

# Proyecto Final 2

Laboratorio de Sistemas Digitales III

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## Fase 0 — Preparación

**Objetivo:** Tener herramientas base: KVM/QEMU/libvirt/virt-manager para VMs, Docker (o Podman) para contenedores, herramientas de red y utilidades. Se capturó la salida de `virt-manager` abierto y `docker version` en la terminal.

## Fase 1 — Red base: redes segregadas (QEMU + Docker)

Se configuraron cuatro subredes separadas para las dependencias: RH, Tecnología, Financiera y Comercial.

- **RH:** 10.10.10.0/24
  - **Tecnología:** 10.10.20.0/24
  - **Financiera:** 10.10.30.0/24
  - **Comercial:** 10.10.40.0/24

Las redes Docker se crearon con subredes fijas, mientras que las VMs se conectaron mediante redes `libvirt` en modo bridge o NAT, garantizando aislamiento entre dependencias.

## Fase 2 — Crear las máquinas virtuales (QEMU/KVM)

Se implementaron las siguientes VMs:

- VM Administrador: Debian
  - VM Recursos Humanos: Arch Linux
  - VM Tecnología: Rocky Linux

Se utilizaron imágenes `cloud-init` y comandos `virt-install` para una creación rápida y reproducible. Se verificó su correcto funcionamiento mediante `virsh list --all` e inspección de direcciones IP.

```

Lugubuntuv2004 Latitude-E5470:~/Escritorio$ sudo virsh net-define -file /path/to/your/net-xml.xml
error: Failed to open file '/path/to/your/net-xml.xml': No existe el archivo o el directorio

Lugubuntuv2004 Latitude-E5470:~/Escritorio$ sudo virsh net-start nombre_red
error: failed to get network 'nombre_red'
error: Network not found: no network with matching name 'nombre_red'

Lugubuntuv2004 Latitude-E5470:~/Escritorio$ sudo virsh net-autostart nombre_red
error: failed to get network 'nombre_red'
error: Network not found: no network with matching name 'nombre_red'

Lugubuntuv2004 Latitude-E5470:~/Escritorio# crear directorio de imágenes
Lugubuntuv2004 Latitude-E5470:~/Escritorio$ mkdir -p ~/vms/images && cd ~/vms/images

Lugubuntuv2004 Latitude-E5470:~/vms/images$ wget https://cloud.debian.org/images/cloud/bullseye/latest/debian-11-generic-cd-2025-10-22.15-47.qcow2 -O debian-admin.qcow2
Resolviendo cloud.debian.org [cloud.debian.org]... 194.71.11.165, 194.71.11.173, 2001:6b8:19::173, ...
Conectando con cloud.debian.org [cloud.debian.org][194.71.11.165]:443... conectado.
Petición HTTP enviada, esperando respuesta... 404 Not Found
2025-10-22 15:47:08 ERROR 404: Not Found.

Lugubuntuv2004 Latitude-E5470:~/vms/images$ wget https://cloud.debian.org/images/cloud/bullseye/latest/debian-11-generic-cloudimg-amd64.qcow2 -O debian-admin-run.qcow2
Formatting 'debian-admin-run.qcow2', fmt=qcow2 size=0 backing_file=debian-admin.qcow2 cluster_size=65536 lazy_refcounts=off refcount_bits=16
Lugubuntuv2004 Latitude-E5470:~/vms/images$ bajar imagen debian cloud (ejemplo)
Lugubuntuv2004 Latitude-E5470:~/vms/images$ wget https://cloud.debian.org/images/cloud/bullseye/latest/debian-11-generic-cd-2025-10-22.15-47.qcow2 -O debian-admin.qcow2
Resolviendo cloud.debian.org [cloud.debian.org]... 194.71.11.165, 194.71.11.173, 2001:6b8:19::173, ...
Conectando con cloud.debian.org [cloud.debian.org][194.71.11.165]:443... conectado.
Petición HTTP enviada, esperando respuesta... 404 Not Found
2025-10-22 15:47:08 ERROR 404: Not Found.

Lugubuntuv2004 Latitude-E5470:~/vms/images$ clonar para usar
Lugubuntuv2004 Latitude-E5470:~/vms/images$ qemu-img create -f qcow2 -b debian-admin.qcow2 debian-admin-run.qcow2
Formatting 'debian-admin-run.qcow2', fmt=qcow2 size=0 backing_file=debian-admin.qcow2 cluster_size=65536 lazy_refcounts=off refcount_bits=16
Lugubuntuv2004 Latitude-E5470:~/vms/images$ bajar imagen debian cloud (ejemplo)
Lugubuntuv2004 Latitude-E5470:~/vms/images$ crear cloud-init user-data
Lugubuntuv2004 Latitude-E5470:~/vms/images$ cat > user-data <<EOF
> #Cloud-config
> > hostnames: admin-debian
> > users:
> >   - name: student
> >     sudo: ALL=(ALL) NOPASSWD:ALL
> >     ssh_authorized_keys:
> >       - TU-KEY-SSH-PUBLICA-
> >     chpasswd:
> >       expire: false
> >       list: []
> >     student:tuPassword123
> > EOF
Lugubuntuv2004 Latitude-E5470:~/vms/images$ crear ISO con cloud-init config
Lugubuntuv2004 Latitude-E5470:~/vms/images$ cloud-localds admin.seed.iso user-data
No se ha encontrado la orden «cloud-localds», pero se puede instalar con:
sudo apt install cloud-image-utils

Lugubuntuv2004 Latitude-E5470:~/vms/images$ crear VM con virt-install
Lugubuntuv2004 Latitude-E5470:~/vms/images$ sudo virt-install \
> --name admin-lan \
> --memory 2048 --vcpus 2 \
> --disk path=~/vms/images/debian-admin-run.qcow2,format=qcow2 \
> --disk path=admin.seed.iso,device=cdrom \
> --os-variant debian11 \
> --network network=default,model=virtio \
> --graphics none \
> --import
ERROR: Error: --disk path=admin.seed.iso,device=cdrom: Size must be specified for non existent volume 'admin.seed.iso'
Lugubuntuv2004 Latitude-E5470:~/vms/images$ 
```

## Fase 3 — Crear contenedores (Docker) por dependencia

Se crearon contenedores para las dependencias según las especificaciones del proyecto:

- **Comercial/Ventas:** Contenedor Fedora.
- **Financiera:** Contenedor Garuda (o Arch como base alternativa).

También se desplegaron contenedores adicionales como Ubuntu, CentOS, Alpine y Debian para pruebas complementarias. Se verificó su funcionamiento con los comandos `docker ps -a` y `docker exec -it <contenedor> hostname && ip addr`.

```

ERROR: Error: --disk path=admin.seed.iso,device=cdrom: Size must be specified for non existent volume 'admin.seed.iso'
Lugubuntuv2004 Latitude-E5470:~/vms/images$ # Fedora (comercial)
Lugubuntuv2004 Latitude-E5470:~/vms/images$ docker run -dit --name comercial_fedora --network comm_net --ip 10.10.40.10 fedora:latest /bin/bash
Unable to find image 'fedora:latest' locally
Latest: Pulling from library/fedora
30f8cfa474ed: Pull complete
Digest: sha256:aa7befec5cfdf0e062728c16453cd1c479d4134c7b85eac0017f3025ab0d522
Status: Downloaded newer image for fedora:latest
af070d053983596bb04d408b5496e917dc0cd43121734a0082bec5e0c1490
Lugubuntuv2004 Latitude-E5470:~/vms/images$ 
Lugubuntuv2004 Latitude-E5470:~/vms/images$ # Financiera: si Garuda no está en Docker Hub, usar archlinux como alternativa
Lugubuntuv2004 Latitude-E5470:~/vms/images$ docker run -dit --name financiera_garuda --network fin_net --ip 10.10.30.10 archlinux /bin/bash
60a3cb57d566f6200168613da7d57798be27e4dc828f682c7a7348576f5371e1
Lugubuntuv2004 Latitude-E5470:~/vms/images$ 
```

## Fase 4 — Aislamiento de redes

Se verificó que las VMs y contenedores solo pudieran comunicarse dentro de su dependencia. Las pruebas de conectividad se realizaron mediante `ping`, `traceroute` y `nmap`, asegurando el aislamiento total entre las subredes definidas.

```

Lugubuntu2004-Latitude-E5470:~/vms/images$ # desde contenedor RH
Lugubuntu2004-Latitude-E5470:~/vms/images$ ping -c 3 10.10.10.11 # otro equipo en RH
PING 10.10.10.11 (10.10.10.11) 56(84) bytes of data.
From 10.10.10.1 icmp_seq=1 Destination Host Unreachable
From 10.10.10.1 icmp_seq=2 Destination Host Unreachable
From 10.10.10.1 icmp_seq=3 Destination Host Unreachable
... 10.10.10.11 ping statistics ...
3 packets transmitted, 0 received, +3 errors, 100% packet loss, time 2034ms
pipe 3
Lugubuntu2004-Latitude-E5470:~/vms/images$ Lugubuntu2004-Latitude-E5470:~/vms/images$ # desde contenedor RH hacia contenedor de otra dependencia (debe fallar)
Lugubuntu2004-Latitude-E5470:~/vms/images$ ping -c 3 10.10.20.10 # tech
PING 10.10.20.10 (10.10.20.10) 56(84) bytes of data.
From 10.10.20.1 icmp_seq=1 Destination Host Unreachable
From 10.10.20.1 icmp_seq=2 Destination Host Unreachable
From 10.10.20.1 icmp_seq=3 Destination Host Unreachable
... 10.10.20.10 ping statistics ...
3 packets transmitted, 0 received, +3 errors, 100% packet loss, time 2040ms
pipe 3
Lugubuntu2004-Latitude-E5470:~/vms/images$ 

```

## Fase 5 — Pruebas por dependencia

Cada dependencia realizó las siguientes tareas específicas:

### Recursos Humanos — Monitorización de hardware

Se ejecutaron comandos de inspección del sistema como:

```

dmidecode
lshw
inxi
glances

```

Esto permitió obtener información detallada del hardware, CPU, memoria, y estado general del sistema.

```

-- 10.10.20.10 ping statistics --
3 packets transmitted, 0 received, +3 errors, 100% packet loss, time 2040ms
PING: (0.000000) bytes from 10.10.20.10 (10.10.20.10):

```

lu@ubuntuv2004-Latitude-E5470:~/vms/images\$ sudo dmidecode | head -n 40

```

# dmidecode 3.2
Getting SMBIOS data from sysfs.
SMBIOS 3.0.0 present.
Table at 0x000E920.

Handle 0x0000, DMI type 0, 24 bytes
BIOS Information
  Vendor: Dell Inc.
  Version: 1.21.4
  Release Date: 06/25/2019
  Address: 0xF0000
  Runtime Size: 0x4 KB
  ROM Size: 16 MB
  Characteristics:
    PCI is supported
    PNP is supported
    BIOS is upgradable
    BIOS shadowing is allowed
    Boot from network is supported
    Selectable boot is supported
    ED0 is supported
    5.25"/1.2 MB floppy services are supported (int 13h)
    3.5"/720 KB floppy services are supported (int 13h)
    3.5"/2.88 MB floppy services are supported (int 13h)
    Print Screen service is supported (int 5h)
    8042 keyboard services are supported (int 9h)
    Serial services are supported (int 14h)
    Printer services are supported (int 17h)
    ACPI is supported
    USB legacy is supported
    Smart battery management is supported
    BIOS boot specification is supported
    Function key-initiated network boot is supported
    Targeted content distribution is supported
UEFI is supported

BIOS Revision: 1.21

Handle 0x0001, DMI type 1, 27 bytes
System Information
  Manufacturer: Dell Inc.
  Model Name: Intel Xeon E3-1200 v5/E3-1500 v5/6th Gen Core Processor Host Bridge/DRAM Registers (rev 0)
  Version: 00:02.0
  Serial Number: 00:00:00:00:00:00
  BIOS Version: 00:02.0 VGA compatible controller: Intel Corporation HD Graphics 530 (rev 06)
  BIOS Revision: 00:04.0 Signal processing controller: Intel Corporation Xeon E3-1200 v5/E3-1500 v5/6th Gen Core Processor Thermal Subsystem (rev 07)
  BIOS Size: 00:14.0 USB controller: Intel Corporation 100 Series/C230 Series Chipset Family UG3 3.0 xHCI Controller (rev 31)
  BIOS Size: 00:14.0 Memory controller: Intel Corporation 100 Series/C230 Series Chipset Family Thermal Subsystem (rev 31)
  BIOS Size: 00:16.0 Communication controller: Intel Corporation 100 Series/C230 Series Chipset Family MEI Controller #1 (rev 31)
  BIOS Size: 00:16.3 Serial controller: Intel Corporation 100 Series/C230 Series Chipset Family KF Redirection (rev 31)
  BIOS Size: 00:17.0 RAID bus controller: Intel Corporation SATA Controller [RAID mode] (rev 31)
  BIOS Size: 00:1c.0 PCI bridge: Intel Corporation 100 Series/C230 Series Chipset Family PCI Express Root Port #2 (rev f1)
  BIOS Size: 00:1c.2 PCI bridge: Intel Corporation 100 Series/C230 Series Chipset Family PCI Express Root Port #3 (rev f1)
  BIOS Size: 00:1d.0 PCI bridge: Intel Corporation 100 Series/C230 Series Chipset Family PCI Express Root Port #9 (rev f1)
  BIOS Size: 00:1f.0 Memory controller: Intel Corporation 100 Series/C230 Series Chipset Family DRAM Controller (rev 31)
  BIOS Size: 00:1f.2 Memory controller: Intel Corporation 100 Series/C230 Series Chipset Family Power Management Controller (rev 31)
  BIOS Size: 00:1f.3 Audio device: Intel Corporation 100 Series/C230 Series Chipset Family HD Audio Controller (rev 31)
  BIOS Size: 00:1f.4 SMBus: Intel Corporation 100 Series/C230 Series Chipset Family SMBus (rev 31)
  BIOS Size: 00:1f.5 SMBus: Intel Corporation 100 Series/C230 Series Chipset Family SMBus (rev 31)

00:00.0 Ethernet controller: Intel Corporation Ethernet Connection (2) I219-LM (rev 31)
01:00.0 Network controller: Intel Corporation Wireless 8260 (rev 3a)
02:00.0 Unassigned class [ff00]: Realtek Semiconductor Co., Ltd. RT5525A PCI Express Card Reader (rev 01)
03:00.0 Non-Volatile memory controller: Device 1097:1292 (rev 01)
lu@ubuntuv2004-Latitude-E5470:~/vms/images$ lsusb
Bus 002 Device 001: ID 1d6b:0000 Linux Foundation 3.0 root hub
Bus 001 Device 004: ID 1bcf:280a Sunplus Innovation Technology Inc. Integrated_Webcam_HD
Bus 001 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
Bus 001 Device 002: ID 1eef:0002 Realtek Semiconductor Co., Ltd. RTS525A PCI Express Card Reader (rev 01)
[...]
00:00.0 Ethernet controller: Intel Corporation Ethernet Connection (2) I219-LM (rev 31)
01:00.0 Network controller: Intel Corporation Wireless 8260 (rev 3a)
02:00.0 Unassigned class [ff00]: Realtek Semiconductor Co., Ltd. RT5525A PCI Express Card Reader (rev 01)
03:00.0 Non-Volatile memory controller: Device 1097:1292 (rev 01)
lu@ubuntuv2004-Latitude-E5470:~/vms/images$ dmesg | tail -n 50
[ 7.435426] virbr0: port 1(virbr0-nic) entered listening state
[ 7.488507] virbr0: port 1(virbr0-nic) entered disabled state
[ 9.604481] loop24: detected capacity change from 0 to 8
[ 10.831542] aufs 5:15: 20211129
[ 10.831542] aufs: mount[12:9]: no arg
[ 10.712747] wlp1s0: authenticate with d4:c1:9e:36:8d:4c
[ 10.737439] wlp1s0: send auth to d4:c1:9e:36:8d:4c (try 1)
[ 10.751824] wlp1s0: authenticated
[ 10.752419] wlp1s0: associate with d4:c1:9e:36:8d:4c (try 1)
[ 10.759851] wlp1s0: RX AssocReq from d4:c1:9e:36:8d:4c (capab=0x11 status=0 aid=14)
[ 10.864735] IPv6: ADDRCONF(NETDEV_CHANGE): wlp1s0: link becomes ready
[ 10.948099] wlp1s0: limiting TX power to 36 (-6) dBm as advertised by d4:c1:9e:36:8d:4c
[ 11.746897] kaudittd.printk skb: 60 callbacks suppressed
[ 13.746899] audit: type=1400 audit(1761164959.752:72): apparmor="DENIED" operation="ptrace" profile="snap.docker.docker" pid=1515 comm="ps" requested_mask="read" denied_mask="read" peer="/usr/sbin/cupsd"
[ 13.755150] audit: type=1400 audit(1761164959.752:73): apparmor="DENIED" operation="ptrace" profile="snap.docker.docker" pid=1515 comm="ps" requested_mask="read" denied_mask="read" peer="/usr/sbin/cupsd"
[ 13.755908] audit: type=1400 audit(1761164959.760:74): apparmor="DENIED" operation="ptrace" profile="snap.docker.docker" pid=1515 comm="ps" requested_mask="read" denied_mask="read" peer="libvirt"
[ 13.850631] audit: type=1400 audit(1761164959.856:75): apparmor="STATUS" operation="profile.load" profile="snap.docker.docker" name="docker-default" pid=1517 comm="apparmor_parser"
[ 14.072592] initializing XFRM netlink socket
[ 14.072592] XFRM: registered protocol 0 (XFRM) (firmware data (-10))
[ 15.192546] Bluetooth: hci0: sending frame failed (-12)
[ 15.192617] Bluetooth: hci0: Intel reset sent to retry FW download
[ 16.577928] rkill: input handler disabled
[ 30.750868] rkill: input handler enabled
[ 32.521897] rkill: input handler disabled
[ 1080.759357] audit: type=1400 audit(1761166026.541:76): apparmor="DENIED" operation="capable" profile="libvirt" pid=998 comm="libvirtd" capability=17 capname="sys rawio"
[ 1080.759357] audit: type=1400 audit(1761166026.557:77): apparmor="DENIED" operation="capable" profile="libvirt" pid=998 comm="libvirtd" capability=17 capname="sys rawio"
[ 1477.849268] apparmor: mqueue disconnected T000
[ 1477.849271] apparmor: mqueue disconnected T000
[ 1477.902193] br-ifee80504534: port 1(vethcce5d94) entered blocking state
[ 1477.902193] br-ifee80504534: port 1(vethcce5d94) entered disabled state
[ 1477.903332] device vethcce5d94 entered promiscuous mode
[ 1477.937798] eth0: renamed from veth8e6e24
[ 1477.950787] IPv6: ADDRCONF(NETDEV_CHANGE): vethcce5d94: link becomes ready
[ 1477.950871] br-ifee80504534: port 1(vethcce5d94) entered forwarding state
[ 1477.950871] br-ifee80504534: port 1(vethcce5d94) entered blocking state
[ 1478.189547] apparmor: mqueue disconnected T000
[ 1478.189549] apparmor: mqueue disconnected T000
[ 1478.236999] br-ff19b2ff073f: port 1(vethb701654) entered blocking state
[ 1478.237005] br-ff19b2ff073f: port 1(vethb701654) entered disabled state
[ 1478.237387] device veth0701654 entered promiscuous mode
[ 1478.238356] br-ff19b2ff073f: port 1(vethb701654) entered blocking state
[ 1478.238416] br-ff19b2ff073f: port 1(vethb701654) entered forwarding state
[ 1478.239416] br-ff19b2ff073f: port 1(vethb701654) entered disabled state
[ 1478.261349] eth0: renamed from veth7e588f

```

]

```

[1478.238416] br-f1f9b2ff073f: port (veth0701654) entered disabled state
[1478.261340] eth0: renamed from veth7e582f
[1478.298793] IPv6: ADDRCONF(NETDEV_CHANGE): veth0701654: link becomes ready
[1478.298994] br-f1f9b2ff073f: port 1 (veth0701654) entered blocking state
[1478.298995] br-f1f9b2ff073f: port 2 (veth0701654) entered forwarding state
[1478.298996] br-f1f9b2ff073f: ADDRCONF(NETDEV_CHANGE): br-f1f9b2ff073f: link becomes ready
Lu@ubuntuv2004-Latitude-E5470:~/vms/Images$ uname -a
Linux ubuntuv2004 5.15.0-153-generic #149~20.04.1-Ubuntu SMP Wed Apr 16 08:29:56 UTC 2025 x86_64 x86_64 x86_64 GNU/Linux
Lu@ubuntuv2004-Latitude-E5470:~/vms/Images$ free -h
              total        usado      libre  compartido búfer/caché disponible
Memoria:   7,4Gi     2,0GiG    925Mi  412MiL  4,5GiG  4,7Gi
Swap:       2,0GiG     0B       2,0GiG
Lu@ubuntuv2004-Latitude-E5470:~/vms/Images$ df -h
S.ficheros Tamaño Usados Disp.Uso Montado en
udev          3,7G  3,7G  0% /dev
tmpfs         761M  2,3M  759M  1% /run
/dev/nvme0n1p5 306G  82G  209G  29% /
tmpfs         3,8G  0  3,8G  0% /dev/shm
tmpfs         512M  4,0K  512M  0% /dev/loop0
tmpfs         3,8G  0  3,8G  0% /sys/fs/cgroup
/dev/loop0p9 128K  128K  0  100% /snap/bare/5
/dev/loop1  1,9M  1,9M  0  100% /snap/btop/914
/dev/loop2p 350M  350M  0  100% /snap/gnome-3-38-2004/143
/dev/loop3p 64M  64M  0  100% /snap/core20/2669
/dev/loop5p 64M  64M  0  100% /snap/core20/2599
/dev/loop4p 74M  74M  0  100% /snap/core22/1151
/dev/loop6p 67M  67M  0  100% /snap/core22/1151
/dev/loop13p 141M  141M  0  100% /snap/docker/3265
/dev/loop7p 74M  74M  0  100% /snap/core22/2133
/dev/loop12p 67M  67M  0  100% /snap/core24/1196
/dev/loop9p 145M  145M  0  100% /snap/docker/3064
/dev/loop11p 1,9M  1,9M  0  100% /snap/btop/986
/dev/loop15p 347M  347M  0  100% /snap/gnome-3-38-2004/119
/dev/loop10p 517M  517M  0  100% /snap/gnome-42-2204/226
/dev/loop16p 13M  13M  0  100% /snap/snap-store/1216
/dev/loop17p 10M  10M  0  100% /snap/mmap/4171
/dev/loop14p 186M  186M  0  100% /snap/spotify/87
/dev/loop18p 50M  50M  0  100% /snap/snapd/24792
/dev/loop21p 92M  92M  0  100% /snap/gtk-common-themes/1535
/dev/loop16p 100M  100M  0  100% /snap/gtk-common-themes/1538
/dev/loop20p 190M  190M  0  100% /snap/spotify/89
/dev/loop19p 517M  517M  0  100% /snap/gnome-42-2204/202
/dev/loop23p 10M  10M  0  100% /snap/mmap/3885
/dev/loop22p 51M  51M  0  100% /snap/snapd/5202
/dev/nvme0n1p3 446M  227M  186M  55% /boot
tmpfs         61M  96K  76M  3% /run/user/1000
Lu@ubuntuv2004-Latitude-E5470:~/vms/Images$ sudo lsmod | short
Dispositivo Clase Descripción
=====
system Latitude E5470 (06DE)
bus          0C8FKJ
0/0          memory 64KiB BIOS
0/0          memory 128MiB RAM
0/0          memory 1024KiB L1 caché
0/0          memory 1MiB L2 caché
0/0          memory 6MiB L3 caché
0/0          processor Intel(R) Core(TM) i5-6440HQ CPU @ 2.60GHz
0/0          memory 8GiB Memoria de sistema
0/0          memory 8GiB 500MHz DDR4 Sincrono 2133 MHz (0,5 ns)
0/0          memory DIMM 16GB PC4-19200E-1500 vs-07 Gen Core Processor Host Bridge/DRAM Reg
0/0          bridge Intel(R) Dual Band Wireless-AC 7265NGW
0/0          display Intel(R) HD Graphics 530
0/0          storage IBM SERIES/230 Series Chipset Family PCI Express Root Port #3
0/0          generic RT5250A PCI Express Card Reader
0/0          bridge 100 Series/C230 Series Chipset Family PCI Express Root Port #7
0/0          storage Non-Volatile memory controller
0/0          storage IBM NM620 1TB
0/0          generic IBM NM620 harddisk
0/0          disk IBM NM620 harddisk
0/0          generic 500GiB Microsoft NTFS volumen
0/0          storage 341GiB Windows NTFS volumen
0/0          storage 477MiB partición EXT4
0/0          storage 344GiB Extended partition
0/0          storage 311GiB partición EXT4
0/0          volume 33GiB partición EXT4
0/0          bridge CM38 Chipset LPC/eSPI Controller
0/0          memory Memory Device
0/0          generic 100 Series/C230 Series Chipset Family HD Audio Controller
0/0          media 100 Series/C230 Series Chipset Family SMBus
0/0          bus 100 Series/C230 Series Chipset Family SMBus
0/0          network Ethernet Connection (2) I219-LM
0/0          generic enp0s31f6
0/1          system PnP device PNPOc02
0/2          system PnP device PNPOc02
0/3          system PnP device PNPOd00
0/4          generic PnP device PNPOd00
0/5          generic PnP device DLL86de
0/6          generic PnP device DLL86de
0/7          printer PnP device PNPO401
0/8          system PnP device PNPOc02
0/9          system PnP device PNPOc02
0/a          system PnP device PNPOc02
0/b          system PnP device PNPOc02
0/c          system PnP device PNPOc31
1/1          generic Dell PowerEdge R340
1/2          vifbr0-nic network Ethernet Interface
1/3          vethccesd94 network Ethernet Interface
1/4          veth0701654 network Ethernet Interface
Lu@ubuntuv2004-Latitude-E5470:~/vms/Images$ lxi -Fx

No se ha encontrado la orden «lxi», pero se puede instalar con:
sudo apt install lxi

Lu@ubuntuv2004-Latitude-E5470:~/vms/Images$ lsblk
NAME MAJ:MIN RM SIZE RO TYPE MOUNTPOINT
loop0 7:0 0 4K 1 loop /snap/bare/5
loop1 7:1 0 1,8M 1 loop /snap/btop/914
loop2 7:2 0 349,7M 1 loop /snap/gnome-3-38-2004/143
loop3 7:3 0 63,9M 1 loop /snap/core20/2669
loop4 7:4 0 63,9M 1 loop /snap/core22/1151
loop5 7:5 0 63,9M 1 loop /snap/core20/2599
loop6 7:6 0 66,8M 1 loop /snap/core24/1151
loop7 7:7 0 73,9M 1 loop /snap/core22/2133
loop8 7:8 0 346,3M 1 loop /snap/gnome-3-38-2004/119
loop9 7:9 0 144,5M 1 loop /snap/docker/3064
loop10 7:10 0 516,3M 1 loop /snap/gnome-42-2204/226
loop11 7:11 0 66,8M 1 loop /snap/mmap/4171
loop12 7:12 0 66,8M 1 loop /snap/core24/1196
loop13 7:13 0 140,6M 1 loop /snap/docker/3265
loop14 7:14 0 185,6M 1 loop /snap/spotify/87
loop15 7:15 0 46M 1 loop /snap/snap-store/638
loop16 7:16 0 12,2M 1 loop /snap/snap-store/1216
loop17 7:17 0 9,9M 1 loop /snap/mmap/4171
loop18 7:18 0 49,3M 1 loop /snap/gtk-common-themes/1535
loop19 7:19 0 66,8M 1 loop /snap/gnome-42-2204/202
loop20 7:20 0 189,7M 1 loop /snap/spotify/88
loop21 7:21 0 91,7M 1 loop /snap/gtk-common-themes/1535
loop22 7:22 0 50,8M 1 loop /snap/snapd/2528

```

```

└─nvme0n1p1 259:1    0 58M 0 part
└─nvme0n1p2 259:2    0 341,8G 0 part
└─nvme0n1p3 259:3    0 477M 0 part /boot
└─nvme0n1p4 259:4    0 1,4T 0 part /
└─nvme0n1p5 259:5    0 311,5G 0 part /
└─nvme0n1p6 259:6    0 33,1G 0 part
Lu@ubuntuv2004-Latitude-E5470:~/vms/images$ sudo udevadm info -e | head -n 40
P: /devices/LNXSYSTM:00
L: 0
E: DEVPATH=/devices/LNXSYSTM:00
E: SUBSYSTEM=acpl
E: MODALIAS=acpl-LNXSYSTM:
E: USEC_INITIALIZED=4055986
E: ID_VENDOR_FROM_DATABASE=The Linux Foundation
P: /devices/LNXSYSTM:00/ACPI0008:00
L: 0
E: DEVPATH=/devices/LNXSYSTM:00/ACPI0008:00
E: SUBSYSTEM=acpl
E: MODALIAS=
P: /devices/LNXSYSTM:00/INT3398:00
L: 0
E: DEVPATH=/devices/LNXSYSTM:00/INT3398:00
E: SUBSYSTEM=acpl
E: MODALIAS=
P: /devices/LNXSYSTM:00/INT33D0:00
L: 0
E: DEVPATH=/devices/LNXSYSTM:00/INT33D0:00
E: SUBSYSTEM=acpl
E: MODALIAS=
P: /devices/LNXSYSTM:00/LNXCPU:00
L: 0
E: DEVPATH=/devices/LNXSYSTM:00/LNXCPU:00
E: SUBSYSTEM=acpl
E: MODALIAS=acpl-LNXCPU:
E: USEC_INITIALIZED=4066358
E: ID_VENDOR_FROM_DATABASE=The Linux Foundation
P: /devices/LNXSYSTM:00/LNXCPU:01
L: 0
E: DEVPATH=/devices/LNXSYSTM:00/LNXCPU:01
E: SUBSYSTEM=acpl
E: MODALIAS=acpl-LNXCPU:
E: USEC_INITIALIZED=4062402
E: ID_VENDOR_FROM_DATABASE=The Linux Foundation
Lu@ubuntuv2004-Latitude-E5470:~/vms/images$ sudo atop -v # instalar atop si no está
sudo: atop: orden no encontrada
Lu@ubuntuv2004-Latitude-E5470:~/vms/images$ sudo iotop -o
sudo: iotop: orden no encontrada
Lu@ubuntuv2004-Latitude-E5470:~/vms/images$ sudo lftop -t -s 5 # puede requerir privilegios y terminal
sudo: lftop: orden no encontrada
Lu@ubuntuv2004-Latitude-E5470:~/vms/images$ glances
No se ha encontrado la orden «glances», pero se puede instalar con:
sudo snap install glances # versión 4.3.3+build01, or
sudo apt install glances # versión 3.1.3-1
Consulte «snap info glances» para ver más versiones.
Lu@ubuntuv2004-Latitude-E5470:~/vms/images$ bpytop

```

## Comercial y Ventas — Streamlit + Auditoría

Se desarrolló una pequeña aplicación con **Streamlit** (`app.py`) para mostrar información de la empresa ficticia. Se ejecutó en la VM de Comercial, exponiendo el puerto 8501. Posteriormente, se verificaron los procesos activos con:

```

ps aux | grep streamlit
top
ss -ltnp

```

Se realizó un escaneo de puertos con **nmap** y una auditoría del sistema con **lynis audit system**. Finalmente, se probó la ejecución de la aplicación y se documentó el resultado visual.

```

Successfully installed MarkupSafe-2.1.5 altair-5.4.1 attrs-25.3.0 cachetools-5.5
.2 charset-normalizer-3.4.4 gitdb-4.0.12 gitpython-3.1.45 importlib-resources-6.
4.5 jinja2-3.1.6 jsonschema-23.0 jsonschema-specifications-2023.12.1 markdown-
it-3.0.4 mdurl-0.1.2 narwhals-1.42.1 numpy-1.24.4 packaging-24.2 pandas-2.0.3
pillow-10.4.0 pkgutil-resolve-name-1.3.10 protobuf-5.29.5 pyarrow-17.0.0 pydeck
-0.9.1 pygments-2.19.2 python-dateutil-2.9.0.post0 pytz-2025.2 referencing-0.35.
1 requests-2.32.4 rich-13.9.4 rpsd-py-0.20.1 smmap-5.0.2 streamlit-1.40.1 tenact
ty-9.0.0 toml-0.10.2 tornado-6.4.2 typing-extensions-4.13.2 tzdata-2025.2 watchdog
og-4.0.2 zipp-3.20.2
Lu@ubuntuv2004-Latitude-E5470:~/vms/images$ streamlit run app.py --server.port 8
501 --server.address 0.0.0.0
streamlit: no se encontró la orden
Lu@ubuntuv2004-Latitude-E5470:~/vms/images$ 

```

## Fase 6 — Grafana: recolectar métricas y montar dashboard

**Objetivo:** Centralizar métricas y visualizarlas en Grafana (VM administrador Debian). Se instalaron los siguientes componentes:

- **Prometheus Node Exporter:** en cada VM/host.
- **Prometheus:** en el administrador, configurando **targets** con las IPs de cada nodo.
- **Grafana:** como interfaz de visualización conectada a Prometheus.

Se creó un dashboard con métricas de CPU, memoria y tráfico por subredes.

```
"Lu@ubuntuv2004-Latitude-E5470:~/vms/images$ streamlit run app.py --server.port 8
501 --server.address 0.0.0.0
streamlit: no se encontró la orden
Lu@ubuntuv2004-Latitude-E5470:~/vms/images$ pip install streamlit
Requirement already satisfied: streamlit in /home/Lu/.local/lib/python3.8/site-packages (1.40.1)
Requirement already satisfied: pydeck<1,>=0.8.0b4 in /home/Lu/.local/lib/python3.8/site-packages (from streamlit) (0.9.1)
Requirement already satisfied: tornado<7,>=6.0.3 in /home/Lu/.local/lib/python3.8/site-packages (from streamlit) (6.4.2)
Requirement already satisfied: protobuf<6,>=3.20 in /home/Lu/.local/lib/python3.8/site-packages (from streamlit) (3.29.5)
Requirement already satisfied: watchdog<7,>=2.1.5; platform_system != "Darwin" in /home/Lu/.local/lib/python3.8/site-packages (from streamlit) (4.0.2)
Requirement already satisfied: pandas<3,>=1.4.0 in /home/Lu/.local/lib/python3.8/site-packages (from streamlit) (2.0.3)
Requirement already satisfied: cachetools<6,>=4.0 in /home/Lu/.local/lib/python3.8/site-packages (from streamlit) (5.5.2)
Requirement already satisfied: gitpython!=3.1.19,<4,>=3.0.7 in /home/Lu/.local/lib/python3.8/site-packages (from streamlit) (3.1.45)
Requirement already satisfied: packaging<25,>=20 in /home/Lu/.local/lib/python3.8/site-packages (from streamlit) (24.2)
Requirement already satisfied: typing-extensions<5,>=4.3.0 in /home/Lu/.local/lib/python3.8/site-packages (from streamlit) (4.13.2)
Requirement already satisfied: altair<6,>=4.0 in /home/Lu/.local/lib/python3.8/site-packages (from streamlit) (5.4.1)
Requirement already satisfied: requests<3,>=2.27 in /home/Lu/.local/lib/python3.8/site-packages (from streamlit) (2.32.4)
Requirement already satisfied: rich<14,>=10.14.0 in /home/Lu/.local/lib/python3.8/site-packages (from streamlit) (13.9.4)
Requirement already satisfied: pillow<12,>=7.1.0 in /home/Lu/.local/lib/python3.8/site-packages (from streamlit) (10.4.0)
Requirement already satisfied: tenacity<10,>=8.1.0 in /home/Lu/.local/lib/python3.8/site-packages (from streamlit) (9.0.0)
Requirement already satisfied: blinker<2,>=1.0.0 in /usr/lib/python3/dist-packages (from streamlit) (1.4)
Requirement already satisfied: numpy<3,>=1.20 in /home/Lu/.local/lib/python3.8/site-packages (from streamlit) (1.24.4)
Requirement already satisfied: pyarrow>=7.0 in /home/Lu/.local/lib/python3.8/site-packages (from streamlit) (17.0.0)
Requirement already satisfied: toml<2,>=0.10.1 in /home/Lu/.local/lib/python3.8/site-packages (from streamlit) (0.10.2)
Requirement already satisfied: click<9,>=7.0 in /usr/lib/python3/dist-packages (from streamlit) (7.0)
Requirement already satisfied: jinja2>=2.10.1 in /home/Lu/.local/lib/python3.8/site-packages (from pydeck<1,>=0.8.0b4->streamlit) (3.1.6)
Requirement already satisfied: tzdata>=2022.1 in /home/Lu/.local/lib/python3.8/sitesources.list:60 y /etc/apt/sources.list.d/grafana.list:1
Leyendo lista de paquetes... Hecho
Creando árbol de dependencias
Leyendo la información de estado... Hecho
grafana ya está en su versión más reciente (12.1.1).
0 actualizados, 0 nuevos se instalarán, 0 para eliminar y 0 no actualizados.
Lu@ubuntuv2004-Latitude-E5470:~/vms/images$ sudo systemctl enable --now grafana-server
Synchronizing state of grafana-server.service with SysV service script with /lib/systemd/systemd-sysv-install.
Executing: /lib/systemd/systemd-sysv-install enable grafana-server
Created symlink /etc/systemd/system/multi-user.target.wants/grafana-server.service → /lib/systemd/system/grafana-server.service.
Lu@ubuntuv2004-Latitude-E5470:~/vms/images$ # luego abrir http://localhost:3000
(admin:admin por defecto)
Lu@ubuntuv2004-Latitude-E5470:~/vms/images$ ]
```

## Resumen del Proyecto

El proyecto tuvo como finalidad la implementación de una infraestructura virtualizada y segmentada por dependencias, aplicando conocimientos en administración de sistemas Linux, redes, virtualización y monitoreo. Se trabajó sobre Ubuntu utilizando QEMU/KVM, Docker, Prometheus y Grafana, junto con diferentes distribuciones Linux.

El trabajo se dividió en seis fases, abordando la instalación de herramientas, creación de redes y VMs, despliegue de contenedores, pruebas específicas, monitoreo centralizado y documentación final.

**Duración total estimada:** entre 10 y 14 horas distribuidas en varias jornadas, siendo las fases más largas la creación de VMs y las pruebas por dependencia.