

TP Virtualisation 1

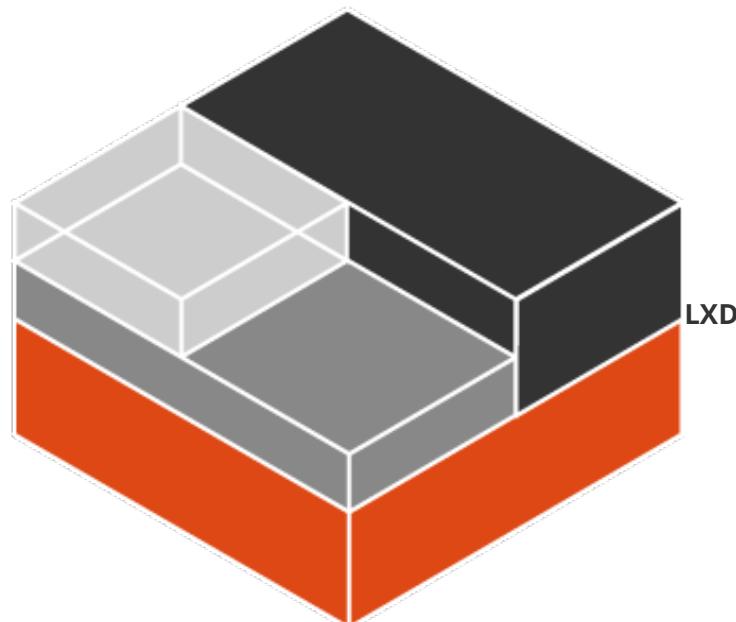
[Yunzhe GUO](#)

Année universitaire 2021-2022

Part-1

1 Mise en place.

1.1 Prérequis

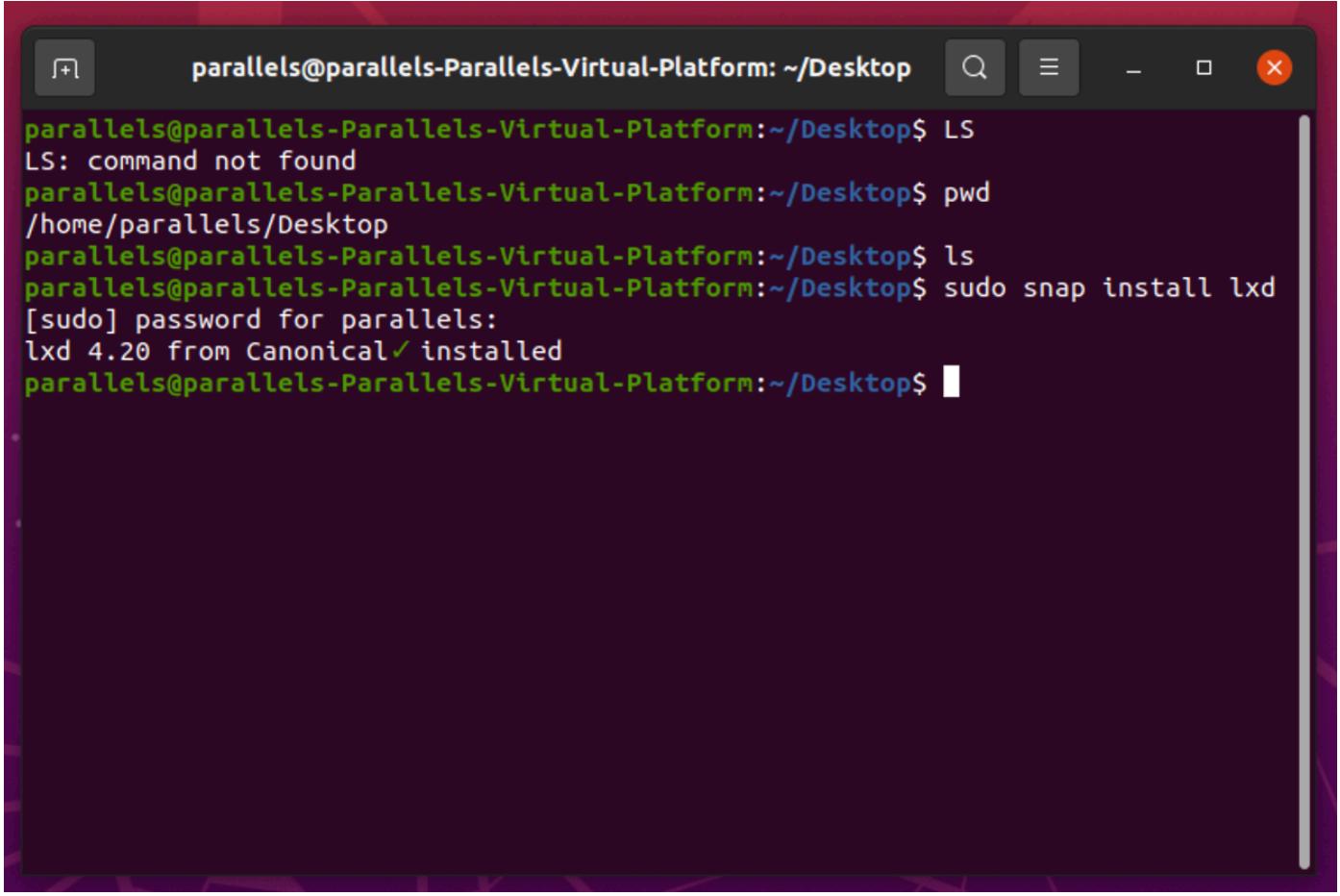


Vous utiliserez [LXD](#) comme première illustration de conteneur. LXD s'appuie sur [lxc](#) -qui est une interface du noyau linux permettant d'isoler un processus ou un ensemble de processus du reste du système- et sur un démon (serveur *lxd*) accessible en ligne de commande ou au travers d'une [API REST](#). Ce serveur permet la configuration des [instances](#) (essentiellement des [containers](#) pour l'instant, même si le support de [machines virtuelles](#) est en cours de développement), des [images](#) qui peuvent être préfabriquées ou [construites à la demande](#) de systèmes sur lesquelles s'appuient ces dernières et un certain nombre de paramètres de configuration : réseau, stockage, contrôle d'accès, etc. Il permet la [migration à chaud](#). Des limites peuvent être configurées sur l'utilisation des ressources (CPU, mémoire, disque, bande passante, etc). Enfin, des accès direct au matériel peuvent être configurés (par exemple pour le [GPU](#) ou des périphériques branchés sur un [hub USB](#)).

1.1.1 Linux

- Ubuntu

```
sudo snap install lxd
```

A screenshot of a terminal window titled "parallels@parallels-Parallels-Virtual-Platform: ~/Desktop". The terminal shows the following command history:

```
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$ ls
LS: command not found
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$ pwd
/home/parallels/Desktop
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$ ls
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$ sudo snap install lxd
[sudo] password for parallels:
lxd 4.20 from Canonical✓ installed
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$
```

2 Premiers pas avec [LXD](#)

2.1 LXD et nftables

Debian 10 Buster et Ubuntu 20.04 Focal proposent `nftables` comme par-feu par défaut. LXD ne supporte pas encore `nftables`, il faut donc adapter. Pour commencer, nous allons utiliser les `iptables` “à l’ancienne” :

```
sudo update-alternatives --set iptables /usr/sbin/iptables-legacy
```

Cette solution ne fonctionne pas pour l’IPv6. Il faut donc désactiver l’IPv6 pour les conteneurs lors du `lxd init` :

```
What IPv6 address should be used? (CIDR subnet notation, "auto" or "none")
[default=auto]: none
```

```
[Response]
We should use none
```

2.2 Initialisation du service (daemon)

L'[Initialisation du service lxd](#) (interface en ligne de commande et points d’entrée HTTP/REST) se fait au moyen de la commande

```
lxd init
```

Le script de commandes associé à `lxd init` vous posera des questions de manière interactive (c'est son comportement par défaut), mais il est possible de l'utiliser de manière [non interactive](#) au moyen d'un fichier [YAML](#) de paramètres ([preseed](#)).

Par exemple :

```
sudo lxd init
```

avec une configuration interactive :

```
Would you like to use LXD clustering? (yes/no) [default=no]:  
Do you want to configure a new storage pool? (yes/no) [default=yes]:  
Name of the new storage pool [default=default]: o4ssd512g  
Name of the storage backend to use (btrfs, dir, lvm, zfs, ceph) [default=btrfs]: btrfs  
Would you like to create a new btrfs subvolume under /var/snap/lxd/common/lxd? (yes/no)  
[default=yes]:  
Would you like to connect to a MAAS server? (yes/no) [default=no]:  
Would you like to create a new local network bridge? (yes/no) [default=yes]:  
What should the new bridge be called? [default=lxdbr0]:  
What IPv4 address should be used? (CIDR subnet notation, "auto" or "none")  
[default=auto]:  
What IPv6 address should be used? (CIDR subnet notation, "auto" or "none")  
[default=auto]:  
Would you like LXD to be available over the network? (yes/no) [default=no]:  
Would you like stale cached images to be updated automatically? (yes/no) [default=yes]  
Would you like a YAML "lxd init" preseed to be printed? (yes/no) [default=no]: yes  
config: {}  
networks:  
- config:  
  ipv4.address: auto  
  ipv6.address: auto  
  description: ""  
  name: lxdbr0  
  type: ""  
  project: default  
  storage_pools:  
  - config:  
    source: /var/snap/lxd/common/lxd/storage-pools/o4ssd512g  
    description: ""  
    name: o4ssd512g  
    driver: btrfs  
  profiles:  
  - config: {}  
    description: ""  
  devices:  
  eth0:
```

```
name: eth0
network: lxdbr0
type: nic
root:
path: /
pool: o4ssd512g
type: disk
name: default
cluster: null
```

Il peut être nécessaire de bénéficier des droits suffisants :

```
sudo adduser $LOGNAME lxd
newgrp lxd
```

2.3 Lancement des instances

Une instance de container peut être créée au moyen de la commande [lxc launch](#) avec la syntaxe

```
lxc launch template nom du container
```

Par exemple

```
lxc launch images:debian/10 buster01
```

Permet de créer un container nommé `buster01` démarré sur une distribution [Debian Buster](#).

```
parallels@parallels-Parallels-Virtual-Platform: ~/Desktop$ lxc --help
-n, --network           Network name
--no-profiles          Create the instance with no profiles applied
-p, --profile           Profile to apply to the new instance
-s, --storage            Storage pool name
--target                Cluster member name
-t, --type               Instance type
--vm                   Create a virtual machine

Global Flags:
  --debug      Show all debug messages
  --force-local Force using the local unix socket
-h, --help              Print help
  --project    Override the source project
-q, --quiet              Don't show progress information
-v, --verbose            Show all information messages
  --version    Print version number
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$ lxc launch image:debian/10 buster01
Error: The remote "image" doesn't exist
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$ lxc launch images:debian/10 buster01
Creating buster01
Starting buster01
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$
```

2.4 État des instances

La commande `lxc ls` permet de vérifier la liste des instances et leur état. Par exemple

```
lxc ls
```

devrait vous conduire à quelque chose qui ressemble à ça :

```
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$ lxc ls
+-----+-----+-----+
|   NAME   |   STATE   |           IPV4           |           IPV6           |
|   TYPE    |   SNAPSHOTS  |                         |
+-----+-----+-----+
| buster01 | RUNNING | 10.172.232.233 (eth0) | fd42:194a:608c:fd3b:216:3eff:fee7:df22 (eth0) |
| CONTAINER | 0          |                         |
+-----+-----+-----+
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$
```

```
+-----+-----+-----+
|   NAME   |   STATE   |           IPV4           |           IPV6           |
|   TYPE    |   SNAPSHOTS  |                         |
+-----+-----+-----+
| buster01 | RUNNING | 10.138.158.46 (eth0) | fd42:8168:b5e7:1e08:216:3eff:fee3:871e |
| (eth0)   | CONTAINER | 0          |                         |
+-----+-----+-----+
|   NAME   |   STATE   |           IPV4           |           IPV6           |
|   TYPE    |   SNAPSHOTS  |                         |
+-----+-----+-----+
```

- L'option `-c` de `lxc ls` permet de spécifier les colonnes à afficher, par exemple

```
lxc ls -c ns
```

```
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$ lxc ls -c ns
+-----+-----+
| NAME | STATE |
+-----+-----+
| buster01 | RUNNING |
+-----+-----+
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$
```

n'affiche que le nom et l'état de chaque instance. Vous pouvez consulter l'aide associée à chaque commande au moyen d'un

```
lxc help ls
```

(de manière similaire aux commandes de `git` ou `iproute2`).

- L'option

```
--format
```

permet de spécifier un format de sortie alternatif, par exemple :

- `json` pour avoir l'état des containers en format [JSON](#)
- `yaml` pour l'avoir en [YAML](#)
- `csv` pour l'avoir en CSV

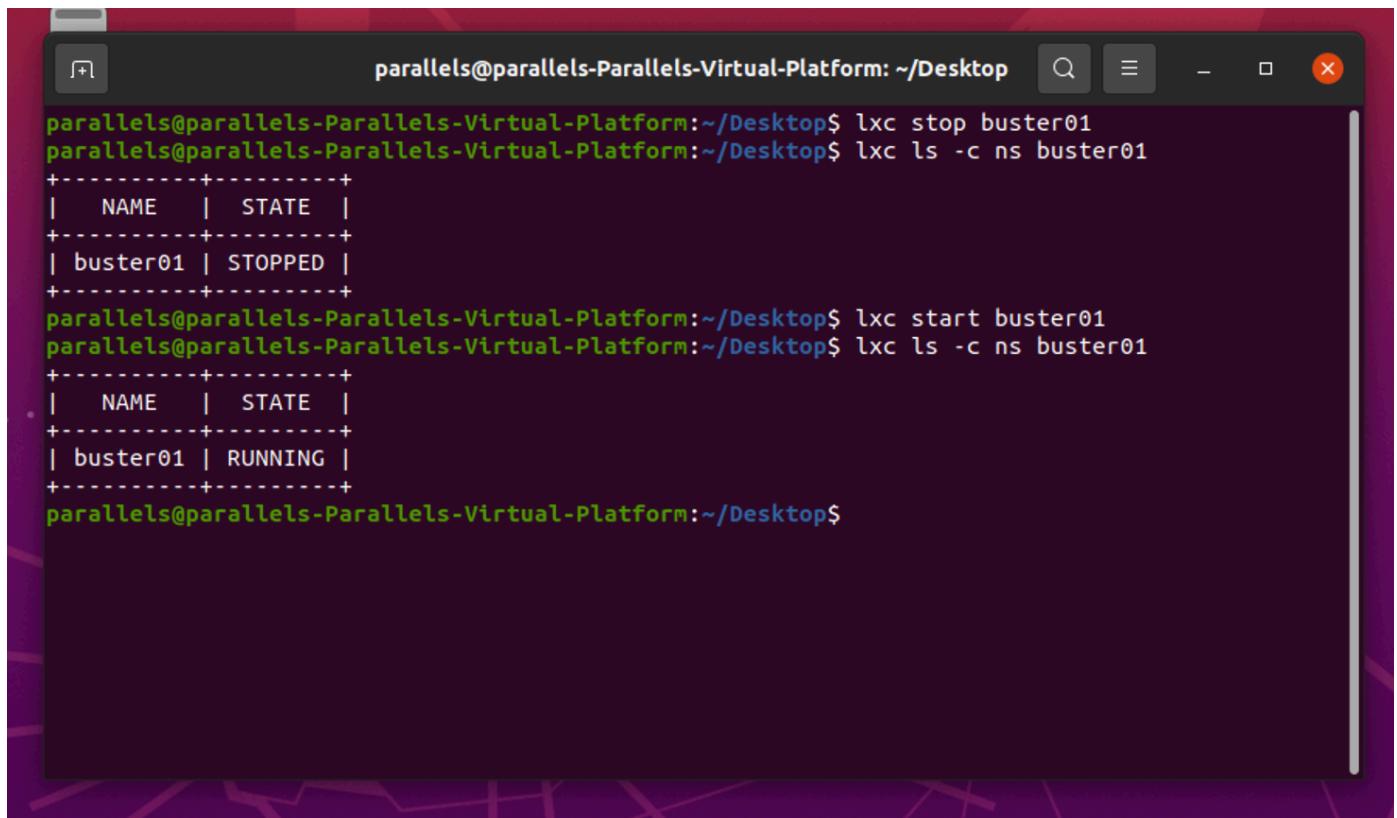
2.5 Arrêt / redémarrage

- `lxc stop nom du container` permet de stopper un container (sans le détruire),
- `lxc start nom du container` permet de le redémarrer.

Par exemple :

```
lxc stop buster01
lxc ls -c ns buster01
+-----+-----+
| NAME | STATE |
```

```
+-----+-----+
| buster01 | STOPPED |
+-----+-----+
lxc start buster01
lxc ls -c ns buster01
+-----+-----+
|   NAME   |   STATE   |
+-----+-----+
| buster01 | RUNNING |
+-----+-----+
```



A screenshot of a terminal window titled "parallels@parallels-Parallels-Virtual-Platform: ~/Desktop". The terminal shows the following command history:

```
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$ lxc stop buster01
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$ lxc ls -c ns buster01
+-----+-----+
|   NAME   |   STATE   |
+-----+-----+
| buster01 | STOPPED |
+-----+-----+
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$ lxc start buster01
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$ lxc ls -c ns buster01
+-----+-----+
|   NAME   |   STATE   |
+-----+-----+
| buster01 | RUNNING |
+-----+-----+
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$
```

2.6 Crédation de processus dans un container

La commande `lxc exec` permet d'exécuter une commande dans un container. Par exemple

```
lxc exec buster01 -- /bin/bash
```

permet d'avoir un shell exécuté dans le contexte d'exécution du container `buster01`.

```
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$ lxc exec buster01 -- /bin/bash
root@buster01:~# pwd
/root
root@buster01:~#
```

2.7 Exercices

- Créez un container `buster01` (si votre système hôte est linux) ou `focal01` (si votre système hôte est linux ou windows ou autre).exit

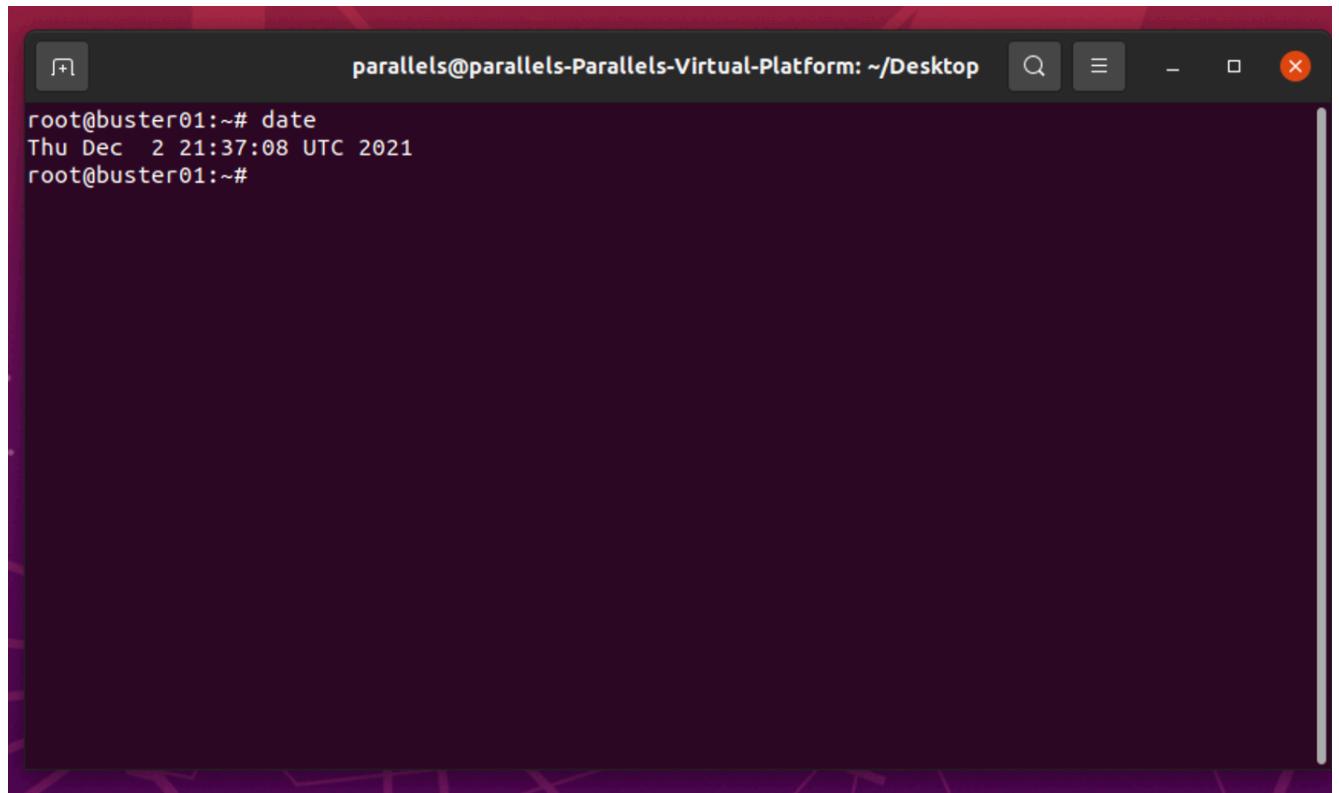
```
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$ lxc
  -n, --network          Network name
  --no-profiles          Create the instance with no profiles applied
  -p, --profile          Profile to apply to the new instance
  -s, --storage          Storage pool name
  --target               Cluster member name
  -t, --type              Instance type
  --vm                  Create a virtual machine

Global Flags:
  --debug      Show all debug messages
  --force-local Force using the local unix socket
  -h, --help    Print help
  --project    Override the source project
  -q, --quiet   Don't show progress information
  -v, --verbose  Show all information messages
  --version    Print version number
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$ lxc launch image:debian/10 buster01
Error: The remote "image" doesn't exist
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$ lxc launch images:debian/10 buster01
Creating buster01
Starting buster01
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$
```

2. Commentez les sorties des commandes `date`, `cat /proc/cpuinfo`, `ls /dev`, `free -h`, `df -h`, `ip link ls`, `ip route ls` et `systemctl status` exécutées dans l'environnement d'exécution de votre container.

[Response]

Date



A screenshot of a terminal window titled "parallels@buster01:~/Desktop". The window has a dark purple background and a light purple header bar. The terminal shows the following output:

```
root@buster01:~# date
Thu Dec  2 21:37:08 UTC 2021
root@buster01:~#
```

It's the time of my linux host machine.

`cat /proc/cpuinfo`

```
parallels@parallels-Parallels-Virtual-Platform: ~/Desktop
root@buster01:~# cat /proc/cpuinfo
processor       : 0
vendor_id      : GenuineIntel
cpu family     : 6
model          : 158
model name    : Intel(R) Core(TM) i9-9880H CPU @ 2.30GHz
stepping        : 13
cpu MHz        : 2304.000
cache size     : 16384 KB
physical id    : 0
siblings        : 2
core id         : 0
cpu cores      : 2
apicid          : 0
initial apicid : 0
fpu             : yes
fpu_exception   : yes
cpuid level    : 22
wp              : yes
flags           : fpu vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov pat pse36 clflush mmx fxsr sse sse2 ss ht syscall nx rdtscp lm constant_tsc nopl xtopology nonstop_tsc cpu id tsc_known_freq pnpi pclmulqdq ssse3 fma cx16 pcid sse4_1 sse4_2 x2apic movbe popcnt tsc_deadline_timer aes xsave avx f16c rdrand hypervisor lahf_lm abm 3dnowprefetch invpcid_single pti fsgsbase tsc_adjust bmi1 avx2 smep bmi2 invpcid rdseed adx smap clflushopt xsaveopt xsavenc d
```

It's the same CPU as my physical machine.

Ls /dev

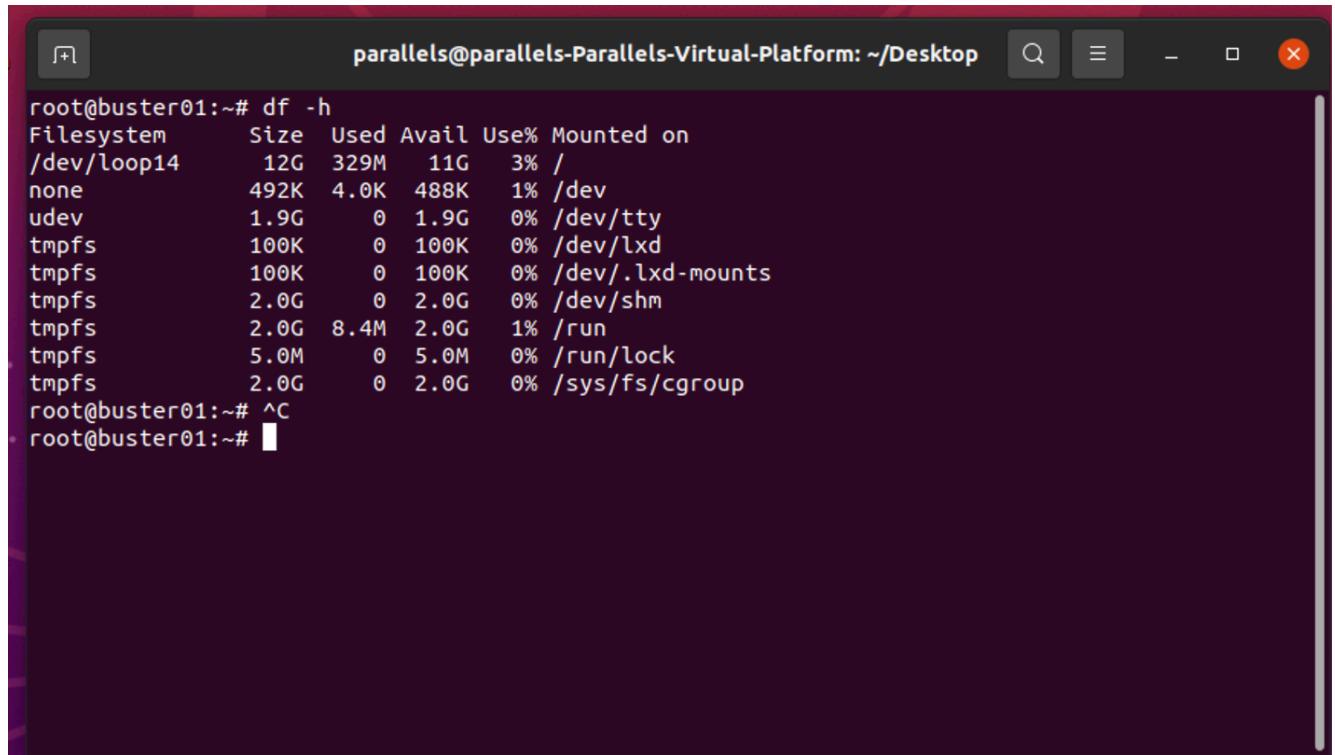
```
parallels@parallels-Parallels-Virtual-Platform: ~/Desktop
root@buster01:~# ls /dev
console  fd   fuse   log   mqueue  null  pts    shm    stdn   tty    zero
core    full  initctl lxd   net     ptmx  random  stderr  stdout  urandom
root@buster01:~#
```

There is one dev more than the traditional linux:**lxd**, it's because the container system should communicate with the host by this dev.

Free -h

The total memory are the same size, but the used one are different.

Df -h



A screenshot of a terminal window titled "parallels@parallels-Parallels-Virtual-Platform: ~/Desktop". The window shows the output of the "df -h" command. The output lists various filesystems with their sizes, used space, available space, usage percentage, and mount points. The root filesystem at "/dev/loop14" has a size of 12G, used 329M, and has 3% usage. Other filesystems like "/dev", "/dev/tty", and "/dev/shm" have very low usage percentages. The terminal prompt "root@" is visible at the bottom.

```
root@buster01:~# df -h
Filesystem      Size  Used Avail Use% Mounted on
/dev/loop14     12G   329M   11G   3% /
none            492K   4.0K   488K   1% /dev
udev            1.9G    0    1.9G   0% /dev/tty
tmpfs           100K    0    100K   0% /dev/lxd
tmpfs           100K    0    100K   0% /dev/.lxd-mounts
tmpfs            2.0G    0    2.0G   0% /dev/shm
tmpfs            2.0G   8.4M   2.0G   1% /run
tmpfs            5.0M    0    5.0M   0% /run/lock
tmpfs            2.0G    0    2.0G   0% /sys/fs/cgroup
root@buster01:~# ^C
root@buster01:~#
```

The disk is different in container.

Ip link ls

```
parallels@parallels-Parallels-Virtual-Platform: ~/Desktop
sh
/dev/loop14      12G  329M   11G   3% /
none            492K  4.0K  488K   1% /dev
udev             1.9G    0  1.9G   0% /dev/tty
tmpfs            100K    0  100K   0% /dev/lxd
tmpfs            100K    0  100K   0% /dev/.lxd-mounts
tmpfs            2.0G    0  2.0G   0% /dev/shm
tmpfs            2.0G  8.4M  2.0G   1% /run
tmpfs            5.0M    0  5.0M   0% /run/lock
tmpfs            2.0G    0  2.0G   0% /sys/fs/cgroup
root@buster01:~# ^C
root@buster01:~# ip link ls
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN mode DEFAULT group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
6: eth0@if7: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP mode DEFAULT group default qlen 1000
    link/ether 00:16:3e:e7:df:22 brd ff:ff:ff:ff:ff:ff link-netnsid 0
root@buster01:~# exit
exit
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$ ip link ls
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN mode DEFAULT group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
2: enp0s5: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP mode DEFAULT group default qlen 1000
    link/ether 00:1c:42:d2:19:bc brd ff:ff:ff:ff:ff:ff
3: lxdbr0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP mode DEFAULT group default qlen 1000
    link/ether 00:16:3e:88:ed:66 brd ff:ff:ff:ff:ff:ff
7: veth34bd075a@if6: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue master lxdbr0 state UP mode DEFAULT group default qlen 1000
    link/ether 0e:9e:bc:ac:03:b9 brd ff:ff:ff:ff:ff:ff link-netnsid 0
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$
```

The host system has 2 ip more than the container system. And they has different ip address.

Ip route ls

```
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$ exec buster01 -- /bin/bash
root@buster01:~# ip route ls
default via 10.172.232.1 dev eth0
10.172.232.0/24 dev eth0 proto kernel scope link src 10.172.232.233
root@buster01:~# exit
exit
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$ ip route ls
default via 10.211.55.1 dev enp0s5 proto dhcp metric 100
10.172.232.0/24 dev lxdbr0 proto kernel scope link src 10.172.232.1
10.211.55.0/24 dev enp0s5 proto kernel scope link src 10.211.55.4 metric 100
169.254.0.0/16 dev enp0s5 scope link metric 100
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$
```

The host system has 2 route more than the container system.

Systemctl status

```

parallels@parallels-Parallels-Virtual-Platform: ~/Desktop
└─4382 dnsmasq --keep-in-foreground --strict-order --bind-interfaces --except-interface=lxd
  └─lxc.monitor.buster01
    └─5480 [lxc monitor] /var/snap/lxd/common/lxd/containers buster01
  └─lxc.payload.buster01
    └─init.scope
      └─5492 /sbin/init
    └─system.slice
      └─networking.service
        └─5889 /sbin/dhclient -4 -v -i -pf /run/dhclient.eth0.pid -lf /var/lib/dhcp/dhc
      └─systemd-journald.service
        └─5863 /lib/systemd/systemd-journald
      └─console-getty.service
        └─5915 /sbin/agetty -o -p -- \u --noclear --keep-baud console 115200,38400,>
      └─dbus.service
        └─5899 /usr/bin/dbus-daemon --system --address=systemd: --nofork --nopidfile>
      └─systemd-logind.service
        └─5901 /lib/systemd/systemd-logind
    └─user.slice
      └─user-1000.slice
        └─user@1000.service
          └─gsd-xsettings.service
            └─2756 /usr/libexec/gsd-xsettings

parallels@parallels-Parallels-Virtual-Platform:~/Desktop$ lxc exec buster01 -- /bin/bash
root@buster01:~# systemctl status
● buster01
  State: running
  Jobs: 0 queued
 Failed: 0 units
   Since: Thu 2021-12-02 21:17:33 UTC; 30min ago
  CGroup: /
    └─.lxc
      └─461 /bin/bash
      └─462 systemctl status
      └─463 pager
    └─init.scope
      └─1 /sbin/init
    └─system.slice
      └─networking.service
        └─393 /sbin/dhclient -4 -v -i -pf /run/dhclient.eth0.pid -lf /var/lib/dhcp/dhc
lient.eth0.leases -I -df /var/lib/dhcp/dhclient6.eth0.leases eth0
      └─systemd-journald.service
        └─368 /lib/systemd/systemd-journald
      └─console-getty.service
        └─419 /sbin/agetty -o -p -- \u --noclear --keep-baud console 115200,38400,9600
  └─linux
    └─dbus.service
      └─403 /usr/bin/dbus-daemon --system --address=systemd: --nofork --nopidfile -->
systemd-activation --syslog-only
      └─systemd-logind.service
        └─405 /lib/systemd/systemd-logind
root@buster01:#

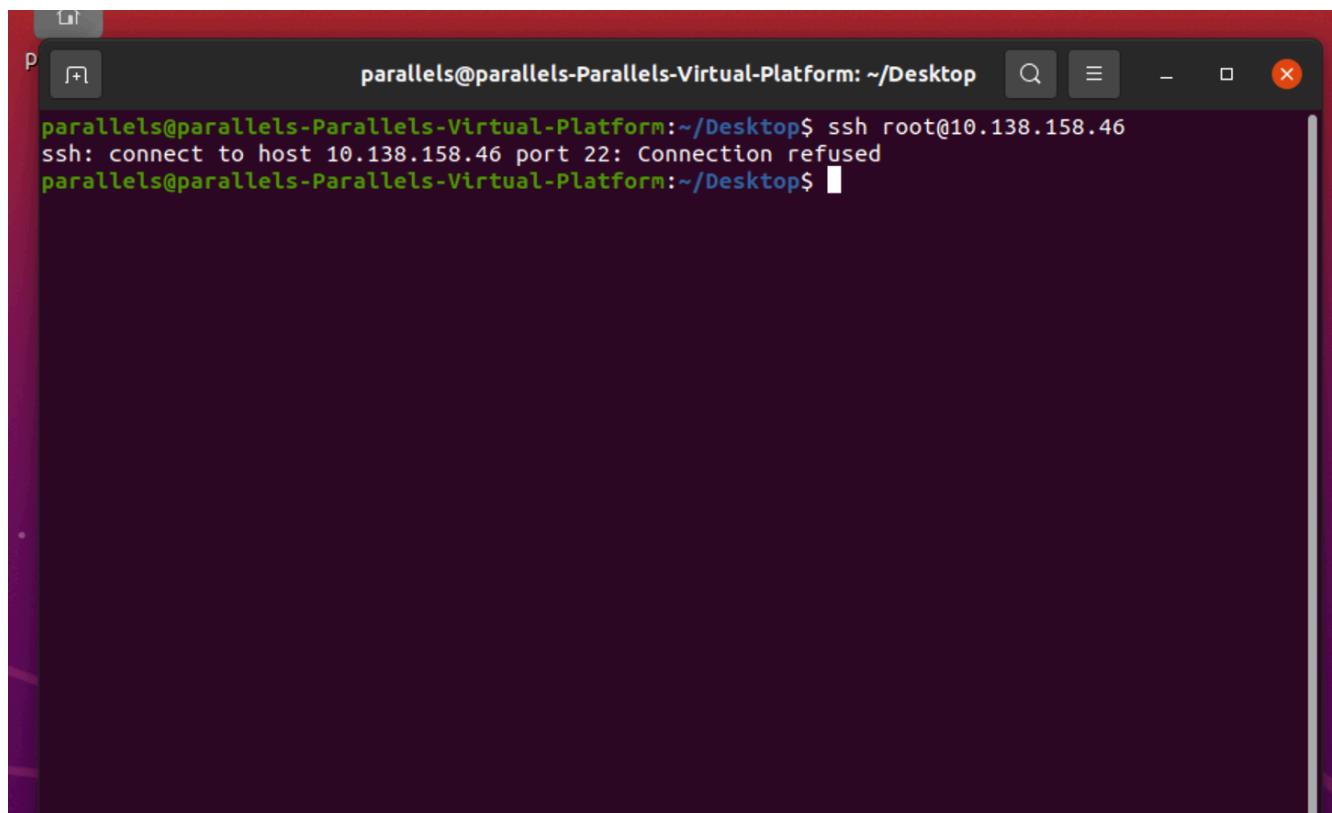
```

They have different processes. But all initiated by `/sbin/init splash`

- Installez et configurez un serveur ssh dans le container. Est-il accessible ? Si oui comment ? Si non pourquoi ? 10.172.232.153

[Response]

No, I can't.



A screenshot of a terminal window titled "parallels@parallels-Parallels-Virtual-Platform: ~/Desktop". The window shows a command being run: "ssh root@10.138.158.46". The output of the command is displayed below the prompt, showing the error: "ssh: connect to host 10.138.158.46 port 22: Connection refused". The terminal has a dark background with light-colored text.

```
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$ ssh root@10.138.158.46
ssh: connect to host 10.138.158.46 port 22: Connection refused
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$
```

4. Créez un second container appelé `nginx01`, de la même façon que ce que vous avez fait pour les 3 exercices précédents. Installez le serveur web [nginx](#) dessus.

```
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$ curl http://10.172.232.153/
<!DOCTYPE html>
<html>
<head>
<title>Welcome to nginx!, Yunzhe GUO from Polytech Nantes.</title>
<style>
  body {
    width: 35em;
    margin: 0 auto;
    font-family: Tahoma, Verdana, Arial, sans-serif;
  }
</style>
</head>
<body>
<h1>Welcome to nginx!</h1>
<p>If you see this page, the nginx web server is successfully installed and
working. Further configuration is required.</p>

<p>For online documentation and support please refer to
<a href="http://nginx.org/">nginx.org</a>.<br/>
Commercial support is available at
<a href="http://nginx.com/">nginx.com</a>.</p>

<p><em>Thank you for using nginx.</em></p>
</body>
</html>
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$ lxc list
+-----+-----+-----+
|     NAME   | STATE   |          IPV4           |          IPV6
|     TYPE    | SNAPSHOTS |
+-----+-----+-----+
+-----+-----+
| buster01 | RUNNING | 10.172.232.233 (eth0) | fd42:194a:608c:fd3b:216:3eff:fee7:df22 (eth0)
| CONTAINER | 0       |                               |
+-----+-----+-----+
+-----+-----+
| nginx01  | RUNNING | 10.172.232.153 (eth0) | fd42:194a:608c:fd3b:216:3eff:fe42:87e5 (eth0)
| CONTAINER | 0       |                               |
+-----+-----+-----+
+-----+-----+
parallels@parallels-Parallels-Virtual-Platform:~/Desktop$
```