

LKMP – build and boot the kernel – Sergio Gonzalez Collado

We start from the version 6.8 of the kernel:

```
sergio@laptop: ~/repos/busyboxLinux/src/linux-stable
sergio@laptop:~/repos/busyboxLinux/src/linux-stable$ git log -1
commit e8f897f4afef0031fe618a8e94127a0934896aba (grafted, HEAD, tag: v6.8)
Author: Linus Torvalds <torvalds@linux-foundation.org>
Date:   Sun Mar 10 13:38:09 2024 -0700

    Linux 6.8
sergio@laptop:~/repos/busyboxLinux/src/linux-stable$
```

Build and compile it:

```
sergio@laptop: ~/repos/busyboxLinux/src/linux-stable
sergio@laptop:~/repos/busyboxLinux/src/linux-stable$ git log -1
commit e8f897f4afef0031fe618a8e94127a0934896aba (grafted, HEAD, tag: v6.8)
Author: Linus Torvalds <torvalds@linux-foundation.org>
Date:   Sun Mar 10 13:38:09 2024 -0700

    Linux 6.8
sergio@laptop:~/repos/busyboxLinux/src/linux-stable$ make defconfig && time make -j$(nproc)
```

```
sergio@laptop: ~/repos/busyboxLinux/src/linux-stable
CC      arch/x86/boot/compressed/early_serial_console.o
CC      arch/x86/boot/compressed/kaslr.o
CC      arch/x86/boot/compressed/ident_map_64.o
CC      arch/x86/boot/compressed/idt_64.o
AS      arch/x86/boot/compressed/idt_handlers_64.o
CC      arch/x86/boot/compressed/pgtable_64.o
CC      arch/x86/boot/compressed/acpi.o
CC      arch/x86/boot/compressed/efi.o
AS      arch/x86/boot/compressed/efi_mixed.o
GZIP    arch/x86/boot/compressed/vmlinux.bin.gz
CC      arch/x86/boot/compressed/misc.o
MKPIGGY arch/x86/boot/compressed/piggy.S
AS      arch/x86/boot/compressed/piggy.o
LD      arch/x86/boot/compressed/vmlinux
ZOFFSET arch/x86/boot/zoffset.h
OBJCOPY arch/x86/boot/vmlinux.bin
AS      arch/x86/boot/header.o
LD      arch/x86/boot/setup.elf
OBJCOPY arch/x86/boot/setup.bin
BUILD   arch/x86/boot/bzImage
Kernel: arch/x86/boot/bzImage is ready  (#5)

real    3m58,713s
user    37m50,049s
sys     4m36,590s
sergio@laptop:~/repos/busyboxLinux/src/linux-stable$
```

To boot the kernel, I use busybox, to create an image and run it with qemu:

```
sergio@laptop: ~/repos/busyboxLinux
sergio@laptop:~/repos/busyboxLinux$ ls
buildBusyBoxLinux.sh  bzImage  initrd  initrd.img  src
sergio@laptop:~/repos/busyboxLinux$ qemu-system-x86_64 -kernel bzImage -initrd initrd.img -nographic -append 'console=ttyS0' -enable-kvm
```

```
sergio@laptop: ~/repos/busyboxLinux
[ 0.000000] Linux version 6.8.0 (sergio@laptop) (gcc (Ubuntu 12.3.0-1ubuntu1-23.04) 12.3.0, GNU ld (GNU Binutils for Ubuntu) 2.40) #5 SMP PREEMPT_DYNAMIC S
[ 0.000000] Command line: console=ttyS0
[ 0.000000] BIOS-provided physical RAM map:
[ 0.000000] BIOS-e820: [mem 0x0000000000000000-0x0000000000009fbfff] usable
[ 0.000000] BIOS-e820: [mem 0x0000000000009fc000-0x0000000000009fffff] reserved
[ 0.000000] BIOS-e820: [mem 0x000000000000f00000-0x000000000000fffff] reserved
[ 0.000000] BIOS-e820: [mem 0x0000000000100000-0x000000000007fdffff] usable
[ 0.000000] BIOS-e820: [mem 0x000000000007fe0000-0x000000000007fffff] reserved
[ 0.000000] BIOS-e820: [mem 0x0000000000fffc0000-0x0000000000ffffff] reserved
[ 0.000000] BIOS-e820: [mem 0x00000000ffffc00000-0x00000000ffffff] reserved
[ 0.000000] BIOS-e820: [mem 0x000000fd00000000-0x000000ffffff] reserved
[ 0.000000] NX (Execute Disable) protection: active
[ 0.000000] APIC: Static calls initialized
[ 0.000000] SMBIOS 2.8 present.
[ 0.000000] DMI: QEMU Standard PC (i440FX + PIIX, 1996), BIOS 1.16.0-debian.1.16.0-5 04/01/2014
[ 0.000000] Hypervisor detected: KVM
[ 0.000000] kvm-clock: Using msrs 4b564d01 and 4b564d00
[ 0.000000] kvm-clock: using sched offset of 225736175 cycles
[ 0.000001] clocksource: kvm-clock: mask: 0xffffffffffffff max_cycles: 0x1cd42e4dffb, max_idle_ns: 881590591483 ns
[ 0.000002] tsc: Detected 3293.810 MHz processor
[ 0.000558] last_pfn = 0x7fe0 max_arch_pfn = 0x400000000
[ 0.000594] MTRR map: 4 entries (3 fixed + 1 variable; max 19), built from 8 variable MTRRs
[ 0.000596] x86/PAT: Configuration [0-7]: WB WC UC- UC WB WP UC- WT
[ 0.002071] found SMP MP-table at [mem 0x000f5ba0-0x000f5baf]
[ 0.002197] RAMDISK: [mem 0x07d7a000-0x07fdffff]
[ 0.002272] ACPI: Early table checksum verification disabled
[ 0.002273] ACPI: RSDP 0x00000000000f59d0 000014 (v00 BOCHS )
[ 0.002276] ACPI: RSDT 0x00000000007fe1a06 000034 (v01 BOCHS BXPC 00000001 BXPC 00000001)
[ 0.002279] ACPI: FACP 0x00000000007fe197a 000074 (v01 BOCHS BXPC 00000001 BXPC 00000001)
[ 0.002281] ACPI: DSDT 0x00000000007fe0040 00193A (v01 BOCHS BXPC 00000001 BXPC 00000001)
[ 0.002283] ACPI: FACS 0x00000000007fe0000 000040
[ 0.002284] ACPI: APIC 0x00000000007fe19ee 000078 (v01 BOCHS BXPC 00000001 BXPC 00000001)
[ 0.002286] ACPI: HPET 0x00000000007fe1a66 000038 (v01 BOCHS BXPC 00000001 BXPC 00000001)
[ 0.002287] ACPI: WAET 0x00000000007fe1a9e 000028 (v01 BOCHS BXPC 00000001 BXPC 00000001)
[ 0.002288] ACPI: Reserving FACP table memory at [mem 0x7fe197a-0x7fe19ed]
[ 0.002289] ACPI: Reserving DSDT table memory at [mem 0x7fe0040-0x7fe1979]
[ 0.002290] ACPI: Reserving FACS table memory at [mem 0x7fe0000-0x7fe003f]
```

```
sergio@laptop: ~/repos/busyboxLinux
[ 0.767319] IPI shorthand broadcast: enabled
[ 0.768941] sched_clock: Marking stable (696006848, 72421517)->(771395681, -2967316)
[ 0.770117] registered taskstats version 1
[ 0.770721] Loading compiled-in X.509 certificates
[ 0.772332] PM: Magic number: 8:933:794
[ 0.773008] printk: legacy console [netcon0] enabled
[ 0.773767] netconsole: network logging started
[ 0.774475] cfg80211: Loading compiled-in X.509 certificates for regulatory database
[ 0.775638] kworker/u2:1 (46) used greatest stack depth: 15000 bytes left
[ 0.776770] Loaded X.509 cert 'sforshee: 00b28ddf47aef9cea7'
[ 0.777701] Loaded X.509 cert 'wens: 61c038651aabdcf94bd0ac7ff06c7248db18c600'
[ 0.778784] platform regulatory.0: Direct firmware load for regulatory.db failed with error -2
[ 0.780026] cfg80211: failed to load regulatory.db
[ 0.780733] ALSA device list:
[ 0.781165] No soundcards found.
[ 0.782043] Freeing unused kernel image (initmem) memory: 2672K
[ 0.783438] Write protecting the kernel read-only data: 26624k
[ 0.784244] Freeing unused kernel image (rodata/data gap) memory: 1568K
[ 0.813340] x86/mm: Checked W+X mappings: passed, no W+X pages found.
[ 0.814035] Run /init as init process
[ 0.814808] mount (49) used greatest stack depth: 14336 bytes left
[ 0.815670] mount (50) used greatest stack depth: 14176 bytes left
Boot took 0.74 seconds
/bin/sh: can't access tty; job control turned off
/ # [ 1.380499] input: ImExPS/2 Generic Explorer Mouse as /devices/platform/i8042/serio1/input/input3
```

The init scrip was:

```
1 #!/bin/sh
2 /bin/mount -t devtmpfs devtmpfs /dev
3 /bin/mount -t proc none /proc
4 /bin/mount -t sysfs none /sys
5 exec 0</dev/console
6 exec 1>/dev/console
7 exec 2>/dev/console
8
9 cat <<!
10 Boot took $(cut -d' ' -f1 /proc/uptime) seconds
11 !
12 exec /bin/sh
```

The init log, was:

```
[ 0.000000] Linux version 6.8.0 (sergio@laptop) (gcc (Ubuntu 12.3.0-1ubuntu1~23.04) 12.3.0, GNU ld (GNU Binutils for Ubuntu) 2.40) #5 SMP
PREEMPT_DYNAMIC Sun May 12 19:31:53 CEST 4
[ 0.000000] Command line: console=ttyS0
[ 0.000000] BIOS-provided physical RAM map:
[ 0.000000] BIOS-e820: [mem 0x0000000000000000-0x0000000000009fbfff] usable
[ 0.000000] BIOS-e820: [mem 0x0000000000009fc00-0x0000000000009ffff] reserved
[ 0.000000] BIOS-e820: [mem 0x000000000000f0000-0x000000000000fffff] reserved
[ 0.000000] BIOS-e820: [mem 0x00000000000100000-0x0000000000007fdffff] usable
[ 0.000000] BIOS-e820: [mem 0x000000000007fe000-0x0000000000007fffff] reserved
[ 0.000000] BIOS-e820: [mem 0x000000000feffc000-0x000000000fefffff] reserved
[ 0.000000] BIOS-e820: [mem 0x00000000fffc0000-0x00000000ffxffffffff] reserved
[ 0.000000] BIOS-e820: [mem 0x000000fd00000000-0x000000fffffffff] reserved
[ 0.000000] NX (Execute Disable) protection: active
[ 0.000000] APIC: Static calls initialized
[ 0.000000] SMBIOS 2.8 present.
[ 0.000000] DMI: QEMU Standard PC (i440FX + PIIX, 1996), BIOS 1.16.0-debian-1.16.0-5 04/01/2014
[ 0.000000] Hypervisor detected: KVM
[ 0.000000] kvm-clock: Using msrs 4b564d01 and 4b564d00
[ 0.000000] kvm-clock: using sched offset of 225736175 cycles
[ 0.000001] clocksource: kvm-clock: mask: 0xffffffffffffffff max_cycles: 0x1cd42e4dffb, max_idle_ns: 881590591483 ns
[ 0.000002] tsc: Detected 3293.810 MHz processor
[ 0.000558] last_pfn = 0x7fe0 max_arch_pfn = 0x400000000
[ 0.000594] MTRR map: 4 entries (3 fixed + 1 variable; max 19), built from 8 variable MTRRs
[ 0.000596] x86/PAT: Configuration [0-7]: WB WC UC- UC WB WP UC- WT
[ 0.002071] found SMP MP-table at [mem 0x000f5ba0-0x000f5baf]
[ 0.002197] RAMDISK: [mem 0x07d7a000-0x07fdffff]
[ 0.002272] ACPI: Early table checksum verification disabled
[ 0.002273] ACPI: RSDP 0x000000000000F59D0 000014 (v00 BOCHS )
[ 0.002276] ACPI: RSDT 0x00000000007FE1AC6 000034 (v01 BOCHS BXPC 00000001 BXPC 00000001)
```

```

[ 0.002279] ACPI: FACP 0x0000000007FE197A 000074 (v01 BOCHS BXPC
00000001 BXPC 00000001)
[ 0.002281] ACPI: DSDT 0x0000000007FE0040 00193A (v01 BOCHS BXPC
00000001 BXPC 00000001)
[ 0.002283] ACPI: FACS 0x0000000007FE0000 000040
[ 0.002284] ACPI: APIC 0x0000000007FE19EE 000078 (v01 BOCHS BXPC
00000001 BXPC 00000001)
[ 0.002286] ACPI: HPET 0x0000000007FE1A66 000038 (v01 BOCHS BXPC
00000001 BXPC 00000001)
[ 0.002287] ACPI: WAET 0x0000000007FE1A9E 000028 (v01 BOCHS BXPC
00000001 BXPC 00000001)
[ 0.002288] ACPI: Reserving FACP table memory at [mem 0x7fe197a-0x7fe19ed]
[ 0.002289] ACPI: Reserving DSDT table memory at [mem 0x7fe0040-0x7fe1979]
[ 0.002290] ACPI: Reserving FACS table memory at [mem 0x7fe0000-0x7fe003f]
[ 0.002290] ACPI: Reserving APIC table memory at [mem 0x7fe19ee-0x7fe1a65]
[ 0.002290] ACPI: Reserving HPET table memory at [mem 0x7fe1a66-0x7fe1a9d]
[ 0.002291] ACPI: Reserving WAET table memory at [mem 0x7fe1a9e-0x7fe1ac5]
[ 0.002463] No NUMA configuration found
[ 0.002463] Faking a node at [mem 0x0000000000000000-0x0000000007fdffff]
[ 0.002465] NODE_DATA(0) allocated [mem 0x07d76000-0x07d79fff]
[ 0.002470] Zone ranges:
[ 0.002471] DMA [mem 0x00000000000001000-0x0000000000ffffff]
[ 0.002472] DMA32 [mem 0x00000000001000000-0x0000000007fdffff]
[ 0.002473] Normal empty
[ 0.002473] Movable zone start for each node
[ 0.002474] Early memory node ranges
[ 0.002474] node 0: [mem 0x00000000000001000-0x000000000009efff]
[ 0.002475] node 0: [mem 0x00000000000100000-0x0000000007fdffff]
[ 0.002476] Initmem setup node 0 [mem 0x00000000000001000-0x0000000007fdffff]
[ 0.002657] On node 0, zone DMA: 1 pages in unavailable ranges
[ 0.002666] On node 0, zone DMA: 97 pages in unavailable ranges
[ 0.002722] On node 0, zone DMA32: 32 pages in unavailable ranges
[ 0.002946] ACPI: PM-Timer IO Port: 0x608
[ 0.002948] ACPI: LAPIC_NMI (acpi_id[0xff] dfl dfl lint[0x1])
[ 0.002968] IOAPIC[0]: apic_id 0, version 17, address 0xfec00000, GSI 0-23
[ 0.002970] ACPI: INT_SRC_OVR (bus 0 bus_irq 0 global_irq 2 dfl dfl)
[ 0.002971] ACPI: INT_SRC_OVR (bus 0 bus_irq 5 global_irq 5 high level)
[ 0.002972] ACPI: INT_SRC_OVR (bus 0 bus_irq 9 global_irq 9 high level)
[ 0.002972] ACPI: INT_SRC_OVR (bus 0 bus_irq 10 global_irq 10 high level)
[ 0.002973] ACPI: INT_SRC_OVR (bus 0 bus_irq 11 global_irq 11 high level)
[ 0.002975] ACPI: Using ACPI (MADT) for SMP configuration information
[ 0.002975] ACPI: HPET id: 0x8086a201 base: 0xfed00000
[ 0.002977] smpboot: Allowing 1 CPUs, 0 hotplug CPUs
[ 0.002985] kvm-guest: APIC: eoi() replaced with kvm_guest_apic_eoi_write()
[ 0.002994] PM: hibernation: Registered nosave memory: [mem 0x00000000-
0x000000fff]
[ 0.002995] PM: hibernation: Registered nosave memory: [mem 0x0009f000-
0x0009ffff]
[ 0.002995] PM: hibernation: Registered nosave memory: [mem 0x000a0000-
0x000effff]
[ 0.002996] PM: hibernation: Registered nosave memory: [mem 0x000f0000-
0x000fffff]
[ 0.002997] [mem 0x08000000-0xfeffbfff] available for PCI devices
[ 0.002997] Booting paravirtualized kernel on KVM
[ 0.002998] clocksource: refined-jiffies: mask: 0xffffffff max_cycles:
0xffffffff, max_idle_ns: 1910969940391419 ns
[ 0.007007] setup_percpu: NR_CPUS:64 nr_cpumask_bits:1 nr_cpu_ids:1
nr_node_ids:1
[ 0.007234] percpu: Embedded 55 pages/cpu s184552 r8192 d32536 u2097152
[ 0.007250] Kernel command line: console=ttyS0
[ 0.007266] Dentry cache hash table entries: 16384 (order: 5, 131072 bytes,
linear)
[ 0.007272] Inode-cache hash table entries: 8192 (order: 4, 65536 bytes,
linear)
[ 0.007282] Fallback order for Node 0: 0
[ 0.007284] Built 1 zonelists, mobility grouping on. Total pages: 31968
[ 0.007285] Policy zone: DMA32
[ 0.007285] mem auto-init: stack:all(zero), heap alloc:off, heap free:off
[ 0.007543] Memory: 85700K/130552K available (18432K kernel code, 2747K
rwdata, 6624K rodata, 2672K init, 1428K bss, 44592K reserved, 0K cma-reserved)
[ 0.007558] SLUB: HWalign=64, Order=0-3, MinObjects=0, CPUs=1, Nodes=1
[ 0.008309] Dynamic Preempt: voluntary

```

```

[ 0.008478] rcu: Preemptible hierarchical RCU implementation.
[ 0.008479] rcu: RCU event tracing is enabled.
[ 0.008479] rcu: RCU restricting CPUs from NR_CPUS=64 to nr_cpu_ids=1.
[ 0.008480] Trampoline variant of Tasks RCU enabled.
[ 0.008480] rcu: RCU calculated value of scheduler-enlistment delay is 100
jiffies.
[ 0.008481] rcu: Adjusting geometry for rcu_fanout_leaf=16, nr_cpu_ids=1
[ 0.009371] NR_IRQS: 4352, nr_irqs: 256, preallocated irqs: 16
[ 0.009542] rcu: srcu_init: Setting srcu_struct sizes based on contention.
[ 0.013429] Console: colour VGA+ 80x25
[ 0.013459] printk: legacy console [ttyS0] enabled
[ 0.078996] ACPI: Core revision 20230628
[ 0.079511] clocksource: hpet: mask: 0xffffffff max_cycles: 0xffffffff,
max_idle_ns: 19112604467 ns
[ 0.080569] APIC: Switch to symmetric I/O mode setup
[ 0.082136] ..TIMER: vector=0x30 apic1=0 pin1=2 apic2=-1 pin2=-1
[ 0.082833] clocksource: tsc-early: mask: 0xffffffffffffffff max_cycles:
0x2f7a74fe427, max_idle_ns: 440795287973 ns
[ 0.083971] Calibrating delay loop (skipped) preset value.. 6587.62 BogomIPS
(lpj=3293810)
[ 0.085094] process: using AMD E400 aware idle routine
[ 0.085640] Last level iTLB entries: 4KB 512, 2MB 255, 4MB 127
[ 0.085968] Last level dTLB entries: 4KB 512, 2MB 255, 4MB 127, 1GB 0
[ 0.086970] Spectre V1 : Mitigation: usercopy/swapgs barriers and __user
pointer sanitization
[ 0.087968] Spectre V2 : Mitigation: Retpolines
[ 0.088446] Spectre V2 : Spectre v2 / SpectreRSB mitigation: Filling RSB on
context switch
[ 0.088968] Spectre V2 : Spectre v2 / SpectreRSB : Filling RSB on VMEXIT
[ 0.089970] x86/fpu: x87 FPU will use FXSAVE
[ 0.110149] Freeing SMP alternatives memory: 48K
[ 0.110652] pid_max: default: 32768 minimum: 301
[ 0.110980] LSM: initializing lsm=capability,selinux,integrity
[ 0.111597] SELinux: Initializing.
[ 0.111983] Mount-cache hash table entries: 512 (order: 0, 4096 bytes,
linear)
[ 0.112742] Mountpoint-cache hash table entries: 512 (order: 0, 4096 bytes,
linear)
[ 0.215939] smpboot: CPU0: AMD QEMU Virtual CPU version 2.5+ (family: 0xf,
model: 0x6b, stepping: 0x1)
[ 0.216033] RCU Tasks: Setting shift to 0 and lim to 1 rcu_task_cb_adjust=1.
[ 0.216808] Performance Events: AMD PMU driver.
[ 0.216972] ... version: 0
[ 0.217395] ... bit width: 48
[ 0.217968] ... generic registers: 4
[ 0.218391] ... value mask: 0000ffffffffffff
[ 0.218968] ... max period: 00007fffffffffff
[ 0.219527] ... fixed-purpose events: 0
[ 0.219968] ... event mask: 0000000000000000f
[ 0.220591] signal: max sigframe size: 1440
[ 0.220988] rcu: Hierarchical SRCU implementation.
[ 0.221495] rcu: Max phase no-delay instances is 400.
[ 0.222074] smp: Bringing up secondary CPUs ...
[ 0.222560] smp: Brought up 1 node, 1 CPU
[ 0.222970] smpboot: Max logical packages: 1
[ 0.223422] smpboot: Total of 1 processors activated (6587.62 BogomIPS)
[ 0.224067] devtmpfs: initialized
[ 0.225060] clocksource: jiffies: mask: 0xffffffff max_cycles: 0xffffffff,
max_idle_ns: 1911260446275000 ns
[ 0.225970] futex hash table entries: 256 (order: 2, 16384 bytes, linear)
[ 0.227017] PM: RTC time: 17:45:35, date: 2024-05-12
[ 0.227609] NET: Registered PF_NETLINK/PF_ROUTE protocol family
[ 0.228007] audit: initializing netlink subsys (disabled)
[ 0.228594] audit: type=2000 audit(1715535935.417:1): state=initialized
audit_enabled=0 res=1
[ 0.229003] thermal_sys: Registered thermal governor 'step_wise'
[ 0.229004] thermal_sys: Registered thermal governor 'user_space'
[ 0.229973] cpuidle: using governor menu
[ 0.231492] PCI: Using configuration type 1 for base access
[ 0.232028] kprobes: kprobe jump-optimization is enabled. All kprobes are
optimized if possible.
[ 0.234031] HugeTLB: registered 2.00 MiB page size, pre-allocated 0 pages

```

```

[ 0.234747] HugeTLB: 28 KiB vmemmap can be freed for a 2.00 MiB page
[ 0.236025] ACPI: Added _OSI(Module Device)
[ 0.236489] ACPI: Added _OSI(Processor Device)
[ 0.236959] ACPI: Added _OSI(3.0 _SCP Extensions)
[ 0.237989] ACPI: Added _OSI(Processor Aggregator Device)
[ 0.238794] ACPI: 1 ACPI AML tables successfully acquired and loaded
[ 0.242048] ACPI: _OSC evaluation for CPUs failed, trying _PDC
[ 0.242721] ACPI: Interpreter enabled
[ 0.242975] ACPI: PM: (supports S0 S3 S4 S5)
[ 0.243428] ACPI: Using IOAPIC for interrupt routing
[ 0.245010] PCI: Using host bridge windows from ACPI; if necessary, use
"pci=nocrs" and report a bug
[ 0.245968] PCI: Using E820 reservations for host bridge windows
[ 0.248053] ACPI: Enabled 2 GPEs in block 00 to 0F
[ 0.250616] ACPI: PCI Root Bridge [PCI0] (domain 0000 [bus 00-ff])
[ 0.251971] acpi PNP0A03:00: _OSC: OS supports [ASPM ClockPM Segments MSI
HPX-Type3]
[ 0.252801] acpi PNP0A03:00: _OSC: not requesting OS control; OS requires
[ExtendedConfig ASPM ClockPM MSI]
[ 0.253973] acpi PNP0A03:00: fail to add MMCONFIG information, can't access
extended configuration space under this bridge
[ 0.256772] PCI host bridge to bus 0000:00
[ 0.256969] pci_bus 0000:00: root bus resource [io 0x0000-0x0cf7 window]
[ 0.257682] pci_bus 0000:00: root bus resource [io 0x0d00-0xffff window]
[ 0.257968] pci_bus 0000:00: root bus resource [mem 0x000a0000-0x000bffff
window]
[ 0.260500] pci_bus 0000:00: root bus resource [mem 0x08000000-0xfebfffff
window]
[ 0.260968] pci_bus 0000:00: root bus resource [mem 0x100000000-0x17ffffff
window]
[ 0.263149] pci_bus 0000:00: root bus resource [bus 00-ff]
[ 0.263756] pci 0000:00:00.0: [8086:1237] type 00 class 0x060000
conventional PCI endpoint
[ 0.266128] pci 0000:00:01.0: [8086:7000] type 00 class 0x060100
conventional PCI endpoint
[ 0.269560] pci 0000:00:01.1: [8086:7010] type 00 class 0x010180
conventional PCI endpoint
[ 0.271775] pci 0000:00:01.1: BAR 4 [io 0xc040-0xc04f]
[ 0.273192] pci 0000:00:01.1: BAR 0 [io 0x01f0-0x01f7]: legacy IDE quirk
[ 0.273968] pci 0000:00:01.1: BAR 1 [io 0x03f6]: legacy IDE quirk
[ 0.274615] pci 0000:00:01.1: BAR 2 [io 0x0170-0x0177]: legacy IDE quirk
[ 0.274968] pci 0000:00:01.1: BAR 3 [io 0x0376]: legacy IDE quirk
[ 0.281335] pci 0000:00:01.3: [8086:7113] type 00 class 0x068000
conventional PCI endpoint
[ 0.282260] pci 0000:00:01.3: quirk: [io 0x0600-0x063f] claimed by PIIX4
ACPI
[ 0.282974] pci 0000:00:01.3: quirk: [io 0x0700-0x070f] claimed by PIIX4
SMB
[ 0.286904] pci 0000:00:02.0: [1234:1111] type 00 class 0x030000
conventional PCI endpoint
[ 0.288148] pci 0000:00:02.0: BAR 0 [mem 0xfd000000-0xfdffffff pref]
[ 0.289760] pci 0000:00:02.0: BAR 2 [mem 0xfebb0000-0xfebb0fff]
[ 0.292135] pci 0000:00:02.0: ROM [mem 0xfeba0000-0xfebaffff pref]
[ 0.298880] pci 0000:00:02.0: Video device with shadowed ROM at [mem
0x000c0000-0x000dffff]
[ 0.301329] pci 0000:00:03.0: [8086:100e] type 00 class 0x020000
conventional PCI endpoint
[ 0.302368] pci 0000:00:03.0: BAR 0 [mem 0xfeb80000-0xfeb9ffff]
[ 0.303326] pci 0000:00:03.0: BAR 1 [io 0xc000-0xc03f]
[ 0.307417] pci 0000:00:03.0: ROM [mem 0xfeb00000-0xfeb7ffff pref]
[ 0.315032] ACPI: PCI: Interrupt link LNKA configured for IRQ 10
[ 0.315746] ACPI: PCI: Interrupt link LNKB configured for IRQ 10
[ 0.317750] ACPI: PCI: Interrupt link LNKC configured for IRQ 11
[ 0.318024] ACPI: PCI: Interrupt link LNKD configured for IRQ 11
[ 0.320460] ACPI: PCI: Interrupt link LNKS configured for IRQ 9
[ 0.321105] iommu: Default domain type: Translated
[ 0.321629] iommu: DMA domain TLB invalidation policy: lazy mode
[ 0.323709] SCSI subsystem initialized
[ 0.324023] ACPI: bus type USB registered
[ 0.324459] usbcore: registered new interface driver usbfs
[ 0.326267] usbcore: registered new interface driver hub
[ 0.326833] usbcore: registered new device driver usb

```

```

[ 0.326975] pps_core: LinuxPPS API ver. 1 registered
[ 0.327500] pps_core: Software ver. 5.3.6 - Copyright 2005-2007 Rodolfo
Giometti <giometti@linux.it>
[ 0.329057] PTP clock support registered
[ 0.329514] Advanced Linux Sound Architecture Driver Initialized.
[ 0.331320] NetLabel: Initializing
[ 0.331690] NetLabel: domain hash size = 128
[ 0.331968] NetLabel: protocols = UNLABELED CIPSOv4 CALIPSO
[ 0.332571] NetLabel: unlabeled traffic allowed by default
[ 0.334440] PCI: Using ACPI for IRQ routing
[ 0.334975] pci 0000:00:02.0: vgaarb: setting as boot VGA device
[ 0.335617] pci 0000:00:02.0: vgaarb: bridge control possible
[ 0.335967] pci 0000:00:02.0: vgaarb: VGA device added:
decodes=io+mem,owns=io+mem,locks=none
[ 0.335969] vgaarb: loaded
[ 0.337723] hpet: 3 channels of 0 reserved for per-cpu timers
[ 0.337976] hpet0: at MMIO 0xfed00000, IRQs 2, 8, 0
[ 0.338491] hpet0: 3 comparators, 64-bit 100.000000 MHz counter
[ 0.348384] clocksource: Switched to clocksource kvm-clock
[ 0.348967] VFS: Disk quotas dquot_6.6.0
[ 0.349028] VFS: Dquot-cache hash table entries: 512 (order 0, 4096 bytes)
[ 0.349825] pnp: PnP ACPI init
[ 0.350301] pnp: PnP ACPI: found 6 devices
[ 0.357089] clocksource: acpi_pm: mask: 0xffffffff max_cycles: 0xffffffff,
max_idle_ns: 2085701024 ns
[ 0.363162] NET: Registered PF_INET protocol family
[ 0.364978] IP idents hash table entries: 2048 (order: 2, 16384 bytes,
linear)
[ 0.365851] tcp_listen_portaddr_hash hash table entries: 256 (order: 0, 4096
bytes, linear)
[ 0.366732] Table-perturb hash table entries: 65536 (order: 6, 262144 bytes,
linear)
[ 0.369606] TCP established hash table entries: 1024 (order: 1, 8192 bytes,
linear)
[ 0.371463] TCP bind hash table entries: 1024 (order: 3, 32768 bytes,
linear)
[ 0.372210] TCP: Hash tables configured (established 1024 bind 1024)
[ 0.375556] UDP hash table entries: 256 (order: 1, 8192 bytes, linear)
[ 0.376248] UDP-Lite hash table entries: 256 (order: 1, 8192 bytes, linear)
[ 0.377002] NET: Registered PF_UNIX/PF_LOCAL protocol family
[ 0.377805] RPC: Registered named UNIX socket transport module.
[ 0.378443] RPC: Registered udp transport module.
[ 0.378936] RPC: Registered tcp transport module.
[ 0.379436] RPC: Registered tcp-with-tls transport module.
[ 0.380012] RPC: Registered tcp NFSv4.1 backchannel transport module.
[ 0.385855] pci_bus 0000:00: resource 4 [io 0x0000-0x0cf7 window]
[ 0.386519] pci_bus 0000:00: resource 5 [io 0x0d00-0xffff window]
[ 0.387169] pci_bus 0000:00: resource 6 [mem 0x000a0000-0x000bffff window]
[ 0.387894] pci_bus 0000:00: resource 7 [mem 0x08000000-0xfebffffff window]
[ 0.388620] pci_bus 0000:00: resource 8 [mem 0x100000000-0x17fffffff window]
[ 0.392471] pci 0000:00:01.0: PIIX3: Enabling Passive Release
[ 0.393085] pci 0000:00:00.0: Limiting direct PCI/PCI transfers
[ 0.393760] PCI: CLS 0 bytes, default 64
[ 0.396580] clocksource: tsc: mask: 0xffffffffffffffff max_cycles:
0x2f7a74fe427, max_idle_ns: 440795287973 ns
[ 0.397684] Unpacking initramfs...
[ 0.400958] Freeing initrd memory: 2456K
[ 0.410229] Initialise system trusted keyrings
[ 0.410738] workingset: timestamp_bits=56 max_order=15 bucket_order=0
[ 0.411492] NFS: Registering the id_resolver key type
[ 0.412030] Key type id_resolver registered
[ 0.412482] Key type id_legacy registered
[ 0.412927] 9p: Installing v9fs 9p2000 file system support
[ 0.420984] Key type asymmetric registered
[ 0.421421] Asymmetric key parser 'x509' registered
[ 0.421961] Block layer SCSI generic (bsg) driver version 0.4 loaded (major
251)
[ 0.422750] io scheduler mq-deadline registered
[ 0.423227] io scheduler kyber registered
[ 0.423728] input: Power Button as
/devices/LNXSYSTM:00/LNXPWRBN:00/input/input0
[ 0.424553] ACPI: button: Power Button [PWRF]

```



```

[ 0.425159] Serial: 8250/16550 driver, 4 ports, IRQ sharing enabled
[ 0.425953] 00:04: ttyS0 at I/O 0x3f8 (irq = 4, base_baud = 115200) is a
16550A
[ 0.426951] Non-volatile memory driver v1.3
[ 0.427397] Linux agpgart interface v0.103
[ 0.427871] ACPI: bus type drm_connector registered
[ 0.428787] loop: module loaded
[ 0.429547] scsi host0: ata_piix
[ 0.429959] scsi host1: ata_piix
[ 0.430322] ata1: PATA max MWDMA2 cmd 0x1f0 ctl 0x3f6 bmdma 0xc040 irq 14
lpm-pol 0
[ 0.431134] ata2: PATA max MWDMA2 cmd 0x170 ctl 0x376 bmdma 0xc048 irq 15
lpm-pol 0
[ 0.432334] e100: Intel(R) PRO/100 Network Driver
[ 0.432843] e100: Copyright(c) 1999-2006 Intel Corporation
[ 0.433422] e1000: Intel(R) PRO/1000 Network Driver
[ 0.433962] e1000: Copyright (c) 1999-2006 Intel Corporation.
[ 0.440305] ACPI: \_SB_.LNKC: Enabled at IRQ 11
[ 0.587876] ata2: found unknown device (class 0)
[ 0.588776] ata2.00: ATAPI: QEMU DVD-ROM, 2.5+, max UDMA/100
[ 0.590085] scsi 1:0:0:0: CD-ROM QEMU QEMU DVD-ROM 2.5+
PQ: 0 ANSI: 5
[ 0.618202] sr 1:0:0:0: [sr0] scsi3-mmc drive: 4x/4x cd/rw xa/form2 tray
[ 0.618919] cdrom: Uniform CD-ROM driver Revision: 3.20
[ 0.631028] sr 1:0:0:0: Attached scsi generic sg0 type 5
[ 0.745881] e1000 0000:00:03:0 eth0: (PCI:33MHz:32-bit) 52:54:00:12:34:56
[ 0.746662] e1000 0000:00:03:0 eth0: Intel(R) PRO/1000 Network Connection
[ 0.747392] e1000e: Intel(R) PRO/1000 Network Driver
[ 0.747927] e1000e: Copyright(c) 1999 - 2015 Intel Corporation.
[ 0.748567] sky2: driver version 1.30
[ 0.749022] usbcore: registered new interface driver usblp
[ 0.749615] usbcore: registered new interface driver usb-storage
[ 0.750280] i8042: PNP: PS/2 Controller [PNP0303:KBD,PNP0f13:MOU] at
0x60,0x64 irq 1,12
[ 0.751665] serio: i8042 KBD port at 0x60,0x64 irq 1
[ 0.752193] serio: i8042 AUX port at 0x60,0x64 irq 12
[ 0.752962] input: AT Translated Set 2 keyboard as
/devices/platform/i8042/serio0/input/input1
[ 0.753945] rtc_cmos 00:05: RTC can wake from S4
[ 0.755826] rtc_cmos 00:05: registered as rtc0
[ 0.756997] rtc_cmos 00:05: alarms up to one day, y3k, 242 bytes nvram, hpet
irqs
[ 0.758182] device-mapper: ioctl: 4.48.0-ioctl (2023-03-01) initialised: dm-
devel@redhat.com
[ 0.759413] hid: raw HID events driver (C) Jiri Kosina
[ 0.760213] usbcore: registered new interface driver usbhid
[ 0.761019] usbhid: USB HID core driver
[ 0.761714] Initializing XFRM netlink socket
[ 0.762347] NET: Registered PF_INET6 protocol family
[ 0.763205] Segment Routing with IPv6
[ 0.763756] In-situ OAM (IOAM) with IPv6
[ 0.764338] sit: IPv6, IPv4 and MPLS over IPv4 tunneling driver
[ 0.765253] NET: Registered PF_PACKET protocol family
[ 0.766012] 9pnet: Installing 9P2000 support
[ 0.766646] Key type dns_resolver registered
[ 0.767319] IPI shorthand broadcast: enabled
[ 0.768941] sched_clock: Marking stable (696006848, 72421517)->(771395681, -
2967316)
[ 0.770117] registered taskstats version 1
[ 0.770721] Loading compiled-in X.509 certificates
[ 0.772332] PM: Magic number: 8:933:794
[ 0.773008] printk: legacy console [netcon0] enabled
[ 0.773767] netconsole: network logging started
[ 0.774475] cfg80211: Loading compiled-in X.509 certificates for regulatory
database
[ 0.775638] kworker/u2:1 (46) used greatest stack depth: 15000 bytes left
[ 0.776770] Loaded X.509 cert 'sforshee: 00b28ddf47aef9cea7'
[ 0.777701] Loaded X.509 cert 'wens:
61c038651aabdcf94bd0ac7ff06c7248db18c600'
[ 0.778784] platform regulatory.0: Direct firmware load for regulatory.db
failed with error -2
[ 0.780026] cfg80211: failed to load regulatory.db

```



```
[ 0.780733] ALSA device list:
[ 0.781165]   No soundcards found.
[ 0.782043] Freeing unused kernel image (initmem) memory: 2672K
[ 0.783438] Write protecting the kernel read-only data: 26624k
[ 0.784244] Freeing unused kernel image (rodata/data gap) memory: 1568K
[ 0.813340] x86/mm: Checked W+X mappings: passed, no W+X pages found.
[ 0.814035] Run /init as init process
[ 0.814808] mount (49) used greatest stack depth: 14336 bytes left
[ 0.815670] mount (50) used greatest stack depth: 14176 bytes left
Boot took 0.74 seconds
```