kernel image (initmem) memory: 1864K
Jan 12 10:13:06 nyx kernel: Write protecting the kernel read-only data: 28672k
Jan 12 10:13:06 nyx kernel: Freeing unused kernel image (text/rodata gap) memory: 2036K
Jan 12 10:13:06 nyx kernel: Freeing unused kernel image (rodata/data gap) memory: 1496K
Jan 12 10:13:06 nyx kernel: x86/mm: Checked W+X mappings: passed, no W+X pages found.
Jan 12 10:13:06 nyx kernel: rodata test: all tests were successful
Jan 12 10:13:06 nyx kernel: Run /init as init process
Jan 12 10:13:06 nyx kernel:   with arguments:
Jan 12 10:13:06 nyx kernel:     /init
Jan 12 10:13:06 nyx kernel:   with environment:
Jan 12 10:13:06 nyx kernel:     HOME=/
Jan 12 10:13:06 nyx kernel:     TERM=linux
Jan 12 10:13:06 nyx kernel:     ROOT_IMAGE=/vmlinuz-linux
Jan 12 10:13:06 nyx kernel: fbcon: Taking over console
Jan 12 10:13:06 nyx kernel: Console: switching to colour frame buffer device 240x67
Jan 12 10:13:06 nyx kernel: xhci_hcd 0000:00:14.0: xHCI Host Controller
Jan 12 10:13:06 nyx kernel: xhci_hcd 0000:00:14.0: new USB bus registered, assigned bus number 1
Jan 12 10:13:06 nyx kernel: xhci_hcd 0000:00:14.0: hcc params 0x200077c1 hci version 0x110 quirks 0x0000000000009810
Jan 12 10:13:06 nyx kernel: sdhci: Secure Digital Host Controller Interface driver
Jan 12 10:13:06 nyx kernel: sdhci: Copyright(c) Pierre Ossman
Jan 12 10:13:06 nyx kernel: i8042: PNP: PS/2 Controller [PNP0303:PS2K] at 0x60,0x64 irq 1
Jan 12 10:13:06 nyx kernel: i8042: PNP: PS/2 appears to have AUX port disabled, if this is incorrect please boot with i8042.nopnp
Jan 12 10:13:06 nyx kernel: usb usb1: New USB device found, idVendor=1d6b, idProduct=0002, bcdDevice= 5.15
Jan 12 10:13:06 nyx kernel: usb usb1: New USB device strings: Mfr=3, Product=2, SerialNumber=1
Jan 12 10:13:06 nyx kernel: usb usb1: Product: xHCI Host Controller
Jan 12 10:13:06 nyx kernel: usb usb1: Manufacturer: Linux 5.15.13-arch1-1 xhci-hcd
Jan 12 10:13:06 nyx kernel: usb usb1: SerialNumber: 0000:00:14.0
Jan 12 10:13:06 nyx kernel: hub 1-0:1.0: USB hub found
Jan 12 10:13:06 nyx kernel: hub 1-0:1.0: 12 ports detected
Jan 12 10:13:06 nyx kernel: serio: i8042 KBD port at 0x60,0x64 irq 1
Jan 12 10:13:06 nyx kernel: xhci_hcd 0000:00:14.0: xHCI Host Controller
Jan 12 10:13:06 nyx kernel: xhci_hcd 0000:00:14.0: new USB bus registered, assigned bus number 2
Jan 12 10:13:06 nyx kernel: xhci_hcd 0000:00:14.0: Host supports USB 3.1 Enhanced SuperSpeed
Jan 12 10:13:06 nyx kernel: usb usb2: New USB device found, idVendor=1d6b, idProduct=0003, bcdDevice= 5.15
Jan 12 10:13:06 nyx kernel: usb usb2: New USB device strings: Mfr=3, Product=2, SerialNumber=1
Jan 12 10:13:06 nyx kernel: usb usb2: Product: xHCI Host Controller
Jan 12 10:13:06 nyx kernel: usb usb2: Manufacturer: Linux 5.15.13-arch1-1 xhci-hcd
Jan 12 10:13:06 nyx kernel: usb usb2: SerialNumber: 0000:00:14.0
Jan 12 10:13:06 nyx kernel: hub 2-0:1.0: USB hub found
Jan 12 10:13:06 nyx kernel: hub 2-0:1.0: 6 ports detected
Jan 12 10:13:06 nyx kernel: usb: port power management may be unreliable
Jan 12 10:13:06 nyx kernel: sdhci_pci 0000:00:14.5: SDHCI controller found [8086:024f] (rev 0)
```

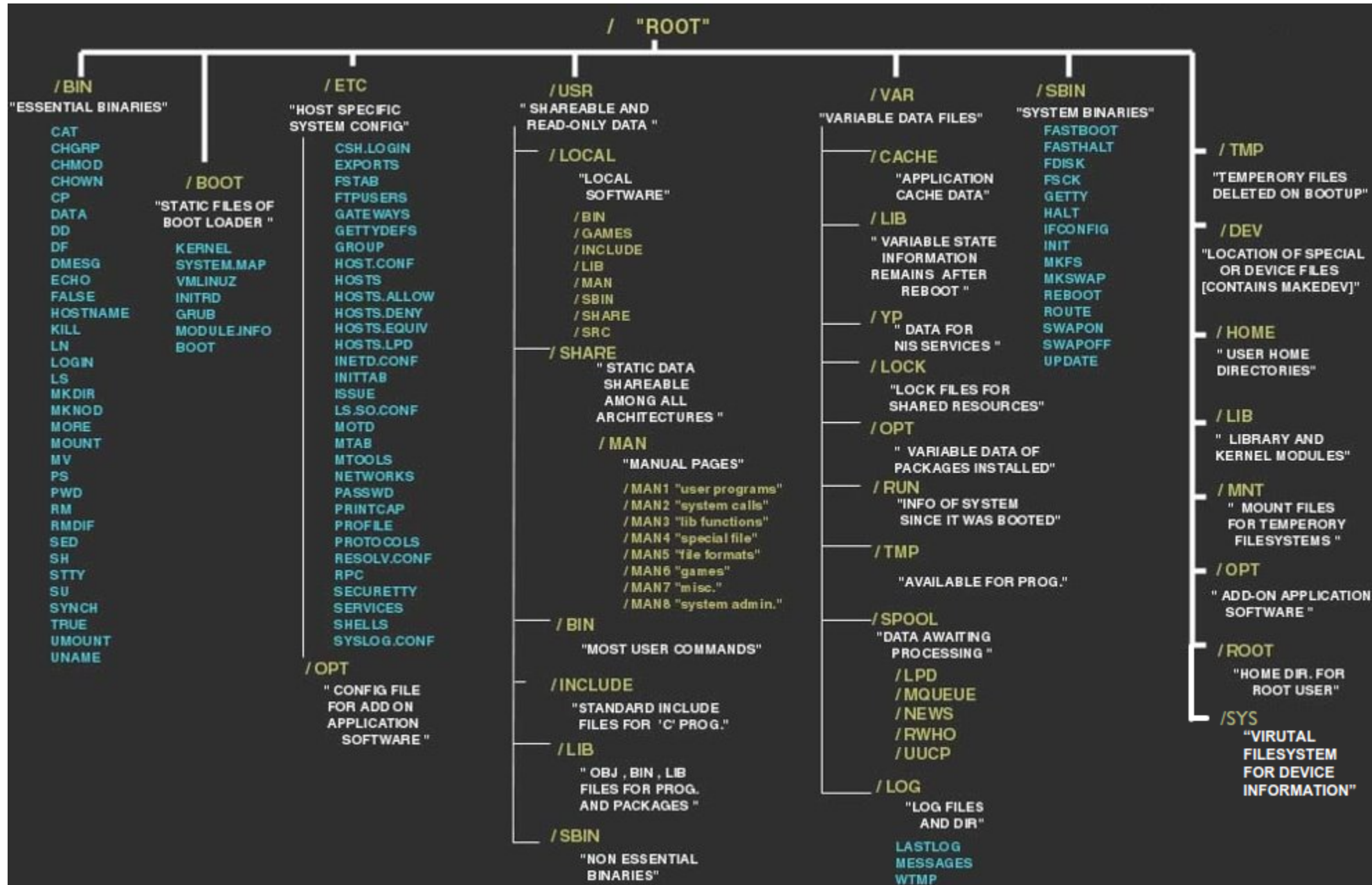

Kernel Log

```
13:06 nyx kernel: Linux version 5.15.13-arch1-1 (linux@archlinux) (gcc (GCC) 11.1.0, GNU ld (GNU Binutils) 2.36.1) #1 SMP PREEMPT Wed, 05 Jan 2022 16:20:13:06 nyx kernel: Command line: BOOT_IMAGE=/vmlinuz-linux root=UUID=6b5b2843-50de-4cef-b562-658fad8e1aed rw loglevel=3 quiet snd-intel-dspcfg.dsp_driver=13:06 nyx kernel: x86/fpu: Supporting XSAVE feature 0x001: 'x87 floating point registers'13:06 nyx kernel: x86/fpu: Supporting XSAVE feature 0x002: 'SSE registers'13:06 nyx kernel: x86/fpu: Supporting XSAVE feature 0x004: 'AVX registers'13:06 nyx kernel: x86/fpu: Supporting XSAVE feature 0x008: 'MPX bounds registers'13:06 nyx kernel: x86/fpu: Supporting XSAVE feature 0x010: 'MPX CSR'13:06 nyx kernel: x86/fpu: xstate_offset[2]: 576, xstate_sizes[2]: 25613:06 nyx kernel: x86/fpu: xstate_offset[3]: 832, xstate_sizes[3]: 6413:06 nyx kernel: x86/fpu: xstate_offset[4]: 896, xstate_sizes[4]: 6413:06 nyx kernel: x86/fpu: Enabled xstate features 0x1f, context size is 960 bytes, using 'compact' format.13:06 nyx kernel: signal: max sigframe size: 203213:06 nyx kernel: BIOS-provided physical RAM map:13:06 nyx kernel: BIOS-e820: [mem 0x0000000000000000-0x000000000009ffff] usable13:06 nyx kernel: BIOS-e820: [mem 0x000000000009ffff-0x00000000000fffff] reserved13:06 nyx kernel: BIOS-e820: [mem 0x0000000000100000-0x0000000000c25aefff] usable13:06 nyx kernel: BIOS-e820: [mem 0x00000000c25eb000-0x00000000c2aeffff] type 2013:06 nyx kernel: BIOS-e820: [mem 0x00000000c2aeb000-0x00000000c38cefff] reserved13:06 nyx kernel: BIOS-e820: [mem 0x00000000c38cf000-0x00000000c3acefff] ACPI NVS13:06 nyx kernel: BIOS-e820: [mem 0x00000000c3acf000-0x00000000c3b4ffff] ACPI data13:06 nyx kernel: BIOS-e820: [mem 0x00000000c3b4f000-0x00000000c3b4ffff] usable13:06 nyx kernel: BIOS-e820: [mem 0x00000000c3b50000-0x00000000d67fffff] reserved13:06 nyx kernel: BIOS-e820: [mem 0x00000000ff380000-0x00000000ffffffff] reserved13:06 nyx kernel: BIOS-e820: [mem 0x0000000100000000-0x00000004277fffff] usable13:06 nyx kernel: NX (Execute Disable) protection: active13:06 nyx kernel: efi: EFI v2.70 by HP13:06 nyx kernel: efi: ACPI=0xc3b4e000 ACPI 2.0=0xc3b4e014 ESRT=0xc2dca298 TPMFinalLog=0xc3a7d000 SMBIOS=0xc2db6000 MEMATTR=0xbe2e401813:06 nyx kernel: SMBIOS 3.2 present.13:06 nyx kernel: DMI: HP HP ProBook 440 G7/869D, BIOS S71 Ver. 01.09.00 04/26/202113:06 nyx kernel: tsc: Detected 2100.000 MHz processor13:06 nyx kernel: tsc: Detected 2099.944 MHz TSC13:06 nyx kernel: e820: update [mem 0x00000000-0x00000fff] usable ==> reserved13:06 nyx kernel: e820: remove [mem 0x000a0000-0x000fffff] usable13:06 nyx kernel: last pfn = 0x427800 max arch pfn = 0x4000000013:06 nyx kernel: x86/PAT: Configuration [0-7]: WB WC UC- UC WB WP UC- WT13:06 nyx kernel: last pfn = 0xc3b50 max arch pfn = 0x4000000013:06 nyx kernel: esrt: Reserving ESRT space from 0x00000000c2dca298 to 0x00000000c2dca348.13:06 nyx kernel: Using GB pages for direct mapping13:06 nyx kernel: Secure boot disabled13:06 nyx kernel: RAMDISK: [mem 0x3658b000-0x372bcfff]13:06 nyx kernel: ACPI: Early table checksum verification disabled13:06 nyx kernel: ACPI: RSDP 0x00000000C3B4E014 000024 (v02 HPQOEM)13:06 nyx kernel: ACPI: XSDT 0x00000000C3AFC188 00013C (v01 HPQOEM SLIC-BPC 00000000 INTL 20160422)13:06 nyx kernel: ACPI: FACP 0x00000000C3B31000 000114 (v06 HPQOEM SLIC-BPC 00000000 HP 00000001)13:06 nyx kernel: ACPI: DSDT 0x00000000C3B06000 027F1A (v02 HPQOEM 869D 00000000 INTL 20160527)13:06 nyx kernel: ACPI: FACS 0x00000000C3A78000 00004013:06 nyx kernel: ACPI: SSDT 0x00000000C3B4C000 0002D7 (v01 HP NVTEC 00000001 INTL 20160527)13:06 nyx kernel: ACPI: SSDT 0x00000000C3B4B000 00012A (v02 HP ShmTable 00000001 INTL 20160527)13:06 nyx kernel: ACPI: SSDT 0x00000000C3B48000 0020AD (v02 CpuRef CpuSsdT 00003000 INTL 20160527)13:06 nyx kernel: ACPI: SSDT 0x00000000C3B47000 000DF9 (v02 CtdpB CtdpB 00001000 INTL 20160527)13:06 nyx kernel: ACPI: SSDT 0x00000000C3B3A000 00CE82 (v02 AcpiRe PLT RTD3 00001000 INTL 20160527)13:06 nyx kernel: ACPI: RTMA 0x00000000C3B39000 00009E (v01 HP HBMArt 00001000 HP 00000001)13:06 nyx kernel: ACPI: SSDT 0x00000000C3B37000 001575 (v02 HP UcsiAcpi 00000001 INTL 20160527)13:06 nyx kernel: ACPI: SSDT 0x00000000C3B36000 0000FB (v02 HP UcsiCntr 00000001 INTL 20160527)
```

Systemd Log

```
systemd[655]: Listening on pipewire-kernel.service.
systemd[655]: Listening on PipeWire Multimedia System Socket.
systemd[655]: Listening on Sound System.
systemd[655]: Listening on D-Bus User Message Bus Socket.
systemd[655]: Reached target Sockets.
systemd[655]: Reached target Basic System.
systemd[1]: Started User Manager for UID 1000.
systemd[655]: Starting Update XDG user dir configuration...
systemd[655]: Finished Update XDG user dir configuration.
systemd[655]: Reached target Main User Target.
systemd[655]: Startup finished in 112ms.
systemd[655]: Started D-Bus User Message Bus.
dbus-daemon[686]: [session uid=1000 pid=686] Activating via systemd: service name='org.freedesktop.portal.Desktop' unit='xdg-desktop-portal.service' requested by ':1.0' (uid=1000 pid=686 comm="/usr/libexec/dbus-daemon")
systemd[655]: Created slice User Core Session Slice.
systemd[655]: Starting Portal service...
dbus-daemon[686]: [session uid=1000 pid=686] Activating via systemd: service name='org.freedesktop.portal.Documents' unit='xdg-document-portal.service' requested by ':1.0' (uid=1000 pid=686 comm="/usr/libexec/dbus-daemon")
systemd[655]: Starting flatpak document portal service...
dbus-daemon[686]: [session uid=1000 pid=686] Activating via systemd: service name='org.freedesktop.impl.portal.PermissionStore' unit='xdg-permission-store.service' requested by ':1.0' (uid=1000 pid=686 comm="/usr/libexec/dbus-daemon")
systemd[655]: Starting sandboxed app permission store...
dbus-daemon[686]: [session uid=1000 pid=686] Successfully activated service 'org.freedesktop.impl.portal.PermissionStore'
systemd[655]: Started sandboxed app permission store.
dbus-daemon[686]: [session uid=1000 pid=686] Successfully activated service 'org.freedesktop.portal.Documents'
systemd[655]: Started flatpak document portal service.
dbus-daemon[686]: [session uid=1000 pid=686] Activating via systemd: service name='org.freedesktop.impl.portal.desktop.gtk' unit='xdg-desktop-portal-gtk.service' requested by ':1.0' (uid=1000 pid=686 comm="/usr/libexec/dbus-daemon")
systemd[655]: Starting Portal service (GTK/GNOME implementation)...
dbus-daemon[686]: [session uid=1000 pid=686] Activating via systemd: service name='org.ally.Bus' unit='at-spi-dbus-bus.service' requested by ':1.0' (uid=1000 pid=686 comm="/usr/libexec/dbus-daemon")
systemd[655]: Starting Accessibility services bus...
dbus-daemon[686]: [session uid=1000 pid=686] Successfully activated service 'org.ally.Bus'
systemd[655]: Started Accessibility services bus.
at-spi-bus-launcher[924]: dbus-daemon[924]: Activating service name='org.ally.atspi.Registry' requested by ':1.0' (uid=1000 pid=894 comm="/usr/libexec/at-spi-bus-launcher")
at-spi-bus-launcher[924]: dbus-daemon[924]: writing oom_score_adj error: Permission denied
at-spi-bus-launcher[924]: dbus-daemon[924]: Successfully activated service 'org.ally.atspi.Registry'
at-spi-bus-launcher[924]: SpiRegistry daemon is running with well-known name - org.ally.atspi.Registry
dbus-daemon[686]: [session uid=1000 pid=686] Successfully activated service 'org.freedesktop.impl.portal.desktop.gtk'
systemd[655]: Started Portal service (GTK/GNOME implementation).
systemd[655]: Started PipeWire Multimedia Service.
dbus-daemon[686]: [session uid=1000 pid=686] Activating service name='org.freedesktop.secrets' requested by ':1.3' (uid=1000 pid=871 comm="/usr/libexec/dbus-daemon")
dbus-daemon[1001]: writing oom_score_adj error: Permission denied
dbus-daemon[686]: [session uid=1000 pid=686] Successfully activated service 'org.freedesktop.secrets'
dbus-daemon[686]: [session uid=1000 pid=686] Successfully activated service 'org.freedesktop.portal.Desktop'
systemd[655]: Started Portal service.
systemd[655]: Starting Sound Service...
pulseaudio[1613]: stat('/etc/pulse/default.pa.d'): No such file or directory
systemd[655]: Started Sound Service.
dbus-daemon[686]: [session uid=1000 pid=686] Activating via systemd: service name='ca.desrt.dconf' unit='dconf.service' requested by ':1.8' (uid=1000 pid=1613 comm="/usr/bin/pulseaudio")
systemd[655]: Starting User preferences database...
dbus-daemon[686]: [session uid=1000 pid=686] Successfully activated service 'ca.desrt.dconf'
systemd[655]: Started User preferences database.
dbus-daemon[686]: [session uid=1000 pid=686] Reloaded configuration
dbus-daemon[686]: [session uid=1000 pid=686] Reloaded configuration
dbus-daemon[686]: [session uid=1000 pid=686] Reloaded configuration
dbus-daemon[686]: [session uid=1000 pid=686] Reloaded configuration
dbus-daemon[686]: [session uid=1000 pid=686] Reloaded configuration
dbus-daemon[686]: [session uid=1000 pid=686] Reloaded configuration
} (END)
```


File System



Explore some of the files in the linux system to obtained useful for information about the system in the command line and then via a bash script.