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LCE512 - Compiling the Kernel and Managing Quotas

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The Linux Kernel

The Kernel is the part of the OS that is responsible for managing peripherals' I/O. Sometimes it is necessary to recompile the Kernel in very **specific** scenarios:

- reducing the Kernel footprint,
- supporting new peripherals,
- adding new functionalities,
- optimising code,
- correcting bugs,
- using experimental functions.

Start by updating CentOS 8:

```
[root@centos8 ~]# dnf update
...
[root@centos8 ~]# reboot
```

Now identify the current Linux kernel:

```
[root@centos8 ~]# uname -r
4.18.0-305.7.1.el8_4.x86_64
```

LAB #1 - Modules

Under normal circumstances it is however preferable to make use of the Kernel modules as opposed to recompiling the Kernel. Kernel modules can be found in the **/lib/modules/<kernel-version>** directory:

```
[root@centos8 ~]# ls /lib/modules/`uname -r`/
bls.conf          modules.builtin    modules.networking  System.map
build             modules.builtin.bin modules.order        updates
```

config	modules.dep	modules.softdep	vdso
kernel	modules.dep.bin	modules.symbols	vmlinuz
modules.alias	modules.devname	modules.symbols.bin	weak-updates
modules.alias.bin	modules.drm	source	
modules.block	modules.modetesting	symvers.gz	

Commands used to manage modules are:

- insmod
- rmmod
- lsmod
- modprobe

For example :

```
[root@centos8 ~]# lsmod
Module                Size  Used by
xt_CHECKSUM           16384  1
ipt_MASQUERADE        16384  3
xt_conntrack          16384  1
ipt_REJECT            16384  2
nft_compat            20480  16
nf_nat_tftp           16384  0
nft_objref            16384  1
nf_conntrack_tftp     16384  3 nf_nat_tftp
nft_counter           16384  33
tun                   53248  1
bridge                192512 0
stp                   16384  1 bridge
llc                   16384  2 bridge,stp
nft_fib_inet          16384  1
nft_fib_ipv4          16384  1 nft_fib_inet
nft_fib_ipv6          16384  1 nft_fib_inet
nft_fib               16384  3 nft_fib_ipv6,nft_fib_ipv4,nft_fib_inet
```

nft_reject_inet	16384	5	
nf_reject_ipv4	16384	2	nft_reject_inet, ipt_REJECT
nf_reject_ipv6	16384	1	nft_reject_inet
nft_reject	16384	1	nft_reject_inet
nft_ct	20480	19	
nf_tables_set	49152	21	
nft_chain_nat	16384	12	
nf_nat	45056	3	ipt_MASQUERADE, nf_nat_tftp, nft_chain_nat
nf_conntrack	172032	6	xt_conntrack, nf_nat, nf_conntrack_tftp, nft_ct, ipt_MASQUERADE, nf_nat_tftp
nf_defrag_ipv6	20480	1	nf_conntrack
nf_defrag_ipv4	16384	1	nf_conntrack
ip_set	49152	0	
nf_tables	172032	414	
nft_ct, nft_compat, nft_reject_inet, nft_fib_ipv6, nft_objref, nft_fib_ipv4, nft_counter, nft_chain_nat, nf_tables_set, nft_reject, nft_fib, nft_fib_inet			
nfnetlink	16384	4	nft_compat, nf_tables, ip_set
sunrpc	540672	1	
ext4	761856	1	
mbcache	16384	1	ext4
jbd2	131072	1	ext4
virtio_balloon	20480	0	
pcspkr	16384	0	
i2c_piix4	24576	0	
joydev	24576	0	
ip_tables	28672	0	
xfs	1515520	1	
libcrc32c	16384	4	nf_conntrack, nf_nat, nf_tables, xfs
sr_mod	28672	0	
sd_mod	53248	3	
cdrom	65536	1	sr_mod
t10_pi	16384	1	sd_mod
sg	40960	0	
ata_generic	16384	0	
bochs_drm	16384	1	

drm_vram_helper	28672	1 bochs_drm
drm_kms_helper	233472	4 drm_vram_helper,bochs_drm
syscopyarea	16384	1 drm_kms_helper
sysfillrect	16384	1 drm_kms_helper
sysimgblt	16384	1 drm_kms_helper
fb_sys_fops	16384	1 drm_kms_helper
drm_ttm_helper	16384	1 drm_vram_helper
ttm	114688	2 drm_vram_helper,drm_ttm_helper
drm	569344	7 drm_kms_helper,drm_vram_helper,bochs_drm,drm_ttm_helper,ttm
ahci	40960	2
libahci	40960	1 ahci
virtio_net	53248	0
net_failover	24576	1 virtio_net
ata_piix	36864	0
serio_raw	16384	0
failover	16384	1 net_failover
libata	270336	4 ata_piix,libahci,ahci,ata_generic
dm_mirror	28672	0
dm_region_hash	20480	1 dm_mirror
dm_log	20480	2 dm_region_hash,dm_mirror
dm_mod	151552	8 dm_log,dm_mirror
fuse	151552	3

To add a module, you can use either the **insmod** or the **modprobe** command. The latter also manages the dependencies of the to-be-installed module:

```
[root@centos8 ~]# modprobe bonding
[root@centos8 ~]# lsmod | more
Module                Size  Used by
bonding                196608  0
xt_CHECKSUM            16384   1
ipt_MASQUERADE         16384   3
xt_conntrack           16384   1
ipt_REJECT              16384   2
```

```

nft_compat      20480  16
nf_nat_tftp     16384   0
nft_objref      16384   1
nf_conntrack_tftp 16384  3 nf_nat_tftp
nft_counter     16384  33
tun             53248   1
bridge         192512   0
stp            16384   1 bridge
llc            16384   2 bridge,stp
nft_fib_inet    16384   1
nft_fib_ipv4    16384   1 nft_fib_inet
nft_fib_ipv6    16384   1 nft_fib_inet
nft_fib         16384   3 nft_fib_ipv6,nft_fib_ipv4,nft_fib_inet
nft_reject_inet 16384   5
nf_reject_ipv4  16384   2 nft_reject_inet,ipt_REJECT
nf_reject_ipv6  16384   1 nft_reject_inet
--More--

```

To delete a module, you can use either the **rmmod** command or the **modprobe -r** command. The latter also deletes any unused dependencies of the deleted module:

```

[root@centos8 ~]# modprobe -r bonding
[root@centos8 ~]# lsmod | more
Module                Size  Used by
xt_CHECKSUM           16384   1
ipt_MASQUERADE        16384   3
xt_conntrack          16384   1
ipt_REJECT            16384   2
nft_compat            20480  16
nf_nat_tftp           16384   0
nft_objref            16384   1
nf_conntrack_tftp     16384   3 nf_nat_tftp
nft_counter           16384  33
tun                   53248   1

```

```

bridge          192512  0
stp             16384  1 bridge
llc             16384  2 bridge,stp
nft_fib_inet    16384  1
nft_fib_ipv4    16384  1 nft_fib_inet
nft_fib_ipv6    16384  1 nft_fib_inet
nft_fib         16384  3 nft_fib_ipv6,nft_fib_ipv4,nft_fib_inet
nft_reject_inet 16384  5
nf_reject_ipv4  16384  2 nft_reject_inet,ipt_REJECT
nf_reject_ipv6  16384  1 nft_reject_inet
nft_reject      16384  1 nft_reject_inet
--More--

```

Module dependencies are resolved by the modprobe command by using the `/lib/modules/<kernel-version>/modules.dep` file. This latter can be created by using the **depmod** command:

```

[root@centos8 ~]# more /lib/modules/`uname -r`/modules.dep
kernel/arch/x86/events/amd/power.ko.xz:
kernel/arch/x86/events/intel/intel-uncore.ko.xz:
kernel/arch/x86/events/intel/intel-cstate.ko.xz:
kernel/arch/x86/events/rapl.ko.xz:
kernel/arch/x86/kernel/cpu/mce/mce-inject.ko.xz:
kernel/arch/x86/crypto/des3_edc-x86_64.ko.xz: kernel/crypto/des_generic.ko.xz
kernel/arch/x86/crypto/camellia-x86_64.ko.xz:
kernel/arch/x86/crypto/blowfish-x86_64.ko.xz: kernel/crypto/blowfish_common.ko.xz
kernel/arch/x86/crypto/twofish-x86_64.ko.xz: kernel/crypto/twofish_common.ko.xz
kernel/arch/x86/crypto/twofish-x86_64-3way.ko.xz: kernel/arch/x86/crypto/twofish-x86_64.ko.
xz kernel/crypto/twofish_common.ko.xz
kernel/arch/x86/crypto/chacha20-x86_64.ko.xz: kernel/crypto/chacha20_generic.ko.xz
kernel/arch/x86/crypto/serpent-sse2-x86_64.ko.xz: kernel/crypto/serpent_generic.ko.xz
kernel/arch/x86/crypto/ghash-clmulni-intel.ko.xz:
kernel/arch/x86/crypto/crc32c-intel.ko.xz:
kernel/arch/x86/crypto/crc32-pclmul.ko.xz:
kernel/arch/x86/crypto/sha512-ssse3.ko.xz: kernel/crypto/sha512_generic.ko.xz

```

```
kernel/arch/x86/crypto/crct10dif-pclmul.ko.xz:
kernel/arch/x86/crypto/poly1305-x86_64.ko.xz: kernel/crypto/poly1305_generic.ko.xz
kernel/arch/x86/crypto/camellia-aesni-avx-x86_64.ko.xz: kernel/arch/x86/crypto/camellia-x86_64.ko.xz
kernel/arch/x86/crypto/cast5-avx-x86_64.ko.xz: kernel/crypto/cast5_generic.ko.xz kernel/cry
--More-- (0%)
```

To see information about a specific module, use the **modinfo** command:

```
[root@centos8 ~]# modinfo bonding
filename:      /lib/modules/4.18.0-305.7.1.el8_4.x86_64/kernel/drivers/net/bonding/bonding.ko.xz
author:        Thomas Davis, tadavis@lbl.gov and many others
description:   Ethernet Channel Bonding Driver
license:       GPL
alias:         rtnl-link-bond
rhelversion:   8.4
srcversion:    445F4CC9A2F7E64E3A87FD0
depends:
intree:        Y
name:          bonding
vermagic:      4.18.0-305.7.1.el8_4.x86_64 SMP mod_unload modversions
sig_id:        PKCS#7
signer:        CentOS kernel signing key
sig_key:       3B:5A:0A:B8:8E:4A:51:C0:AA:FF:97:FD:CB:94:D6:B6:D2:46:B8:17
sig_hashalgo:  sha256
signature:     B2:3A:20:BE:2B:F3:E0:5A:1A:74:0E:69:76:40:2A:D4:80:10:2C:5A:
               B7:F1:1E:7A:71:13:29:F0:0A:4A:28:EE:81:33:C8:C2:5C:BD:FF:E4:
               3F:A9:15:A3:9A:0E:A7:98:9E:99:06:23:10:47:D3:B2:48:B3:F1:61:
               BE:4B:B0:FC:62:B9:3B:D6:64:CC:E3:29:01:4D:91:92:32:FD:EB:54:
               44:F1:2C:1B:23:30:F1:3E:EE:69:EA:94:54:D9:A0:8D:16:53:F5:20:
               DE:38:A0:13:E8:2F:89:66:CB:11:D7:AA:30:37:7B:EC:DF:A1:69:29:
               7F:4E:80:4D:34:6E:F2:07:01:FA:18:23:94:58:10:C6:97:27:68:B9:
               D8:08:5E:9D:00:17:F4:1B:48:BE:CA:BF:5C:5A:A8:6D:36:EE:3F:95:
               BA:BE:59:82:EE:7B:CA:BB:32:1E:E3:05:ED:C9:C2:C8:10:64:B9:29:
```

```

B8:09:4B:79:42:65:1A:FA:99:96:BA:7E:2D:6E:75:F1:91:0E:F4:9A:
8F:11:10:9F:70:BD:35:06:BE:F0:4C:D8:AB:D5:C4:E1:B3:A2:2A:CA:
58:CA:9E:16:1D:0C:BE:9C:37:A1:82:20:6F:24:CD:23:63:F7:F5:BC:
6E:81:14:F0:52:DA:04:0E:9D:CC:17:60:2D:B0:D8:BD:6E:2C:AD:E7:
50:48:49:B6:57:96:AC:FD:A4:29:33:01:43:92:32:88:A2:AC:CB:93:
2F:C3:29:F3:01:77:84:00:AB:AA:C8:59:43:F1:DA:90:7B:5F:9A:A9:
CA:60:97:34:85:5E:98:56:73:03:0D:D7:8D:A6:AB:51:D4:8C:92:91:
0C:0A:BA:6B:92:01:16:FE:8B:86:80:11:5F:8E:21:BD:C2:2F:02:58:
A6:CF:6C:E3:87:28:8B:4D:CE:54:8C:00:B3:F7:AE:9E:01:81:1E:83:
AE:6D:58:B0:10:98:36:D9:69:76:E2:C0:E2:15:94:3B:D4:14:19:D9:
59:86:75:31

```

```

parm:      max_bonds:Max number of bonded devices (int)
parm:      tx_queues:Max number of transmit queues (default = 16) (int)
parm:      num_grat_arp:Number of peer notifications to send on failover event (alias of num_unsol_na) (int)
parm:      num_unsol_na:Number of peer notifications to send on failover event (alias of num_grat_arp) (int)
parm:      miimon:Link check interval in milliseconds (int)
parm:      updelay:Delay before considering link up, in milliseconds (int)
parm:      downdelay:Delay before considering link down, in milliseconds (int)
parm:      use_carrier:Use netif_carrier_ok (vs MII ioctls) in miimon; 0 for off, 1 for on (default) (int)
parm:      mode:Mode of operation; 0 for balance-rr, 1 for active-backup, 2 for balance-xor, 3 for
broadcast, 4 for 802.3ad, 5 for balance-tlb, 6 for balance-alb (charp)
parm:      primary:Primary network device to use (charp)
parm:      primary_reselect:Reselect primary slave once it comes up; 0 for always (default), 1 for only if
speed of primary is better, 2 for only on active slave failure (charp)
parm:      lacp_rate:LACPDU tx rate to request from 802.3ad partner; 0 for slow, 1 for fast (charp)
parm:      ad_select:802.3ad aggregation selection logic; 0 for stable (default), 1 for bandwidth, 2 for
count (charp)
parm:      min_links:Minimum number of available links before turning on carrier (int)
parm:      xmit_hash_policy:balance-alb, balance-tlb, balance-xor, 802.3ad hashing method; 0 for layer 2
(default), 1 for layer 3+4, 2 for layer 2+3, 3 for encap layer 2+3, 4 for encap layer 3+4, 5 for vlan+srcmac
(charp)
parm:      arp_interval:arp interval in milliseconds (int)
parm:      arp_ip_target:arp targets in n.n.n.n form (array of charp)
parm:      arp_validate:validate src/dst of ARP probes; 0 for none (default), 1 for active, 2 for backup, 3

```

```
for all (charp)
parm:      arp_all_targets:fail on any/all arp targets timeout; 0 for any (default), 1 for all (charp)
parm:      fail_over_mac:For active-backup, do not set all slaves to the same MAC; 0 for none (default), 1
for active, 2 for follow (charp)
parm:      all_slaves_active:Keep all frames received on an interface by setting active flag for all slaves;
0 for never (default), 1 for always. (int)
parm:      resend_igmp:Number of IGMP membership reports to send on link failure (int)
parm:      packets_per_slave:Packets to send per slave in balance-rr mode; 0 for a random slave, 1 packet
per slave (default), >1 packets per slave. (int)
parm:      lp_interval:The number of seconds between instances where the bonding driver sends learning
packets to each slaves peer switch. The default is 1. (uint)
```

Finally, files in the **/etc/modprobe.d** directory are used to specify certain options to be passed to modules when they are loaded and also any aliases used to refer to modules:

```
[root@centos8 ~]# ls /etc/modprobe.d
firewalld-sysctls.conf  lockd.conf  nvdimmm-security.conf  tuned.conf
kvm.conf                mlx4.conf   truescale.conf         vhost.conf

[root@centos8 ~]# cat /etc/modprobe.d/kvm.conf
# Setting modprobe kvm_intel/kvm_amd nested = 1
# only enables Nested Virtualization until the next reboot or
# module reload. Uncomment the option applicable
# to your system below to enable the feature permanently.
#
# User changes in this file are preserved across upgrades.
#
# For Intel
#options kvm_intel nested=1
#
# For AMD
#options kvm_amd nested=1
```

LAB #2 - Compiling and Installing a Kernel and Modules

Firstly, activate the **CentOS-Linux-PowerTools** repository by setting the **enabled** directive to **1**:

```
[root@centos8 ~]# vi /etc/yum.repos.d/CentOS-Linux-PowerTools.repo
[root@centos8 ~]# cat /etc/yum.repos.d/CentOS-Linux-PowerTools.repo
# CentOS-Linux-PowerTools.repo
#
# The mirrorlist system uses the connecting IP address of the client and the
# update status of each mirror to pick current mirrors that are geographically
# close to the client. You should use this for CentOS updates unless you are
# manually picking other mirrors.
#
# If the mirrorlist does not work for you, you can try the commented out
# baseurl line instead.

[powertools]
name=CentOS Linux $releasever - PowerTools
mirrorlist=http://mirrorlist.centos.org/?release=$releasever&arch=$basearch&repo=PowerTools&infra=$infra
#baseurl=http://mirror.centos.org/$contentdir/$releasever/PowerTools/$basearch/os/
gpgcheck=1
enabled=1
gpgkey=file:///etc/pki/rpm-gpg/RPM-GPG-KEY-centosofficial
```

Now install the package group “Development Tools” and the packages required for compiling the Kernel:

```
[root@centos8 ~]# dnf groupinstall "Development Tools"
...
[root@centos8 ~]# dnf install asciidoc audit-libs-devel bash bc binutils binutils-devel bison diffutils elfutils
elfutils-devel elfutils-libelf-devel findutils flex gawk gcc gettext gzip htmldoc hostname make module-init-
tools ncurses-devel net-tools newt-devel numactl-devel openssl patch pciutils-devel perl perl-ExtUtils-Embed
pesign redhat-rpm-config rpm-build rpmdevtools sh-utils tar xmlto xz zlib-devel
```

...

2.1 - Move /home



Important - You should not compile a Kernel as the root user for security reasons. To compile a Kernel a user requires **at least** 20 GB of free disk space in their home directory.



To do - Log out of your **CentOS8_SSH_10.0.2.45** session and open a new session using the **CentOS8_ROOT_10.0.2.45** connection.

Create a partition on **/dev/sdc** :

```
[root@centos8 ~]# fdisk /dev/sdc
```

```
Welcome to fdisk (util-linux 2.32.1).
Changes will remain in memory only, until you decide to write them.
Be careful before using the write command.
```

```
Device does not contain a recognized partition table.
Created a new DOS disklabel with disk identifier 0xc321702b.
```

```
Command (m for help): n
```

```
Partition type
```

```
  p   primary (0 primary, 0 extended, 4 free)
```

```
  e   extended (container for logical partitions)
```

```
Select (default p):
```

```
Using default response p.
```

```
Partition number (1-4, default 1):  
First sector (2048-41943039, default 2048):  
Last sector, +sectors or +size{K,M,G,T,P} (2048-41943039, default 41943039):
```

Created a new partition 1 of type 'Linux' and of size 20 GiB.

```
Command (m for help): w  
The partition table has been altered.  
Calling ioctl() to re-read partition table.  
Syncing disks.
```

Now create an ext4 filesystem on **/dev/sdc1** :

```
[root@centos8 ~]# mkfs.ext4 /dev/sdc1  
mke2fs 1.45.6 (20-Mar-2020)  
Discarding device blocks: done  
Creating filesystem with 16776960 4k blocks and 4194304 inodes  
Filesystem UUID: dc92c0d7-919b-4fff-8719-53e9e7e628dd  
Superblock backups stored on blocks:  
    32768, 98304, 163840, 229376, 294912, 819200, 884736, 1605632, 2654208,  
    4096000, 7962624, 11239424  
  
Allocating group tables: done  
Writing inode tables: done  
Creating journal (65536 blocks): done  
Writing superblocks and filesystem accounting information: done
```

Mount **/dev/sdc1** on /mnt :

```
[root@centos8 ~]# mount /dev/sdc1 /mnt
```

Copy the content of /home to /mnt :

```
[root@centos8 ~]# cp -a /home/* /mnt
```

Unmount /dev/sdc1 and move /home to /root :

```
[root@centos8 ~]# umount /mnt
[root@centos8 ~]# mv /home /root
```

Get the UUID of /dev/sdc1 :

```
[root@centos8 ~]# ls -l /dev/disk/by-uuid/ | grep sdc1
lrwxrwxrwx. 1 root root 10 Jul 19 12:02 f76d6b66-985b-4a91-af9c-4987e8c1443c -> ../../sdc
[root@centos8 ~]#
```

Edit the **/etc/fstab** file add a line for /dev/sdc1:

```
[root@centos8 ~]# vi /etc/fstab
[root@centos8 ~]# cat /etc/fstab

#
# /etc/fstab
# Created by anaconda on Wed Jun 16 06:21:32 2021
#
# Accessible filesystems, by reference, are maintained under '/dev/disk/'.
# See man pages fstab(5), findfs(8), mount(8) and/or blkid(8) for more info.
#
# After editing this file, run 'systemctl daemon-reload' to update systemd
# units generated from this file.
#
/dev/mapper/cl_centos8-root / xfs defaults 0 0
UUID=1c04981e-5317-4b73-9695-3ce25246835d /boot ext4 defaults 1 2
/dev/mapper/cl_centos8-swap swap swap defaults 0 0
UUID=f76d6b66-985b-4a91-af9c-4987e8c1443c /home ext4 defaults 1 2
```

Create a new mount point for /home:

```
[root@centos8 ~]# mkdir /home
```

Mount /dev/sdc1 :

```
[root@centos8 ~]# mount -a
[root@centos8 ~]# mount
sysfs on /sys type sysfs (rw,nosuid,nodev,noexec,relatime,seclabel)
proc on /proc type proc (rw,nosuid,nodev,noexec,relatime)
devtmpfs on /dev type devtmpfs (rw,nosuid,seclabel,size=1882880k,nr_inodes=470720,mode=755)
securityfs on /sys/kernel/security type securityfs (rw,nosuid,nodev,noexec,relatime)
tmpfs on /dev/shm type tmpfs (rw,nosuid,nodev,seclabel)
devpts on /dev/pts type devpts (rw,nosuid,noexec,relatime,seclabel,gid=5,mode=620,ptmxmode=000)
tmpfs on /run type tmpfs (rw,nosuid,nodev,seclabel,mode=755)
tmpfs on /sys/fs/cgroup type tmpfs (ro,nosuid,nodev,noexec,seclabel,mode=755)
cgroup on /sys/fs/cgroup/systemd type cgroup
(rw,nosuid,nodev,noexec,relatime,seclabel,xattr,release_agent=/usr/lib/systemd/systemd-cgroups-
agent,name=systemd)
pstore on /sys/fs/pstore type pstore (rw,nosuid,nodev,noexec,relatime,seclabel)
bpf on /sys/fs/bpf type bpf (rw,nosuid,nodev,noexec,relatime,mode=700)
cgroup on /sys/fs/cgroup/hugetlb type cgroup (rw,nosuid,nodev,noexec,relatime,seclabel,hugetlb)
cgroup on /sys/fs/cgroup/memory type cgroup (rw,nosuid,nodev,noexec,relatime,seclabel,memory)
cgroup on /sys/fs/cgroup/cpu,cpuacct type cgroup (rw,nosuid,nodev,noexec,relatime,seclabel,cpu,cpuacct)
cgroup on /sys/fs/cgroup/rdma type cgroup (rw,nosuid,nodev,noexec,relatime,seclabel,rdma)
cgroup on /sys/fs/cgroup/pids type cgroup (rw,nosuid,nodev,noexec,relatime,seclabel,pids)
cgroup on /sys/fs/cgroup/cpuset type cgroup (rw,nosuid,nodev,noexec,relatime,seclabel,cpuset)
cgroup on /sys/fs/cgroup/perf_event type cgroup (rw,nosuid,nodev,noexec,relatime,seclabel,perf_event)
cgroup on /sys/fs/cgroup/freezer type cgroup (rw,nosuid,nodev,noexec,relatime,seclabel,freezer)
cgroup on /sys/fs/cgroup/blkio type cgroup (rw,nosuid,nodev,noexec,relatime,seclabel,blkio)
cgroup on /sys/fs/cgroup/net_cls,net_prio type cgroup (rw,nosuid,nodev,noexec,relatime,seclabel,net_cls,net_prio)
cgroup on /sys/fs/cgroup/devices type cgroup (rw,nosuid,nodev,noexec,relatime,seclabel,devices)
none on /sys/kernel/tracing type tracefs (rw,relatime,seclabel)
configfs on /sys/kernel/config type configfs (rw,relatime)
```

```

/dev/mapper/cl_centos8-root on / type xfs (rw,relatime,seclabel,attr2,inode64,logbufs=8,logbsize=32k,noquota)
selinuxfs on /sys/fs/selinux type selinuxfs (rw,relatime)
mqueue on /dev/mqueue type mqueue (rw,relatime,seclabel)
hugetlbfs on /dev/hugepages type hugetlbfs (rw,relatime,seclabel,pagesize=2M)
debugfs on /sys/kernel/debug type debugfs (rw,relatime,seclabel)
systemd-1 on /proc/sys/fs/binfmt_misc type autofs
(rw,relatime,fd=40,prgrp=1,timeout=0,minproto=5,maxproto=5,direct,pipe_ino=6022)
fusectl on /sys/fs/fuse/connections type fusectl (rw,relatime)
/dev/sda1 on /boot type ext4 (rw,relatime,seclabel)
sunrpc on /var/lib/nfs/rpc_pipefs type rpc_pipefs (rw,relatime)
tmpfs on /run/user/1000 type tmpfs (rw,nosuid,nodev,relatime,seclabel,size=382500k,mode=700,uid=1000,gid=1000)
tmpfs on /run/user/42 type tmpfs (rw,nosuid,nodev,relatime,seclabel,size=382500k,mode=700,uid=42,gid=42)
gvfsd-fuse on /run/user/1000/gvfs type fuse.gvfsd-fuse (rw,nosuid,nodev,relatime,user_id=1000,group_id=1000)
tmpfs on /run/user/0 type tmpfs (rw,nosuid,nodev,relatime,seclabel,size=382500k,mode=700)
gvfsd-fuse on /run/user/0/gvfs type fuse.gvfsd-fuse (rw,nosuid,nodev,relatime,user_id=0,group_id=0)
/dev/sdc1 on /home type ext4 (rw,relatime,seclabel)

```

Check the current size of /home :

```

[root@centos8 ~]# df -h

```

Filesystem	Size	Used	Avail	Use%	Mounted on
devtmpfs	1.8G	0	1.8G	0%	/dev
tmpfs	1.9G	0	1.9G	0%	/dev/shm
tmpfs	1.9G	9.4M	1.9G	1%	/run
tmpfs	1.9G	0	1.9G	0%	/sys/fs/cgroup
/dev/mapper/cl_centos8-root	28G	5.2G	23G	19%	/
/dev/sda1	976M	289M	620M	32%	/boot
tmpfs	374M	16K	374M	1%	/run/user/1000
tmpfs	374M	1.2M	373M	1%	/run/user/42
/dev/sdc1	63G	67M	60G	1%	/home



To do - Log out of your **CentOS8_ROOT_10.0.2.45** session and open a new session



using the **CentOS8_SSH_10.0.2.45** connection.

2.2 - Preparing the Environment

To create the Kernel Source Tree in /home/trainee, use the **rpmdev-setuptree** command:

```
[trainee@centos8 ~]$ rpmdev-setuptree
...>
[trainee@centos8 ~]$ ls -laR rpmbuild/
rpmbuild/:
total 28
drwxrwxr-x.  7 trainee trainee 4096 Jul 19 12:10 .
drwxr-xr-x. 17 trainee trainee 4096 Jul 19 12:10 ..
drwxrwxr-x.  2 trainee trainee 4096 Jul 19 12:10 BUILD
drwxrwxr-x.  2 trainee trainee 4096 Jul 19 12:10 RPMS
drwxrwxr-x.  2 trainee trainee 4096 Jul 19 12:10 SOURCES
drwxrwxr-x.  2 trainee trainee 4096 Jul 19 12:10 SPECS
drwxrwxr-x.  2 trainee trainee 4096 Jul 19 12:10 SRPMS

rpmbuild/BUILD:
total 8
drwxrwxr-x. 2 trainee trainee 4096 Jul 19 12:10 .
drwxrwxr-x. 7 trainee trainee 4096 Jul 19 12:10 ..

rpmbuild/RPMS:
total 8
drwxrwxr-x. 2 trainee trainee 4096 Jul 19 12:10 .
drwxrwxr-x. 7 trainee trainee 4096 Jul 19 12:10 ..

rpmbuild/SOURCES:
total 8
```

```
drwxrwxr-x. 2 trainee trainee 4096 Jul 19 12:10 .
drwxrwxr-x. 7 trainee trainee 4096 Jul 19 12:10 ..
```

```
rpmbuild/SPECS:
```

```
total 8
```

```
drwxrwxr-x. 2 trainee trainee 4096 Jul 19 12:10 .
drwxrwxr-x. 7 trainee trainee 4096 Jul 19 12:10 ..
```

```
rpmbuild/SRPMS:
```

```
total 8
```

```
drwxrwxr-x. 2 trainee trainee 4096 Jul 19 12:10 .
drwxrwxr-x. 7 trainee trainee 4096 Jul 19 12:10 ..
```

Download the Kernel source RPM:

```
[trainee@centos8 ~]$ uname -a
Linux centos8.ittraining.loc 4.18.0-305.7.1.el8_4.x86_64 #1 SMP Tue Jun 29 21:55:12 UTC 2021 x86_64 x86_64 x86_64
GNU/Linux
```

```
[trainee@centos8 ~]$ cat /etc/centos-release
CentOS Linux release 8.4.2105
```

```
[trainee@centos8 ~]$ wget
https://vault.centos.org/8.4.2105/BaseOS/Source/SPackages/kernel-4.18.0-305.7.1.el8_4.src.rpm
--2021-07-14 02:54:14--
https://vault.centos.org/8.4.2105/BaseOS/Source/SPackages/kernel-4.18.0-305.7.1.el8_4.src.rpm
Resolving vault.centos.org (vault.centos.org)... 81.171.33.194, 2a05:d014:10:7803:4af1:9320:7050:d28e
Connecting to vault.centos.org (vault.centos.org)|81.171.33.194|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 123000617 (117M) [application/x-rpm]
Saving to: 'kernel-4.18.0-305.7.1.el8_4.src.rpm'

kernel-4.18.0-305.7.1. 100%[=====>] 117.30M  1.49MB/s    in 79s
```

```
2021-07-14 02:55:33 (1.49 MB/s) - 'kernel-4.18.0-305.7.1.el8_4.src.rpm' saved [123000617/123000617]
```

Now install the required dependencies:

```
[trainee@centos8 ~]$ su -  
Mot de passe : fenestros  
  
[root@centos8 ~]# dnf install yum-utils  
...  
  
[root@centos8 ~]# yum-builddep /home/trainee/kernel-4.18.0-305.7.1.el8_4.src.rpm  
...
```

Install the **kernel-4.18.0-305.7.1.el8_4.src.rpm** package:

```
[root@centos8 ~]# exit  
logout  
[trainee@centos8 ~]$ rpm -Uvh kernel-4.18.0-305.7.1.el8_4.src.rpm  
Updating / installing...  
  1:kernel-4.18.0-305.7.1.el8_4      warning: user mockbuild does not exist - using root  
warning: group mockbuild does not exist - using root  
warning: user mockbuild does not exist - using root  
warning: group mockbuild does not exist - using root  
warning: user mockbuild does not exist - using root  
warning: group mockbuild does not exist - using root  
warning: user mockbuild does not exist - using root  
warning: group mockbuild does not exist - using root  
warning: user mockbuild does not exist - using root  
warning: group mockbuild does not exist - using root  
warning: user mockbuild does not exist - using root  
warning: group mockbuild does not exist - using root  
warning: user mockbuild does not exist - using root  
warning: group mockbuild does not exist - using root  
warning: user mockbuild does not exist - using root
```

[illegible]

[illegible]

```
warning: group mockbuild does not exist - using root
##### [100%]
warning: user mockbuild does not exist - using root
warning: group mockbuild does not exist - using root
warning: user mockbuild does not exist - using root
warning: group mockbuild does not exist - using root
warning: user mockbuild does not exist - using root
warning: group mockbuild does not exist - using root
warning: user mockbuild does not exist - using root
warning: group mockbuild does not exist - using root
warning: user mockbuild does not exist - using root
warning: group mockbuild does not exist - using root
warning: user mockbuild does not exist - using root
warning: group mockbuild does not exist - using root
warning: user mockbuild does not exist - using root
warning: group mockbuild does not exist - using root
warning: user mockbuild does not exist - using root
warning: group mockbuild does not exist - using root
```



Important - Note that the errors are not important.

2.3 - Preparing the Kernel Source Tree

Move to the `~/rpmbuild/SPECS` directory and use the **rpmbuild** command to create the Kernel Source Tree:

```
[trainee@centos7 ~]$ cd ~/rpmbuild/SPECS
[trainee@centos7 SPECS]$ rpmbuild -bp --target=$(uname -m) kernel.spec
...
```

At the end of the process, check what has been created:

```
[trainee@centos8 SPECS]$ ls -la ~/rpmbuild/BUILD/kernel-4.18.0-305.7.1.el8_4/linux-4.18.0-305.7.1.el8.x86_64/
total 812
drwxr-xr-x. 26 trainee trainee 4096 Jul 14 03:13 .
drwxr-xr-x.  3 trainee trainee 4096 Jul 14 03:12 ..
drwxr-xr-x. 27 trainee trainee 4096 Jul 14 03:13 arch
drwxr-xr-x.  3 trainee trainee 4096 Jun 14 10:33 block
drwxr-xr-x.  2 trainee trainee 4096 Jul 14 03:13 certs
-rw-r--r--.  1 trainee trainee 13079 Jun 14 10:33 .clang-format
-rw-r--r--.  1 trainee trainee   59 Jun 14 10:33 .cocciconfig
drwxr-xr-x.  2 trainee trainee 4096 Jul 14 03:13 configs
-rw-r--r--.  1 trainee trainee  423 Jun 14 10:33 COPYING-4.18.0
-rw-r--r--.  1 trainee trainee 98651 Jun 14 10:33 CREDITS
drwxr-xr-x.  4 trainee trainee 4096 Jun 14 10:33 crypto
drwxr-xr-x. 119 trainee trainee 4096 Jul 14 03:13 Documentation
drwxr-xr-x. 137 trainee trainee 4096 Jun 14 10:33 drivers
drwxr-xr-x.  2 trainee trainee 4096 Jul 14 03:13 firmware
drwxr-xr-x. 73 trainee trainee 4096 Jun 14 10:33 fs
-rw-r--r--.  1 trainee trainee   68 Jun 14 10:33 .get_maintainer.conf
-rw-r--r--.  1 trainee trainee   31 Jun 14 10:33 .get_maintainer.ignore
-rw-r--r--.  1 trainee trainee   76 Jun 14 10:33 .gitattributes
-rw-r--r--.  1 trainee trainee 1639 Jun 14 10:33 .gitlab-ci-private.yml
-rw-r--r--.  1 trainee trainee 1668 Jun 14 10:33 .gitlab-ci.yml
drwxr-xr-x. 30 trainee trainee 4096 Jun 14 10:33 include
drwxr-xr-x.  2 trainee trainee 4096 Jun 14 10:33 init
drwxr-xr-x.  2 trainee trainee 4096 Jun 14 10:33 ipc
-rw-r--r--.  1 trainee trainee 2245 Jun 14 10:33 Kbuild
-rw-r--r--.  1 trainee trainee   575 Jun 14 10:33 Kconfig
drwxr-xr-x. 19 trainee trainee 4096 Jul 14 03:13 kernel
drwxr-xr-x. 20 trainee trainee 12288 Jul 14 03:13 lib
drwxr-xr-x.  5 trainee trainee 4096 Jun 14 10:33 LICENSES
-rw-r--r--.  1 trainee trainee  9559 Jun 14 10:33 .mailmap
-rw-r--r--.  1 trainee trainee 471696 Jun 14 10:33 MAINTAINERS
-rw-r--r--.  1 trainee trainee 61558 Jun 14 10:33 Makefile
-rw-r--r--.  1 trainee trainee  1324 Jun 14 10:33 Makefile.rhelver
```

```
-rw-r--r--.  1 trainee trainee      0 Jul 14 03:13 .mismatches
drwxr-xr-x.  3 trainee trainee  4096 Jun 14 10:33 mm
drwxr-xr-x. 72 trainee trainee  4096 Jun 14 10:33 net
-rw-r--r--.  1 trainee trainee   800 Jun 14 10:33 README
drwxr-xr-x. 28 trainee trainee  4096 Jun 14 10:33 samples
-rw-r--r--.  1 trainee trainee      0 Jul 14 03:12 .scmversion
drwxr-xr-x. 14 trainee trainee  4096 Jul 14 03:13 scripts
drwxr-xr-x. 10 trainee trainee  4096 Jun 14 10:33 security
drwxr-xr-x. 26 trainee trainee  4096 Jun 14 10:33 sound
drwxr-xr-x. 33 trainee trainee  4096 Jun 14 10:33 tools
drwxr-xr-x.  2 trainee trainee  4096 Jul 14 03:13 usr
drwxr-xr-x.  4 trainee trainee  4096 Jun 14 10:33 virt
```

The .config File

Move to `~/rpmbuild/BUILD/kernel-*/linux-*/`:

```
[trainee@centos8 SPECS]$ cd ~/rpmbuild/BUILD/kernel-*/linux-*/
```

Copy the **configs/kernel-4.18.0-`uname -m`.config** file to **.config** in the current working directory:

```
[trainee@centos8 linux-4.18.0-305.7.1.el8.x86_64]$ cp configs/kernel-4.18.0-`uname -m`.config .config
```

Update the .config file with the configuration Kernel settings:

```
[trainee@centos8 linux-4.18.0-305.7.1.el8.x86_64]$ make oldconfig
scripts/kconfig/conf  --oldconfig Kconfig
#
# configuration written to .config
#
```





Important - The above command reads the `.config` file of the current Kernel and compares the contents with the new configuration. In the case where there are any new configurations that are required, the command asks for the relevant information.

The **.config** file is generated by one of three binaries and should not be edited manually:

- `make config`
- `make menuconfig`
- `make xconfig`

Run the **make menuconfig** command:

```
[trainee@centos8 linux-4.18.0-305.7.1.el8.x86_64]$ make menuconfig
UPD      scripts/kconfig/.mconf-cfg
HOSTCC   scripts/kconfig/mconf.o
HOSTCC   scripts/kconfig/lxdialog/checklist.o
HOSTCC   scripts/kconfig/lxdialog/inputbox.o
HOSTCC   scripts/kconfig/lxdialog/menubox.o
HOSTCC   scripts/kconfig/lxdialog/textbox.o
HOSTCC   scripts/kconfig/lxdialog/util.o
HOSTCC   scripts/kconfig/lxdialog/yesno.o
HOSTLD   scripts/kconfig/mconf
scripts/kconfig/mconf  Kconfig
#
# using defaults found in /boot/config-4.18.0-305.7.1.el8_4.x86_64
#
```

Looking at the interface, you will see lines used to configure the Kernel. In the case a letter is used, these are:

- **y**,
 - the configuration is included in the Kernel,
- **m**,
 - the configuration is not included in the Kernel but in a Kernel module,

- **n**,
 - the configuration is neither included in the Kernel nor in a Kernel module.

At this stage, simply save the configuration and exit the interface:

```
*** End of the configuration.
*** Execute 'make' to start the build or try 'make help'.
```

Check the presence of the **.config** file:

```
[trainee@centos8 linux-4.18.0-305.7.1.el8.x86_64]$ ls -a
.      certs          configs      Documentation  .get_maintainer.conf  .gitlab-ci.yml  Kbuild  LICENSES
Makefile.rhelver  README      security    virt
..     .clang-format  COPYING-4.18.0  drivers      .get_maintainer.ignore  include        Kconfig  .mailmap
.mismatches      samples     sound
arch  .coocciconfig  CREDITS      firmware    .gitattributes        init          kernel  MAINTAINERS
mm     .scmversion   tools
block .config       crypto       fs          .gitlab-ci-private.yml  ipc          lib     Makefile
net    scripts      usr
```

Lokk at the contents of the .config file:

```
[trainee@centos8 linux-4.18.0-305.7.1.el8.x86_64]$ more .config
#
# Automatically generated file; DO NOT EDIT.
# Linux/x86 4.18.0 Kernel Configuration
#
#
# Compiler: gcc (GCC) 8.4.1 20200928 (Red Hat 8.4.1-1)
#
CONFIG_64BIT=y
CONFIG_X86_64=y
CONFIG_X86=y
```

```
CONFIG_INSTRUCTION_DECODER=y
CONFIG_OUTPUT_FORMAT="elf64-x86-64"
CONFIG_ARCH_DEFCONFIG="arch/x86/configs/x86_64_defconfig"
CONFIG_LOCKDEP_SUPPORT=y
CONFIG_STACKTRACE_SUPPORT=y
CONFIG_MMU=y
CONFIG_ARCH_MMAP_RND_BITS_MIN=28
CONFIG_ARCH_MMAP_RND_BITS_MAX=32
CONFIG_ARCH_MMAP_RND_COMPAT_BITS_MIN=8
CONFIG_ARCH_MMAP_RND_COMPAT_BITS_MAX=16
CONFIG_GENERIC_ISA_DMA=y
CONFIG_GENERIC_BUG=y
CONFIG_GENERIC_BUG_RELATIVE_POINTERS=y
CONFIG_GENERIC_HWEIGHT=y
CONFIG_ARCH_MAY_HAVE_PC_FDC=y
CONFIG_GENERIC_CALIBRATE_DELAY=y
CONFIG_ARCH_HAS_CPU_RELAX=y
CONFIG_ARCH_HAS_CACHE_LINE_SIZE=y
CONFIG_ARCH_HAS_FILTER_PGPROT=y
CONFIG_HAVE_SETUP_PER_CPU_AREA=y
CONFIG_NEED_PER_CPU_EMBED_FIRST_CHUNK=y
CONFIG_NEED_PER_CPU_PAGE_FIRST_CHUNK=y
CONFIG_ARCH_HIBERNATION_POSSIBLE=y
CONFIG_ARCH_SUSPEND_POSSIBLE=y
CONFIG_ARCH_WANT_HUGE_PMD_SHARE=y
CONFIG_ARCH_WANT_GENERAL_HUGETLB=y
CONFIG_ZONE_DMA32=y
CONFIG_AUDIT_ARCH=y
CONFIG_ARCH_SUPPORTS_OPTIMIZED_INLINING=y
CONFIG_ARCH_SUPPORTS_DEBUG_PAGEALLOC=y
CONFIG_HAVE_INTEL_TXT=y
CONFIG_X86_64_SMP=y
--More-- (0%)
```

The Makefile File

The Makefile contains the Kernel name and the following information:

- VERSION,
- PATCHLEVEL,
- SUBLEVEL,
- EXTRAVERSION.

Values for the first three directives are managed directly by **kernel.org** and Linus Torvalds whilst the EXTRAVERSION is managed by Red Hat:

```
[trainee@centos8 linux-4.18.0-305.7.1.el8.x86_64]$ more Makefile
# SPDX-License-Identifier: GPL-2.0
VERSION = 4
PATCHLEVEL = 18
SUBLEVEL = 0
EXTRAVERSION =
NAME = Merciless Moray

#
# DRM backport version
#
RHEL_DRM_VERSION = 5
RHEL_DRM_PATCHLEVEL = 9
RHEL_DRM_SUBLEVEL = 14

# *DOCUMENTATION*
# To see a list of typical targets execute "make help"
# More info can be located in ./README
# Comments in this file are targeted only to the developer, do not
# expect to learn how to build the kernel reading this file.

# That's our default target when none is given on the command line
PHONY := _all
```

```
_all:

# o Do not use make's built-in rules and variables
#   (this increases performance and avoids hard-to-debug behaviour);
# o Look for make include files relative to root of kernel src
MAKEFLAGS += -rR --include-dir=$(CURDIR)

# Avoid funny character set dependencies
unexport LC_ALL
LC_COLLATE=C
LC_NUMERIC=C
export LC_COLLATE LC_NUMERIC

# Avoid interference with shell env settings
unexport GREP_OPTIONS

# Set RHEL variables
# Use this spot to avoid future merge conflicts
include Makefile.rhelver

# We are using a recursive build, so we need to do a little thinking
--Plus--(2%)
```



Important - The 2.6 version of the Linux Kernel came into being in **2003**. Version 3.0 came out on the 20th anniversary of the Linux Kernel.

2.4 - Configuring the Kernel

Add the value shown by the **uname -i** command to the first line of the .config file:

```
[trainee@centos8 linux-4.18.0-305.7.1.el8.x86_64]$ uname -i
x86_64
[trainee@centos8 linux-4.18.0-305.7.1.el8.x86_64]$ vi .config
[trainee@centos8 linux-4.18.0-305.7.1.el8.x86_64]$ head .config
# x86_64
#
# Automatically generated file; DO NOT EDIT.
# Linux/x86 4.18.0 Kernel Configuration
#
#
# Compiler: gcc (GCC) 8.4.1 20200928 (Red Hat 8.4.1-1)
#
CONFIG_64BIT=y
```

Rename the .config file and place it in the **~/rpmbuild/SOURCES/** directory:

```
[trainee@centos8 linux-4.18.0-305.7.1.el8.x86_64]$ cp .config ~/rpmbuild/SOURCES/config-`uname -m`-generic
[trainee@centos8 linux-4.18.0-305.7.1.el8.x86_64]$ ls ~/rpmbuild/SOURCES
centos-ca-secureboot.der  cpupower.config          filter-x86_64.sh          kernel-
s390x.config              mod-extra.list           Module.kabi_s390x
centos-dup.x509           cpupower.service        generate_all_configs.sh   kernel-s390x-
debug.config              mod-internal.list       Module.kabi_x86_64
centos-kpatch.x509        debrand-rh-i686-cpu.patch generate_bls_conf.sh      kernel-s390x-
zfcpdump.config          mod-sign.sh              parallel_xz.sh
centos.pem                debrand-rh_taint.patch   kernel-aarch64.config     kernel-
x86_64.config             Module.kabi_aarch64       process_configs.sh
centossecureboot001.der   debrand-single-cpu.patch kernel-aarch64-debug.config kernel-x86_64-
debug.config              Module.kabi_dup_aarch64   x509.genkey
centossecureboot201.der   filter-aarch64.sh         kernel-abi-stablelists-4.18.0-305.tar.bz2
kvm_stat.logrotate       Module.kabi_dup_ppc64le
centossecurebootca2.der   filter-modules.sh         kernel-kabi-dw-4.18.0-305.tar.bz2
linux-4.18.0-305.7.1.el8_4.tar.xz Module.kabi_dup_s390x
check-kabi                filter-ppc64le.sh         kernel-ppc64le.config     linux-kernel-
```

test.patch	Module.kabi_dup_x86_64		
config-x86_64-generic	filter-s390x.sh	kernel-ppc64le-debug.config	mod-blacklist.sh
Module.kabi_ppc64le			

Copy the entire contents of the **configs** directory to the **~/rpmbuild/SOURCES/** directory:

```
[trainee@centos8 linux-4.18.0-305.7.1.el8.x86_64]$ cp configs/* ~/rpmbuild/SOURCES/
```

Edit the **buildid** directive in the **~/rpmbuild/SPECS/kernel.spec** file in order to distinguish the future newly compiled Kernel from the current Kernel:

```
[trainee@centos8 linux-4.18.0-305.7.1.el8.x86_64]$ cd ~/rpmbuild/SPECS

[trainee@centos8 SPECS]$ vi kernel.spec

[trainee@centos8 SPECS]$ head -n 50 kernel.spec
# We have to override the new %%install behavior because, well... the kernel is special.
%global __spec_install_pre %{__build_pre}

# At the time of this writing (2019-03), RHEL8 packages use w2.xzdio
# compression for rpms (xz, level 2).
# Kernel has several large (hundreds of mbytes) rpms, they take ~5 mins
# to compress by single-threaded xz. Switch to threaded compression,
# and from level 2 to 3 to keep compressed sizes close to "w2" results.
#
# NB: if default compression in /usr/lib/rpm/redhat/macros ever changes,
# this one might need tweaking (e.g. if default changes to w3.xzdio,
# change below to w4T.xzdio):
%define _binary_payload w3T.xzdio

# For a kernel released for public testing, released_kernel should be 1.
# For internal testing builds during development, it should be 0.
%global released_kernel 1

%global distro_build 305
```

```
# Sign the x86_64 kernel for secure boot authentication
%ifarch x86_64 aarch64
%global signkernel 1
%else
%global signkernel 0
%endif

# Sign modules on all arches
%global signmodules 1

# Compress modules only for architectures that build modules
%ifarch noarch
%global zipmodules 0
%else
%global zipmodules 1
%endif

%if %{zipmodules}
%global zipsed -e 's/\.ko$/\.ko.xz/'
%endif

%define buildid .i2tch

%define rpmversion 4.18.0
%define pkgrelease 305.7.1.el8_4

# allow pkg_release to have configurable %{?dist} tag
%define specrelease 305.7.1%{?dist}

%define pkg_release %{specrelease}%{?buildid}
```

2.5 - Compiling the Kernel

Compiling the Kernel can take a long time (~5 heures). Execute the following command:

```
[trainee@centos7 SPECS]$ rpmbuild -bb --target=`uname -m` kernel.spec 2> build-err.log | tee build-out.log &
```



Important - Once you are sure that the compilation process has started without errors, stop it using ^C. Stop the virtual machine and ask the Instructor to start the virtual machine in which the Kernel has already been compiled.

When the compilation has finished, you would see the following output:

```
...
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/kernel-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/kernel-headers-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/kernel-cross-headers-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/kernel-debuginfo-common-x86_64-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/perf-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/perf-debuginfo-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/python3-perf-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/python3-perf-debuginfo-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/kernel-tools-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/kernel-tools-libs-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/kernel-tools-libs-devel-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/kernel-tools-debuginfo-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/bpftool-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/bpftool-debuginfo-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/kernel-selftests-internal-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/kernel-debug-core-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/kernel-debug-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
```

```

Wrote: /home/trainee/rpmbuild/RPMS/x86_64/kernel-debug-devel-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/kernel-debug-modules-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/kernel-debug-modules-extra-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/kernel-debug-modules-internal-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/kernel-debug-debuginfo-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/kernel-core-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/kernel-devel-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/kernel-modules-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/kernel-modules-extra-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/kernel-modules-internal-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/kernel-debuginfo-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/kernel-ipa clones-internal-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
Executing(%clean): /bin/sh -e /var/tmp/rpm-tmp.rk0gfs

[1]+  Done                  rpmbuild -bb --target=`uname -m` kernel.spec 2> build-err.log | tee build-out.log

```

The installable RPMs can be found in the **/home/trainee/rpmbuild/RPMS/x86_64/** directory:

```

[trainee@centos8 SPECS]$ cd ../RPMS
[trainee@centos8 RPMS]$ ls
x86_64
[trainee@centos8 RPMS]$ cd x86_64/
[trainee@centos8 x86_64]$ ls
bpftool-4.18.0-305.7.1.el8.i2tch.x86_64.rpm          kernel-debuginfo-common-
x86_64-4.18.0-305.7.1.el8.i2tch.x86_64.rpm  kernel-selftests-internal-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
bpftool-debuginfo-4.18.0-305.7.1.el8.i2tch.x86_64.rpm  kernel-debug-
modules-4.18.0-305.7.1.el8.i2tch.x86_64.rpm          kernel-tools-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
kernel-4.18.0-305.7.1.el8.i2tch.x86_64.rpm          kernel-debug-modules-
extra-4.18.0-305.7.1.el8.i2tch.x86_64.rpm          kernel-tools-debuginfo-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
kernel-core-4.18.0-305.7.1.el8.i2tch.x86_64.rpm      kernel-debug-modules-
internal-4.18.0-305.7.1.el8.i2tch.x86_64.rpm  kernel-tools-libs-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
kernel-cross-headers-4.18.0-305.7.1.el8.i2tch.x86_64.rpm  kernel-devel-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
kernel-tools-libs-devel-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
kernel-debug-4.18.0-305.7.1.el8.i2tch.x86_64.rpm      kernel-headers-4.18.0-305.7.1.el8.i2tch.x86_64.rpm

```

```

perf-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
kernel-debug-core-4.18.0-305.7.1.el8.i2tch.x86_64.rpm      kernel-ipa clones-
internal-4.18.0-305.7.1.el8.i2tch.x86_64.rpm      perf-debuginfo-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
kernel-debug-debuginfo-4.18.0-305.7.1.el8.i2tch.x86_64.rpm  kernel-modules-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
python3-perf-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
kernel-debug-devel-4.18.0-305.7.1.el8.i2tch.x86_64.rpm      kernel-modules-
extra-4.18.0-305.7.1.el8.i2tch.x86_64.rpm      python3-perf-debuginfo-4.18.0-305.7.1.el8.i2tch.x86_64.rpm
kernel-debuginfo-4.18.0-305.7.1.el8.i2tch.x86_64.rpm      kernel-modules-
internal-4.18.0-305.7.1.el8.i2tch.x86_64.rpm

```

Note that the compilation has consumed over 20 GB of disk space:

```

[trainee@centos8 x86_64]$ df -h
Filesystem                Size      Used Avail Use% Mounted on
devtmpfs                  1.8G         0   1.8G   0% /dev
tmpfs                     1.9G         0   1.9G   0% /dev/shm
tmpfs                     1.9G    9.4M   1.9G   1% /run
tmpfs                     1.9G         0   1.9G   0% /sys/fs/cgroup
/dev/mapper/cl_centos8-root 28G    5.5G   23G  20% /
/dev/sda1                 976M    289M   620M  32% /boot
tmpfs                     374M     24K   374M   1% /run/user/1000
tmpfs                     374M    1.2M   373M   1% /run/user/42
/dev/sdc1                 63G     21G   39G  35% /home

```

2.6 - Installing the Kernel

Now install the new Kernel. Installing the new Kernel can take a long time (~2 heures). Use the following command:

```

[root@centos8 x86_64]# dnf localinstall kernel-*.rpm
Last metadata expiration check: 2:25:32 ago on Tue 20 Jul 2021 08:37:00 EDT.
Dependencies resolved.

```

Package Repository	Size	Architecture	Version
=====			
Installing:			
kernel		x86_64	
4.18.0-305.7.1.el8.i2tch		@commandline	5.9 M
kernel-core		x86_64	
4.18.0-305.7.1.el8.i2tch		@commandline	36 M
kernel-cross-headers		x86_64	
4.18.0-305.7.1.el8.i2tch		@commandline	11 M
kernel-debug		x86_64	
4.18.0-305.7.1.el8.i2tch		@commandline	5.9 M
kernel-debug-core		x86_64	
4.18.0-305.7.1.el8.i2tch		@commandline	63 M
kernel-debug-debuginfo		x86_64	
4.18.0-305.7.1.el8.i2tch		@commandline	683 M
kernel-debug-devel		x86_64	
4.18.0-305.7.1.el8.i2tch		@commandline	19 M
kernel-debug-modules		x86_64	
4.18.0-305.7.1.el8.i2tch		@commandline	54 M
kernel-debug-modules-extra		x86_64	
4.18.0-305.7.1.el8.i2tch		@commandline	7.2 M
kernel-debug-modules-internal		x86_64	
4.18.0-305.7.1.el8.i2tch		@commandline	6.3 M
kernel-debuginfo		x86_64	
4.18.0-305.7.1.el8.i2tch		@commandline	570 M
kernel-debuginfo-common-x86_64		x86_64	
4.18.0-305.7.1.el8.i2tch		@commandline	75 M
kernel-devel		x86_64	
4.18.0-305.7.1.el8.i2tch		@commandline	18 M
kernel-ipa clones-internal		x86_64	
4.18.0-305.7.1.el8.i2tch		@commandline	20 M
kernel-modules		x86_64	

4.18.0-305.7.1.el8.i2tch	@commandline	28 M
kernel-modules-extra	x86_64	
4.18.0-305.7.1.el8.i2tch	@commandline	6.5 M
kernel-modules-internal	x86_64	
4.18.0-305.7.1.el8.i2tch	@commandline	6.1 M
kernel-selftests-internal	x86_64	
4.18.0-305.7.1.el8.i2tch	@commandline	19 M
kernel-tools-debuginfo	x86_64	
4.18.0-305.7.1.el8.i2tch	@commandline	6.2 M
kernel-tools-libs-devel	x86_64	
4.18.0-305.7.1.el8.i2tch	@commandline	5.9 M
Downgrading:		
kernel-headers	x86_64	
4.18.0-305.7.1.el8.i2tch	@commandline	7.1 M
kernel-tools	x86_64	
4.18.0-305.7.1.el8.i2tch	@commandline	6.1 M
kernel-tools-libs	x86_64	
4.18.0-305.7.1.el8.i2tch	@commandline	5.9 M

Transaction Summary

```

=====
=====
Install    20 Packages
Downgrade   3 Packages

```

```

Total size: 1.6 G
Is this ok [y/N]: y

```

When all is installed, re-start the virtual machine:

```
[root@centos7 ~]# reboot
```

Open a session as trainee and become root. List the installed Kernels:

```
[root@centos8 ~]# rpm -qa | grep kernel
kernel-modules-4.18.0-305.3.1.el8.x86_64
kernel-tools-4.18.0-305.7.1.el8.i2tch.x86_64
kernel-headers-4.18.0-305.7.1.el8.i2tch.x86_64
kernel-debuginfo-4.18.0-305.7.1.el8.i2tch.x86_64
kernel-debug-core-4.18.0-305.7.1.el8.i2tch.x86_64
kernel-modules-internal-4.18.0-305.7.1.el8.i2tch.x86_64
kernel-modules-4.18.0-305.7.1.el8_4.x86_64
kernel-debug-modules-4.18.0-305.7.1.el8.i2tch.x86_64
kernel-devel-4.18.0-305.7.1.el8.i2tch.x86_64
kernel-tools-debuginfo-4.18.0-305.7.1.el8.i2tch.x86_64
kernel-tools-libs-4.18.0-305.7.1.el8.i2tch.x86_64
kernel-debug-modules-internal-4.18.0-305.7.1.el8.i2tch.x86_64
kernel-cross-headers-4.18.0-305.7.1.el8.i2tch.x86_64
kernel-core-4.18.0-305.7.1.el8_4.x86_64
kernel-devel-4.18.0-305.7.1.el8_4.x86_64
kernel-debuginfo-common-x86_64-4.18.0-305.7.1.el8.i2tch.x86_64
kernel-debug-modules-extra-4.18.0-305.7.1.el8.i2tch.x86_64
kernel-debug-devel-4.18.0-305.7.1.el8.i2tch.x86_64
kernel-tools-libs-devel-4.18.0-305.7.1.el8.i2tch.x86_64
kernel-modules-extra-4.18.0-305.7.1.el8.i2tch.x86_64
kernel-4.18.0-305.7.1.el8_4.x86_64
kernel-4.18.0-305.7.1.el8.i2tch.x86_64
kernel-core-4.18.0-305.7.1.el8.i2tch.x86_64
kernel-selftests-internal-4.18.0-305.7.1.el8.i2tch.x86_64
kernel-debug-debuginfo-4.18.0-305.7.1.el8.i2tch.x86_64
kernel-debug-4.18.0-305.7.1.el8.i2tch.x86_64
kernel-4.18.0-305.3.1.el8.x86_64
kernel-core-4.18.0-305.3.1.el8.x86_64
kernel-modules-4.18.0-305.7.1.el8.i2tch.x86_64
kernel-ipa clones-internal-4.18.0-305.7.1.el8.i2tch.x86_64
```

Check the **saved-entry** from the **/boot/grub2/grubenv** file:

```
[root@centos8 ~]# grep i2tch /boot/grub2/grubenv  
saved_entry=95bd69e34a7444a7b58cb74fbfb86df2-4.18.0-305.7.1.el8.i2tch.x86_64
```

Finally, check the output of the **uname -r** command:

```
[root@centos8 ~]# uname -r  
4.18.0-305.7.1.el8.i2tch.x86_64
```

LAB #3 - Managing Quotas

User and group disk quotas can be placed on partitions **only**.



To do - Log out of your **CentOS8_SSH_10.0.2.45** session and open a new session using the **CentOS8_ROOT_10.0.2.45** connection.

Before configuring the quotas, set SELINUX to **permissive** mode for the current session:

```
[root@centos8 ~]# getenforce  
Enforcing  
[root@centos8 ~]# setenforce permissive  
[root@centos8 ~]# getenforce  
Permissive  
[root@centos8 ~]#
```

Edit the **/etc/sysconfig/selinux** file:

```
[root@centos8 ~]# vi /etc/sysconfig/selinux  
[root@centos8 ~]# cat /etc/sysconfig/selinux
```

```
# This file controls the state of SELinux on the system.
# SELINUX= can take one of these three values:
#     enforcing - SELinux security policy is enforced.
#     permissive - SELinux prints warnings instead of enforcing.
#     disabled - No SELinux policy is loaded.
SELINUX=permissive
# SELINUXTYPE= can take one of these three values:
#     targeted - Targeted processes are protected,
#     minimum - Modification of targeted policy. Only selected processes are protected.
#     mls - Multi Level Security protection.
SELINUXTYPE=targeted
```

Now check that the **quota** package is installed:

```
[root@centos8 ~]# rpm -qa | grep quota
quota-4.04-12.el8.x86_64
quota-nls-4.04-12.el8.noarch
```

Edit the **/etc/fstab** file and add the **usrquota** and **grpquota** options to the **/home** line:

```
[root@centos8 ~]# vi /etc/fstab
[root@centos8 ~]# cat /etc/fstab

#
# /etc/fstab
# Created by anaconda on Wed Jun 16 06:21:32 2021
#
# Accessible filesystems, by reference, are maintained under '/dev/disk/'.
# See man pages fstab(5), findfs(8), mount(8) and/or blkid(8) for more info.
#
# After editing this file, run 'systemctl daemon-reload' to update systemd
# units generated from this file.
#
/dev/mapper/cl_centos8-root / xfs defaults 0 0
```

UUID=1c04981e-5317-4b73-9695-3ce25246835d /boot	ext4	defaults	1 2
/dev/mapper/cl_centos8-swap swap	swap	defaults	0 0
UUID=f76d6b66-985b-4a91-af9c-4987e8c1443c /home	ext4	defaults,usrquota,grpquota	1 2

Restart the virtual machine:

```
[root@centos8 ~]# reboot
```



To do - Open a new session using the **CentOS8_ROOT_10.0.2.45** connection.

Check that the **usrquota** and **grpquota** options have been activated on /home:

```
[root@centos8 ~]# cat /etc/mtab | grep /home
/dev/sdc1 /home ext4 rw,seclabel,relatime,quota,usrquota,grpquota 0 0
```

3.1 - The quotacheck Command

To activate the quotas on /home, use the **quotacheck** command:

```
[root@centos8 ~]# quotacheck -cugvm -f /dev/sdc1
quotacheck: Your kernel probably supports journaled quota but you are not using it. Consider switching to
journaled quota to avoid running quotacheck after an unclean shutdown.
quotacheck: Scanning /dev/sdc1 [/home] done
quotacheck: Cannot stat old user quota file /home/aquota.user: No such file or directory. Usage will not be
subtracted.
quotacheck: Cannot stat old group quota file /home/aquota.group: No such file or directory. Usage will not be
subtracted.
quotacheck: Cannot stat old user quota file /home/aquota.user: No such file or directory. Usage will not be
subtracted.
quotacheck: Cannot stat old group quota file /home/aquota.group: No such file or directory. Usage will not be
```

```
subtracted.  
quotacheck: Checked 6763 directories and 129772 files  
quotacheck: Old file not found.  
quotacheck: Old file not found.
```

The command line switches of the **quotacheck** command are as follows:

```
[root@centos8 ~]# quotacheck --help  
Utility for checking and repairing quota files.  
quotacheck [-gucbfinvdmMR] [-F <quota-format>] filesystem|-a  
  
-u, --user           check user files  
-g, --group          check group files  
-c, --create-files   create new quota files  
-b, --backup         create backups of old quota files  
-f, --force          force check even if quotas are enabled  
-i, --interactive    interactive mode  
-n, --use-first-dquot use the first copy of duplicated structure  
-v, --verbose        print more information  
-d, --debug          print even more messages  
-m, --no-remount     do not remount filesystem read-only  
-M, --try-remount    try remounting filesystem read-only,  
                    continue even if it fails  
-R, --exclude-root   exclude root when checking all filesystems  
-F, --format=formatname check quota files of specific format  
-a, --all            check all filesystems  
-h, --help           display this message and exit  
-V, --version        display version information and exit
```

Bugs to jack@suse.cz

Two files, **aquota.user** and **aquota.group** are created in /home:

```
[root@centos8 ~]# ls -la /home
```

```
total 40
drwxr-xr-x.  4 root    root    4096 Jul 21 11:27 .
dr-xr-xr-x. 17 root    root     224 Jul 19 12:05 ..
-rw-----.  1 root    root    7168 Jul 21 11:27 aquota.group
-rw-----.  1 root    root    7168 Jul 21 11:27 aquota.user
drwx-----.  2 root    root   16384 Jul 19 12:02 lost+found
drwxr-xr-x. 17 trainee trainee 4096 Jul 21 11:22 trainee
```

Now create a user called **fenestros** having a password **fenestros** :

```
[root@centos8 ~]# groupadd fenestros && useradd fenestros -c Fenestr0s -d /home/fenestros -g fenestros -s /bin/bash
[root@centos8 ~]# passwd fenestros
Changing password for user fenestros.
New password:
BAD PASSWORD: The password contains the user name in some form
Retype new password:
passwd: all authentication tokens updated successfully.
```

3.2 - The edquota Command

Set a 10Mo quota for the fenestros user:

```
[root@centos8 ~]# edquota -u fenestros -f /home
```

The **vi** editor launches and you will see the following output:

```
Disk quotas for user fenestros (uid 1001):
  Filesystem            blocks      soft      hard    inodes      soft      hard
  /dev/sdc1              0          0          0         0          0          0
```

Change the file as follows:

Disk quotas for user fenestros (uid 1001):

Filesystem	blocks	soft	hard	inodes	soft	hard
/dev/sdc1	0	8000	10000	0	0	0



Important - This sets a **soft** quota of 8 000 KB and a **hard** quota of 10 000 KB for the fenestros user. When fenestros goes over the soft limit, he/she will receive a warning message. Going over the hard limit means that he/she can no longer save files to **/home/fenestros**. Note that you can set a quota by size or by the number of inodes.

Save and quit the file.

The command line switches of the **edquota** command are as follows:

```
[root@centos8 ~]# edquota --help
```

edquota: Usage:

```
edquota [-rm] [-u] [-F formatname] [-p username] [-f filesystem] username ...
edquota [-rm] -g [-F formatname] [-p groupname] [-f filesystem] groupname ...
edquota [-rm] -P [-F formatname] [-p projectname] [-f filesystem] projectname ...
edquota [-u|g|-P] [-F formatname] [-f filesystem] -t
edquota [-u|g|-P] [-F formatname] [-f filesystem] -T username|groupname|projectname ...
```

```
-u, --user          edit user data
-g, --group         edit group data
-P, --project       edit project data
-r, --remote        edit remote quota (via RPC)
-m, --no-mixed-pathnames trim leading slashes from NFSv4 mountpoints
-F, --format=formatname edit quotas of a specific format
-p, --prototype=name copy data from a prototype user/group
    --always-resolve  always try to resolve name, even if it is
                     composed only of digits
-f, --filesystem=filesystem edit data only on a specific filesystem
```

```
-t, --edit-period      edit grace period
-T, --edit-times       edit grace time of a user/group
-h, --help             display this help text and exit
-V, --version          display version information and exit
```

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Important - The procedure is similar in the case that you specify a group quota. In this case, use the **-g** switch of the edquota command.

3.3 - The quotaon Command

Now apply the quotas :

```
[root@centos8 ~]# quotaon -a
```

The command line switches of the **quotaon** command are as follows:

```
[root@centos8 ~]# quotaon --help
quotaon: Usage:
    quotaon [-guPvp] [-F quotaformat] [-x state] -a
    quotaon [-guPvp] [-F quotaformat] [-x state] filesystems ...

-a, --all                turn quotas on for all filesystems
-f, --off                turn quotas off
-u, --user               operate on user quotas
-g, --group              operate on group quotas
-P, --project            operate on project quotas
-p, --print-state        print whether quotas are on or off
-x, --xfs-command=cmd    perform XFS quota command
```

```
-F, --format=formatname  operate on specific quota format
-v, --verbose            print more messages
-h, --help              display this help text and exit
-V, --version            display version information and exit
```



important - To turn **off** quotas, use the **quotaoff** command.

3.4 - The repquota Command

To see quotas, use the **repquota** command:

```
[root@centos8 ~]# repquota /home
*** Report for user quotas on device /dev/sdc1
Block grace time: 7days; Inode grace time: 7days
```

		Block limits				File limits			
User	used	soft	hard	grace	used	soft	hard	grace	
root	-- 20	0	0		2	0	0		
trainee	-- 21495888	0	0		136532	0	0		



Important - Note that fenestros is not visible in this list. With RHEL / CentOS, quotas are not visible until the user has connected for the first time.

The command line switches of the **repquota** command are as follows:

```
[root@centos8 ~]# repquota --help
repquota: Utility for reporting quotas.
```

Usage:

```
repquota [-vugsi] [-c|C] [-t|n] [-F quotaformat] [-O (default | xml | csv)] (-a | mntpoint)
```

-v, --verbose	display also users/groups without any usage
-u, --user	display information about users
-g, --group	display information about groups
-P, --project	display information about projects
-s, --human-readable	show numbers in human friendly units (MB, GB, ...)
-t, --truncate-names	truncate names to 9 characters
-p, --raw-grace	print grace time in seconds since epoch
-n, --no-names	do not translate uid/gid to name
-i, --no-autofs	avoid autofs mountpoints
-c, --cache	translate big number of ids at once
-C, --no-cache	translate ids one by one
-F, --format=formatname	report information for specific format
-O, --output=format	format output as xml or csv
-a, --all	report information for all mount points with quotas
-h, --help	display this help message and exit
-V, --version	display version information and exit

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3.5 - The quota Command

To see quotas for a specific user, use the **quota** command:

```
[root@centos8 ~]# quota fenestros
Disk quotas for user fenestros (uid 1001): no limited resources used
[root@centos8 ~]# su - fenestros
[fenestros@centos8 ~]$ touch test
[fenestros@centos8 ~]$ exit
logout
[root@centos8 ~]# quota fenestros
```

Disk quotas for user fenestros (uid 1001):

Filesystem	blocks	quota	limit	grace	files	quota	limit	grace
/dev/sdc1	8	8000	10000		3	0	0	

The command line switches of the **quota** command are as follows:

```
[root@centos8 ~]# quota --help
quota: Usage: quota [-guPqvswim] [-l | [-Q | -A]] [-F quotaformat]
      quota [-qvswim] [-l | [-Q | -A]] [-F quotaformat] -u username ...
      quota [-qvswim] [-l | [-Q | -A]] [-F quotaformat] -g groupname ...
      quota [-qvswugPQm] [-F quotaformat] -f filesystem ...

-u, --user                display quota for user
-g, --group                display quota for group
-P, --project              display quota for project
-q, --quiet                print more terse message
-v, --verbose              print more verbose message
-s, --human-readable        display numbers in human friendly units (MB, GB...)
    --always-resolve        always try to translate name to id, even if it is
                           composed of only digits
-w, --no-wrap              do not wrap long lines
-p, --raw-grace             print grace time in seconds since epoch
-l, --local-only            do not query NFS filesystems
-Q, --quiet-refuse          do not print error message when NFS server does
                           not respond
-i, --no-autofs             do not query autofs mountpoints
-F, --format=formatname    display quota of a specific format
-f, --filesystem-list      display quota information only for given filesystems
-A, --all-nfs               display quota for all NFS mountpoints
-m, --no-mixed-pathnames   trim leading slashes from NFSv4 mountpoints
    --show-mntpoint         show mount point of the file system in output
    --hide-device           do not show file system device in output
-h, --help                 display this help message and exit
-V, --version               display version information and exit
```

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3.6 - The warnquota Command

The **warnquota** command checks user and group disk usage and sends out messages when the **soft** limit is reached. This command is normally called by a cron job however it is possible to use it interactively. With RHEL/CentOS, warnquota is not installed by default:

```
[root@centos8 ~]# which warnquota
/usr/bin/which: no warnquota in (/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/root/bin)
```

Install the **quota-warnquota** package:

```
[root@centos7 ~]# dnf install quota-warnquota
...
```

The command line switches of the **warnquota** command are as follows:

```
[root@centos8 ~]# warnquota --help
warnquota: Usage:
  warnquota [-ugsid] [-F quotaformat] [-c configfile] [-q quotatabfile] [-a adminsfile] [filesystem...]

-u, --user                warn users
-g, --group                warn groups
-s, --human-readable      send information in more human friendly units
-i, --no-autofs            avoid autofs mountpoints
-d, --no-details          do not send quota information itself
-F, --format=formatname   use quotafiles of specific format
-c, --config=config-file  non-default config file
-q, --quota-tab=quotatab-file non-default quotatab
-a, --admins-file=admins-file non-default admins file
-h, --help                display this help message and exit
-v, --version              display version information and exit
```

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