Version : **2024.01**

Dernière mise-à-jour : 2024/11/08 12:39

LCF607 - Gestion du Noyau et des Quotas

Contenu du Module

Rôle du noyau

Le noyau ou *kernel* est la partie du système d'exploitation qui gère les entrées/sorties avec des périphériques. Dans certains cas il est préférable de recompiler le noyau de Linux. La motivation de cette recompilation peut être :

- la diminution de la taille du noyau,
- la prise en charge de nouveau matériel,
- l'ajout de fonctionnalités,
- l'optimisation du code,
- la correction de bogues,
- le besoin d'une fonctionnalité expérimentale.

Commencez par mettre à jour CentOS 8 :

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

Identifiez ensuite le noyau utilisé par votre machine virtuelle :

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

LAB #1 - Modules

Dans le cas d'une utilisation courante de Linux, il est cependant préférable de faire appel aux **modules**. Les modules se trouvent dans le répertoire **/lib/modules/<version-du-noyau>** :

```
[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.modesetting  symvers.gz
```

Les commandes pour manipuler les modules sont :

- insmod
- rmmod
- lsmod
- modprobe

Par exemple :

```
[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,nf
t_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
```

Pour ajouter un module, on peut utiliser la commande **insmod** ou **modprobe**. Cette dernière ajoute non seulement le module passé en argument mais également ses dépendances :

```
[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--
```

Pour supprimer un module, on peut utiliser la commande **rmmod** ou **modprobe -r**. Cette dernière essaie de supprimer les dépendances non-utilisées :

```
[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--
```

Les dépendances des modules sont résolues par la commande **modprobe** grâce aux fichier **/lib/modules/<version-du-noyau>/modules.dep**. Ce dernier peut être créé manuellement grâce à la commande **depmod** :

```
[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_ede-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%)
```

Il est possible d'obtenir des informations sur un module grâce à la commande **modinfo** :

```
[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)
```

Dernièrement, les fichiers dans le repertoire **/etc/modprobe.d** sont utilisés pour spécifier les options éventuelles à passer aux modules lors de leur chargement ainsi que les alias utilisés pour leur faire référence :

```
[root@centos8 ~]# ls /etc/modprobe.d
firewalld-sysctls.conf  lockd.conf  nvdimm-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 - Compilation et installation du noyau et des modules

Activez le dépôt **CentOS-Stream-PowerTools** en passant la directive **enabled** à **1** :

```
[root@centos8 ~]# vi /etc/yum.repos.d/CentOS-Stream-PowerTools.repo
[root@centos8 ~]# cat /etc/yum.repos.d/CentOS-Stream-PowerTools.repo
# CentOS-PowerTools.repo
#
# The mirror system uses the connecting IP address of the client and the
# update status of each mirror to pick mirrors that are updated to and
# 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, as a fall back you can try the
# remarked out baseurl= line instead.
#
#

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

Installez maintenant les paquets necéssaires :

```
[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 hmaccalc 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 rpmdevtools clang dwarves java-
devel kabi-dw libbabeltrace-devel libbpf-devel libcap-devel libmnl-devel libnl3-devel libtraceevent-devel llvm
python3-devel python3-docutils
...
```

2.1 - Déplacer /home

Important - Il n'est pas conseillé de compiler en tant que root pour des raisons de sécurité. Pour pouvoir utiliser le compte d'un utilisateur pour créer un nouveau noyau, celui-ci doit disposer de plus de 10 Go d'espace libre.

A faire - **Déconnectez-vous** de votre session **CentOS8_SSH_10.0.2.45** et re-connectez-vous à la VM en tant que root en utilisant la connexion **CentOS8_ROOT_10.0.2.45**.

Créez ensuite une seule partition sur **/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.
```

Créez maintenant un système de fichiers ext4 sur **/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
```

Montez **/dev/sdc1** sur /mnt :

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

Copiez le contenu de /home vers /mnt :

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

Démontez /dev/sdc1 et déplacez /home vers /root :

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

Identifiez l'UUID de /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 ~]#
```

Editez le fichier **/etc/fstab** et ajoutez une ligne pour /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
```

Créez le point de montage /home :

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

Montez /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,pgrp=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)
```

Notez la taille de /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
```

A faire - **Déconnectez-vous** de votre session **CentOS8_ROOT_10.0.2.45** et re-connectez-vous à la VM en tant que trainee en utilisant la connexion **CentOS8_SSH_10.0.2.45**.

2.2 - Préparer l'Environnement

Pour créer l'arborescence de l'environnement de création de paquets dans /home/trainee, utilisez la commande **rpmdev-setuptree** :

```
[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 ..
```

Téléchargez le rpm source du noyau :

```
[root@centos8 ~]# uname -a
Linux centos8.ittraining.loc 4.18.0-553.6.1.el8.x86_64 #1 SMP Thu May 30 04:13:58 UTC 2024 x86_64 x86_64 x86_64
GNU/Linux

[root@centos8 ~]# cat /etc/centos-release
CentOS Stream release 8

[trainee@centos8 ~]$ wget
https://mirror.stream.centos.org/SIGs/8/kmods/source/kernels/kernel-4.18.0-553.16.1.el8_10.src.rpm
```

Installez maintenant les dépendances pour le rpm source en tant que root :

```
[trainee@centos8 ~]$ su -
Mot de passe : fenestros

[root@centos8 ~]# dnf install yum-utils
...
```

```
[root@centos8 ~]# yum-builddep /home/trainee/kernel-4.18.0-553.16.1.el8_10.src.rpm
...
```

Installez maintenant le paquet **kernel-4.18.0-553.16.1.el8_10.src.rpm** :

```
[root@centos8 ~]# exit
logout
[trainee@centos8 ~]$ rpm -Uvh kernel-4.18.0-553.16.1.el8_10.src.rpm
Updating / installing...
   1:kernel-4.18.0-553.16.1.el8_10      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
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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
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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
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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
################################# [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 - Les erreurs sont sans importance.

2.3 - Préparer l'Arborescence Source du Noyau

Naviguez vers le repertoire **~/rpmbuild/SPECS** et utilisez la commande **rpmbuild** pour préparer l'arborescence source du noyau :

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

A l'issu du processus, examinez l'arborescence :

```
[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
```

Le Fichier .config

Changez de répertoire de travail :

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

Copiez le fichier **configs/kernel-4.18.0-`uname -m`.config** vers **.config** dans le répertoire courant :

```
[trainee@centos8 linux-4.18.0-553.16.1.el8.x86_64]$ cp configs/kernel-4.18.0-`uname -m`.config .config
```

Mettez à jour le fichier .config par rapport à la configuration actuelle du noyau :

```
[trainee@centos8 linux-4.18.0-553.16.1.el8.x86_64]$ make oldconfig
scripts/kconfig/conf  --oldconfig Kconfig
#
# configuration written to .config
#
```

Important - Cette commande lit le fichier .config du noyau actuel et le compare avec celui des sources du noyau. S'il existent des nouvelles configurations à effectuer dans les sources du noyau, la commande vous pose des questions.

La configuration du noyau se trouve dans un fichier dénommé **.config**. Le fichier **.config** est généré par une des trois commandes suivantes et ne doit **pas** être édité manuellement :

- make config

- make menuconfig
- make xconfig

Exécutez la commande **make menuconfig** :

```
[trainee@centos8 linux-4.18.0-553.16.1.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
```

Dans l'interface, vous pouvez constater la présence de lignes correspondantes à des fonctionalités suivies par une lettre ou une valeur. Dans le cas d'une lettre, la signification est la suivante :

- **y**,
  - la fonctionalité est incluse dans le noyau monolithique ou dans le cas d'une dépendance d'un module, dans le module concerné,
- **m**,
  - la fonctionalité est incluse en tant que module,
- **n**,
  - la fonctionalité n'est pas incluse.

Important - Cette commande permet la modification de la configuration du noyau.

Sauvegardez simplement la configuration actuelle et sortez de l'interface :

```
*** End of the configuration.
```

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

Vérifiez que le fichier **.config** a été“ créé par l'exécution de makeconfig :

```
[trainee@centos8 linux-4.18.0-553.16.1.el8.x86_64]$ ls -a
.                       .gitattributes  Documentation   Makefile.rhelver  drivers   lib       tools
..                      .gitlab-ci.yml  Kbuild          README            firmware  mm        usr
.clang-format           .mailmap        Kconfig         arch              fs        net       virt
.cocciconfig            .mismatches     Kconfig.redhat  block             include   samples
.config                 .scmversion     LICENSES        certs             init      scripts
.config.old             COPYING-4.18.0  MAINTAINERS     configs           ipc       security
.get_maintainer.ignore  CREDITS         Makefile        crypto            kernel    sound
```

Consultez ce fichier :

```
[trainee@centos8 linux-4.18.0-553.16.1.el8.x86_64]$ more .config
#
# Automatically generated file; DO NOT EDIT.
# Linux/x86 4.18.0 Kernel Configuration
#

#
# Compiler: gcc (GCC) 8.5.0 20210514 (Red Hat 8.5.0-22)
#
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
--More--(0%)
```

Le Fichier Makefile

Le fichier **Makefile** contient le nom du noyau et spécifie les informations suivantes :

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

Les trois premières informations sont gérées par **kernel.org** et Linus Torvalds en personne tandis que l'EXTRAVERSION est gérée par Red Hat :

```
[trainee@centos8 linux-4.18.0-553.16.1.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 = 6
RHEL_DRM_PATCHLEVEL = 3
RHEL_DRM_SUBLEVEL =
RHEL_DRM_EXTRAVERSION =
```

```
# *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
--More--(0%)
```

Important - La version 2.6 du noyau a vu le jour en **2003**. Les **SUBLEVEL** se suivaient régulièrement. Avec la version 2.6 du noyau, la valeur paire du **PATCHLEVEL** indiquait que le noyau était stable. Quand vous recompilez le noyau à partir des sources, vous devez modifier la valeur de l'EXTRAVERSION. Le passage à la version 3.0 fut décidé par Linus Torvalds à l'occasion des 20 ans du noyau Linux. Depuis l'arrivée de la version 3 du noyau, la signification de la valeur de PATCHLEVEL paire et impaire a été abondonnée.

2.4 - Paramétrage du noyau

Insérez la sortie de la commande **uname -i** sur la première ligne du fichier .config :

```
[trainee@centos8 linux-4.18.0-553.16.1.el8.x86_64]$ uname -i
x86_64

[trainee@centos8 linux-4.18.0-553.16.1.el8.x86_64]$ vi .config

[trainee@centos8 linux-4.18.0-553.16.1.el8.x86_64]$ head .config
# x86_64
#
# Automatically generated file; DO NOT EDIT.
```

```
# Linux/x86 4.18.0 Kernel Configuration
#

#
# Compiler: gcc (GCC) 8.5.0 20210514 (Red Hat 8.5.0-22)
#
CONFIG_64BIT=y
```

Renommez le fichier .config en le plaçant dans le répertoire **~/rpmbuild/SOURCES/** :

```
[trainee@centos8 linux-4.18.0-553.16.1.el8.x86_64]$ cp .config ~/rpmbuild/SOURCES/config-`uname -m`-generic

[trainee@centos8 linux-4.18.0-553.16.1.el8.x86_64]$ ls ~/rpmbuild/SOURCES
Module.kabi_aarch64      filter-s390x.sh                           linux-4.18.0-553.16.1.el8_10.tar.xz
Module.kabi_dup_aarch64  filter-x86_64.sh                          linux-kernel-test.patch
Module.kabi_dup_ppc64le  gating.yaml                               mod-blacklist.sh
Module.kabi_dup_s390x    generate_all_configs.sh                   mod-extra.list
Module.kabi_dup_x86_64   generate_bls_conf.sh                      mod-internal.list
Module.kabi_ppc64le      kernel-aarch64-debug.config               mod-sign.sh
Module.kabi_s390x        kernel-aarch64.config                     parallel_xz.sh
Module.kabi_x86_64       kernel-abi-stablelists-4.18.0-553.tar.bz2 process_configs.sh
centossecureboot201.cer  kernel-kabi-dw-4.18.0-553.tar.bz2         redhatsecureboot302.cer
centossecurebootca2.cer  kernel-ppc64le-debug.config               redhatsecureboot303.cer
check-kabi               kernel-ppc64le.config                     redhatsecureboot501.cer
config-x86_64-generic    kernel-s390x-debug.config                 redhatsecurebootca3.cer
cpupower.config          kernel-s390x-zfcpdump.config              redhatsecurebootca7.cer
cpupower.service         kernel-s390x.config                       rheldup3.x509
filter-aarch64.sh        kernel-x86_64-debug.config                rhelkpatch1.x509
filter-modules.sh        kernel-x86_64.config                      rpminspect.yaml
filter-ppc64le.sh        kvm_stat.logrotate                        x509.genkey
```

Copiez le contenu du répertoire **configs** vers le répertoire **~/rpmbuild/SOURCES/** :

```
[trainee@centos8 linux-4.18.0-553.16.1.el8.x86_64]$ cp configs/* ~/rpmbuild/SOURCES/
```

Editez la directive **buildid** dans le fichier **~/rpmbuild/SPECS/kernel.spec** :

```
[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

%global distro_build 553

# Sign the x86_64 kernel for secure boot authentication
%ifarch x86_64 aarch64 s390x ppc64le
%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 .ittraining

%define specversion 4.18.0
%define pkgrelease 553.16.1.el8_10

# allow pkg_release to have configurable %%{?dist} tag
%define specrelease 553.16.1%{?dist}

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

# libexec dir is not used by the linker, so the shared object there
# should not be exported to RPM provides
%global __provides_exclude_from ^%{_libexecdir}/kselftests
```

2.5 - Compiler le Noyau

La compilation du noyau peut prendre beaucoup de temps (~5 heures). La commande utilisée est la suivante :

```
[trainee@centos8 SPECS]$ rpmbuild -bb --target=`uname -m` kernel.spec 2> build-err.log | tee build-out.log &
[1] 96990
[trainee@centos8 SPECS]$ Building target platforms: x86_64
Building for target x86_64
```

```
...
```

Important - La compilation peut prendre des heures.

A l'issu du processus, les RPMs se trouvent dans le répertoire **/home/trainee/rpmbuild/RPMS/x86_64/** :

```
...
Wrote: /home/trainee/rpmbuild/RPMS/x86_64/kernel-4.18.0-553.16.1.el8.ittraining.x86_64.rpm
...

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

Notez que la génération du nouveau noyau peut consommer jusqu'à 21 Go d'espace disque :

```
[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 - Installer le Nouveau Noyau

Installez maintenant les paquets **kernel***. L'installation du noyau peut prendre beaucoup de temps (~2 heures). La commande utilisée est la suivante :
:

```
[trainee@centos8 SPECS]$ cd ../RPMS/x86_64

[root@centos8 x86_64]# dnf localinstall kernel-*.rpm
```

A l'issu de l'installation, re-démarrez la VM :

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

Connectez-vous en tant que trainee et devenez root. Constatez l'entrée **saved-entry** du fichier **/boot/grub2/grubenv** :

```
[root@centos8 ~]# grep ittraining /boot/grub2/grubenv
saved_entry=95bd69e34a7444a7b58cb74fbfb86df2-4.18.0-553.16.1.el8.ittraining.x86_64
```

Dernièrement, vérifiez l'utilisation du nouveau noyau :

```
[root@centos8 ~]# uname -r
4.18.0-553.16.1.el8.ittraining.x86_64
```

LAB #3 - Gestion des Quotas

Sous Linux il est possible de mettre en place des quotas par utilisateur et par groupe. Ceci étant, Linux ne sait pas gérer des quotas par répertoire, uniquement des quotas par partition. L'administrateur met souvent des quotas en place sur l'arborescence de /home pour limiter l'espace de stockage occupé par les utilisateurs.

Déconnectez-vous et reconnectez-vous **directement** en tant que root :

```
root@computeXX:~# ssh -l root 10.0.2.45
root@10.0.2.45's password: fenestros
Activate the web console with: systemctl enable --now cockpit.socket

Last login: Wed Jul 21 11:14:31 2021
```

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

Avant de mettre en place des quotas, configurer SELINUX en mode **permissive** afin de ne pas avoir d'erreurs de ce dernier :

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

Editez ensuite le fichier /etc/sysconfig/selinux ainsi :

```
[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
```

Commencez par vérifiez que le paquet **quota** est bien installé :

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

Editez le fichier **/etc/fstab** en ajoutant les options **usrquota** et **grpquota** à la ligne **/home** :

```
[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
```

Redémarrez la VM :

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

Reconnectez-vous **directement** en tant que root :

```
root@computeXX:~# ssh -l root 10.0.2.45
root@10.0.2.45's password: fenestros
Activate the web console with: systemctl enable --now cockpit.socket

Last login: Wed Jul 21 11:19:46 2021
[root@centos8 ~]#
```

Vérifiez ensuite que les options **usrquota** et **grpquota** soient prises en compte :

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

3.1 - La Commande quotacheck

Pour activer les quotas sur /home, il convient d'utiliser la commande **quotacheck** :

```
[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.
```

Les options de la commande quotacheck sont :

```
[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
```

Les quotas ont été activés et les fichier **aquota.user** et **aquota.group** ont été créés dans le répertoire /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
```

Créez maintenant un utilisateur **fenestros** avec le mot de passe **fenestros** :

```
[root@centos8 ~]# groupadd fenestros && useradd fenestros -c FenestrOs -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 - La Commande edquota

Mettez en place maintenant un quota de 10Mo pour l'utilisateur **fenestros** :

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

L'éditeur **vi** se lance et vous obtiendrez un résultat similaire à celui-ci :

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

Modifiez ce fichier ainsi :

```
Disk quotas for user fenestros (uid 1001):
  Filesystem                   blocks       soft       hard     inodes     soft     hard
  /dev/sdc1                         0       8000      10000          0        0        0
```

Sauvegardez et quittez le fichier.

Les options de la commande **edquota** sont :

```
[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

Bugs to: jack@suse.cz
```

Important - Pour mettre en place un quota par group, la procédure est similaire. Il suffit d'utiliser l'option -g de la commande edquota.

3.3 - La Commande quotaon

Appliquez maintenant les quotas :

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

Les options de la commande **quotaon** sont :

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

-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
```

De cette manière vous avez mis en place un quota **souple** pour fenestros de 8 000 Ko et un quota **stricte** de 10 000 Ko.

Quand l'utilisateur fenestros aura dépassé le quota **souple**, il recevra un message d'avertissement. Quand il dépasse le quota **stricte**, il ne pourra plus enregistrer dans /home, sauf dans le cas où il supprime des fichiers pour retomber en dessous de la limite **stricte**.

Il est à noter que vous pouvez soit mettre en place un quota en taille, soit mettre en place un quota basé sur le nombre d'inodes utilisés par l'utilisateur.

important - La commande pour désactivez les quotas est **quotaoff**.

3.4 - La Commande repquota

Pour visualiser les quotas utilisez la commande **repquota** :

```
[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 - Notez que l'utilisateur fenestros ne figure pas dans la liste. Sous RHEL / CentOS, le quota n'est pas visible tant que l'utilisateur ne s'est pas connecté pour la première fois.

Les options de la commande **repquota** sont :

```
[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

Bugs to jack@suse.cz
```

3.5 - La Commande quota

Pour visualiser les quotas d'un utilisateur spécifique, il convient d'utiliser la commande **quota** :

```
[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
```

Les options de la commande **quota** sont :

```
[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

Bugs to: jack@suse.cz
```

3.6 - La Commande warnquota

La commande **warnquota** vérifie le ou les disques et envoie un message par mail à tout utilisateur qui a dépassé la limite soft. Elle est enrègle générale appelée par un job cron. Cependant elle peut aussi est appelée d'une manière intéractive.

Sous RHEL/CentOS, warnquota n'est pas installé par défaut :

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

Installez donc le paquet **quota-warnquota** :

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

Les options de la commande **warnquota** sont :

```
[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

warnquota: Bugs to jack@suse.cz
```
