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NETWORK ADMINISTRATION · DUT S3 · PRACTICAL SESSION 01

Build srv1 and client1: two Fedora Server VMs on a private lab network

In this session you build the lab used for the whole module. You install a Fedora Server virtual machine, practise the commands from Masterclass 01, give the server a fixed address, clone it into a second machine, then administer the server remotely from your own laptop with SSH and Cockpit. The session ends with a troubleshooting challenge in pairs.

BY THE END OF THE SESSION YOU WILL HAVE

- **srv1**: Fedora Server 44, updated, with two network cards (NAT for the Internet, `labnet` for the lab) and the fixed address `192.168.50.1/24`
- **client1**: a clone of srv1 on `labnet` only, with the temporary address `192.168.50.10/24`
- A successful `ping` in both directions, and a snapshot of each VM
- SSH access from your laptop to srv1 with a key instead of a password, and the Cockpit web console

BEFORE YOU COME

- A laptop with at least 8 GB of RAM and 40 GB of free disk space
- Oracle VirtualBox 7.2 installed (current release on 22 Sep 2026: 7.2.20)
- The Fedora Server 44 **DVD ISO** for x86_64, downloaded from `fedoraproject.org/server/download`
- Your notes from Masterclass 01

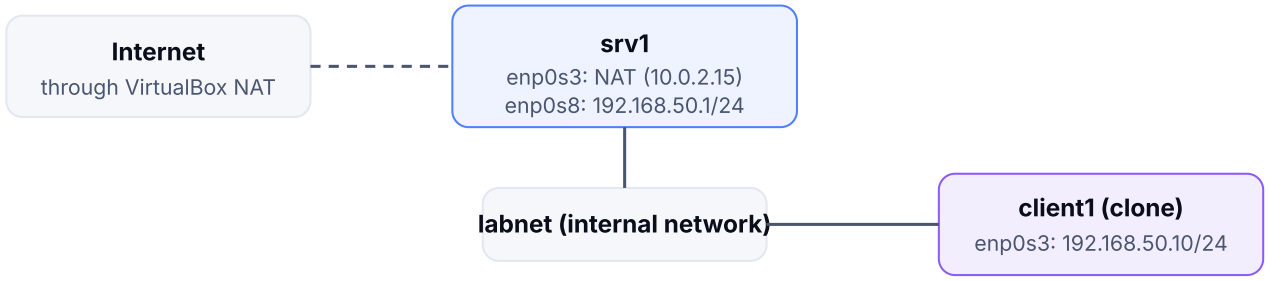
Duration	4 hours, in class, including a 15-minute break. Work alone, except in Part 9 (pairs). Help your neighbour when you finish a part.
Deliverable	The answers to the **questions** (violet boxes) and the output of each **checkpoint** command (green boxes), in one PDF report. Show each checkpoint to the teacher during the session. The submission deadline is announced in class.
Conventions	`$` at the start of a line means "type this command" (do not type the `$`). Lines starting with `#` are comments. `sudo` asks for **your own** password; nothing is shown while you type it.

Time	Part	Content
0:00	0	Check VirtualBox and the ISO
0:10	1	Create srv1 and install Fedora Server
0:45	2	First commands, name and updates
1:10	3	Files, users, permissions, finding information
1:40	4	Packages and services
1:55		**Break (15 min)**
2:10	5	The network: NAT and a fixed address on labnet
2:30	6	client1: clone, configure, test
2:55	7	SSH from your laptop: password, then key
3:20	8	The Cockpit web console
3:35	9	Troubleshooting challenge in pairs
3:55		Shut down, snapshots, what to hand in

APPLE SILICON MAC (M1 TO M4)?

These Macs need the **aarch64** image of Fedora Server, and VirtualBox support for them is limited. Use UTM with the aarch64 ISO, or pair with a classmate who has an Intel or AMD laptop, and tell the teacher at the start of the session. All commands are the same; only interface names may differ.

THE LAB AT THE END OF TODAY



Interface names are the usual ones in VirtualBox. Always check the real names on your VM with `ip -br address`.

Part 0 Check your laptop and the ISO

10 min

1. Open VirtualBox and check its version in **Help ▸ About VirtualBox**. It should be 7.2.x. If you have an older version, tell the teacher; most steps still work.

2 Check that the ISO file is complete and authentic. The Fedora download page offers a **CHECKSUM** file next to the ISO. Compute the SHA-256 checksum of your ISO and compare it with the line for your file name:

USE THE COMMAND FOR YOUR LAPTOP'S SYSTEM

```
# Linux
$ sha256sum Fedora-Server-dvd-x86_64-44-*.iso
# macOS
$ shasum -a 256 Fedora-Server-dvd-x86_64-44-*.iso
# Windows (PowerShell, in the folder of the ISO)
PS> Get-FileHash .\Fedora-Server-dvd-x86_64-44-*.iso -Algorithm SHA256
```

If the two values differ, the download is damaged: download it again before going further.

QUESTION 1

Why is a checksum useful even when the download finished without any error message?

Part 1 Create srv1 and install Fedora Server

35 min

1.1 Create the virtual machine

In VirtualBox, click **New** and use these settings. If VirtualBox offers an **unattended installation**, do not use it: we want to see every step of the installer.

Setting	Value	Why
Name	`srv1`	The name you will see in VirtualBox
ISO image	Fedora-Server-dvd-x86_64-44	The installation DVD, inserted in the virtual drive
Type / version	Linux / Fedora (64-bit)	Lets VirtualBox choose suitable virtual hardware
Processors	2	Enough for a text-only server
Memory	2048 MB (4096 MB if you have 16 GB or more)	Fedora Server has no desktop, so 2 GB is enough
Hard disk	20 GB, dynamically allocated	The file grows only as space is used

1.2 Configure the two network cards

Before starting the VM, open **Settings ▸ Network**:

Card	Attached to	Role
Adapter 1	NAT	Internet access, to install and update packages
Adapter 2	Internal Network, name `labnet`	The private lab network, shared only with our other VMs

SPELLING MATTERS

Type `labnet` in lower case, exactly like this, on every VM. `Labnet` or `lab-net` would create a different, separate network. Never use **Bridged Adapter** in this module: in the DHCP session, your server would answer real machines on the campus network.

1.3 Install Fedora Server

1. Start srv1 and choose **Install Fedora 44** in the boot menu. The installer (Anaconda) starts.
2. Language: English is recommended, so that error messages match the documentation. Keyboard: choose your real layout (usually **French AZERTY**); this is the most common cause of "wrong password" problems later.
3. Time zone: **Africa/Casablanca**.
4. Installation destination: select the 20 GB disk and keep **automatic** partitioning.
5. User creation: create the account `admin` with a password you will remember, and tick the option that makes this user an **administrator** (it adds the user to the `wheel` group, which may use `sudo`). The root account can stay disabled.
6. Begin the installation. When it finishes, click **Reboot**. If the VM boots the installer again, remove the ISO in **Settings ▸ Storage** and restart.

After the reboot you see a text login prompt, not a desktop. This is normal for a server. Log in as `admin`.

CHECKPOINT 1

- [ ] You are logged in on srv1 and the prompt looks like `[admin@localhost ~]$` (or similar).

Part 2 First commands, name and updates

25 min

2.1 Identify the machine

BASH · SRV1

```
$ whoami
$ hostnamectl
$ cat /etc/os-release
$ ip -br address
```

QUESTIONS 2 TO 4

2. Which Fedora version and which kernel version are installed? Give the line and the command where you found each.
3. List the network interfaces shown by `ip -br address`. Which one has an IPv4 address, which address, and why does the other one have none?
4. What do the parts of the prompt `[admin@localhost ~]$` mean? What would change if you were root?

2.2 Give the server its name

BASH · SRV1

```
$ sudo hostnamectl set-hostname srv1.lab.internal
$ hostnamectl
```

The prompt shows the new name after your next login (type `exit`, then log in again). We use the `.internal` domain because it is reserved for private networks and will never exist on the Internet.

2.3 Update the system

BASH · SRV1

```
$ sudo dnf upgrade --refresh
# answer y when dnf asks for confirmation; this can take several minutes
$ sudo reboot
```

While the update runs, read Part 3. After the reboot, shut the VM down cleanly with `sudo poweroff` and take a snapshot in VirtualBox (**Snapshots ▸ Take**) named **clean install**. Start srv1 again.

CHECKPOINT 2

- ☐ The prompt shows `srv1`.
- ☐ The update is finished.
- ☐ The snapshot **clean install** exists.

Part 3 Files, users and permissions

30 min

3.1 Move around and handle files

BASH · SRV1

```
$ pwd
$ cd /etc
$ ls -l hostname hosts
$ cd ~
$ mkdir backups
$ cp /etc/hosts backups/hosts.bak
$ ls -l backups
$ nano backups/hosts.bak      # add a comment line starting with #, save with Ctrl+O, quit
with Ctrl+X
$ cat backups/hosts.bak
```

QUESTIONS 5 TO 7

5. What is the absolute path of your home directory? Which command shows it, and which symbol stands for it?
6. Explain each part of the permissions `-rw-r--r--` shown for `/etc/hostname`. Who is the owner?
7. Try `nano /etc/hostname` **without** sudo, change nothing, and try to save. What message do you get, and why? (Quit without saving.)

3.2 Create a second administrator

BASH · SRV1

```
$ sudo useradd -m -G wheel student1
$ sudo passwd student1
$ id student1
$ getent passwd student1
$ ls -ld /home/student1
```

QUESTION 8

What does the option `-m` do, and what does `-G wheel` allow student1 to do? Prove your answer for `-G wheel` with one command run as student1 (log in as student1 with `su - student1`, then `exit`).

3.3 Find information on the system

On a server you rarely know where everything is. These commands help you search instead of guessing.

BASH · SRV1

```
$ grep -w 22 /etc/services            # which service uses port 22?
$ grep -w -e 67 -e 68 -e 53 /etc/services
$ ls -l /etc | wc -l                   # | sends the output of ls to wc
$ ls /var/log
$ journalctl -b | less                 # everything logged since boot, q to quit
$ history | tail -n 15
$ man ls                               # / searches, n jumps to the next match, q quits
```

QUESTIONS 9 AND 10

9. Which services use ports 53, 67 and 68, and with which transport protocols? Give the command you used.
10. In the manual of `ls`, find the option that sorts files by modification time, newest first. Use it on `/etc` and give the name of the most recently modified file.

Part 4 Packages and services

15 min

BASH · SRV1

```
$ dnf search tcpdump
$ sudo dnf install tcpdump
$ systemctl status sshd          # press q to leave
$ systemctl is-enabled sshd
$ sudo firewall-cmd --list-all
$ journalctl -u sshd --since today
```

We install `tcpdump` now because the DHCP practical uses it to watch packets.

QUESTIONS 11 AND 12

11. Is the SSH service running? Will it start again after a reboot? Copy the two words from the output that prove each answer.
12. Which services does the firewall allow in its active zone?

BREAK · 15 MINUTES

Before the break, shut srv1 down with `sudo poweroff` if the update has finished, so that nothing is lost if your laptop goes to sleep.

Part 5 The network: NAT and a fixed address

20 min

5.1 Look before you change anything

BASH · SRV1

```
$ ip -br address
$ ip route
$ nmcli device status
$ nmcli connection show
$ ping -c 3 fedoraproject.org
```

QUESTION 13

What is the default gateway of srv1, and through which interface does it go? Which VirtualBox card does this interface correspond to?

5.2 Give enp0s8 a fixed address

Check first that your second card is really called `enp0s8`; if not, use its real name in the commands.

BASH · SRV1 · NMCLI

```
$ sudo nmcli connection add type ethernet \
      ifname enp0s8 con-name labnet \
      ipv4.method manual \
      ipv4.addresses 192.168.50.1/24 \
      ipv6.method disabled
$ sudo nmcli connection up labnet
$ ip -br address show enp0s8
$ nmcli connection show labnet | grep ipv4
$ ping -c 3 fedoraproject.org      # the Internet must still work
```

DO NOT ADD A GATEWAY ON LABNET

srv1 already has its default gateway through the NAT card. A second default gateway on labnet would break Internet access. A host has one default gateway.

QUESTION 14

Run `sudo ls /etc/NetworkManager/system-connections/`. Which file stores your new settings, and why can it survive a reboot?

CHECKPOINT 3

☐ `ip -br address show enp0s8` shows `UP` and `192.168.50.1/24`. ☐ `ping -c 3 fedoraproject.org` still works.
Shut srv1 down (`sudo poweroff`) and take a snapshot named **srv1 network ok**.

Part 6 client1: clone, configure, test

25 min

6.1 Clone srv1

1. srv1 must be powered off. Right-click srv1 ▸ **Clone**. Name: `client1`. Clone type: **Full clone**. MAC address policy: **Generate new MAC addresses for all network adapters**.

2. In the settings of **client1** only: Adapter 1 ▸ **Internal Network**, name `labnet`. Adapter 2 ▸ untick **Enable Network Adapter**. client1 has no Internet access, by design.
3. Start client1 and log in as `admin` (same password as srv1: it is a copy).

6.2 Make client1 a different machine

A clone is an exact copy, including the name and the machine ID that some network software uses to identify the host. Change both, and remove the labnet settings copied from srv1:

BASH · CLIENT1

```
$ sudo hostnamectl set-hostname client1.lab.internal
$ sudo rm /etc/machine-id
$ sudo systemd-machine-id-setup
$ sudo nmcli connection delete labnet
$ sudo reboot
```

6.3 A temporary fixed address on labnet

After the reboot, check the interface name: on client1 the labnet card is now the first card, usually `enp0s3`. In the DHCP practical this address will be replaced by an automatic one.

BASH · CLIENT1

```
$ ip -br address
$ sudo nmcli connection add type ethernet \
      ifname enp0s3 con-name labnet \
      ipv4.method manual ipv4.addresses 192.168.50.10/24
$ sudo nmcli connection up labnet
$ ping -c 3 192.168.50.1          # client1 to srv1
```

Start srv1 again and test the other direction from srv1: `ping -c 3 192.168.50.10`.

CHECKPOINT 4

☐ client1 pings srv1 and srv1 pings client1, with 0% packet loss. ☐ Snapshot of client1 named **client1 network ok**.

QUESTIONS 15 AND 16

15. Can client1 ping `fedoraproject.org` ? Explain why, using the VirtualBox network modes.
16. Why did we generate new MAC addresses when cloning? What problem would two VMs with the same MAC address cause on labnet?

Part 7 SSH from your laptop

25 min

Real servers are rarely administered from their own screen. You log in remotely with SSH (TCP port 22). srv1's NAT card hides it from your laptop, so we ask VirtualBox to forward a port of the laptop to port 22 of srv1.

7.1 Forward a port

srv1 can stay running. In VirtualBox: srv1 ▸ **Settings** ▸ **Network** ▸ **Adapter 1 (NAT)** ▸ **Port Forwarding**, then add these two rules (the second one is for Part 8):

Name	Protocol	Host IP	Host port	Guest IP	Guest port
ssh	TCP	127.0.0.1	2222	(empty)	22
cockpit	TCP	127.0.0.1	9090	(empty)	9090

Host IP 127.0.0.1 means that only your own laptop can use these ports, not other machines on the campus Wi-Fi.

7.2 Log in with a password

Open a terminal **on your laptop** (Terminal on macOS and Linux, PowerShell on Windows 10 and 11, which include the OpenSSH client):

YOUR LAPTOP

```
$ ssh -p 2222 admin@127.0.0.1
# the first time, ssh shows the server's key fingerprint and asks yes/no
```

Before answering `yes`, check that the fingerprint really belongs to srv1. On srv1's own screen:

BASH · SRV1

```
$ ssh-keygen -lf /etc/ssh/ssh_host_ed25519_key.pub
```

If the two fingerprints match, type `yes`, then your password. You are now working on srv1 from your laptop: run `hostnamectl` to be sure.

7.3 Log in with a key instead of a password

YOUR LAPTOP · NOT INSIDE THE SSH SESSION

```
$ ssh-keygen -t ed25519            # press Enter to accept the default file; choose a
passphrase
# macOS and Linux
$ ssh-copy-id -p 2222 admin@127.0.0.1
# Windows PowerShell (ssh-copy-id does not exist there): one line
PS> type $env:USERPROFILE\.ssh\id_ed25519.pub | ssh -p 2222 admin@127.0.0.1 "mkdir -p ~/.ssh
&& chmod 700 ~/.ssh && cat >> ~/.ssh/authorized_keys && chmod 600 ~/.ssh/authorized_keys"
$ ssh -p 2222 admin@127.0.0.1      # now asks for the key's passphrase, not admin's password
```

Copy a file from your laptop to srv1 with the same connection, then check it on srv1:

YOUR LAPTOP

```
$ scp -P 2222 somefile.txt admin@127.0.0.1:      # capital -P for scp
```

CHECKPOINT 5

- ☐ From your laptop, `ssh -p 2222 admin@127.0.0.1` logs in with your key.
- ☐ The copied file is in admin's home directory on srv1.

QUESTIONS 17 AND 18

17. Why does SSH ask you to confirm the server's fingerprint the first time? What attack does this check protect against?
18. With key authentication, which file stays secret on your laptop, and which file was copied to srv1? Which of the two may you safely give to someone else?

Part 8 The Cockpit web console

15 min

Cockpit is a web interface for administering a Linux server. It is installed by default on Fedora Server and listens on TCP port 9090.

BASH · SRV1 (OR THROUGH YOUR SSH SESSION)

```
$ sudo systemctl enable --now cockpit.socket
$ systemctl status cockpit.socket
$ sudo firewall-cmd --list-services       # cockpit should be in the list
```

1. On your laptop, open a browser at `https://127.0.0.1:9090` (the port forwarding rule from Part 7.1). The browser warns about the certificate: Cockpit made its own self-signed certificate. In this lab, accept the warning and continue.
2. Log in as `admin`. Tick **administrative access** if Cockpit asks, so that you can change settings.
3. Find, without typing any command: the hostname, the Fedora version, the `labnet` connection and its address (**Networking**), the state of `sshd` (**Services**), and the last messages of the `sshd` service (**Logs**).

CHECKPOINT 6

- [ ] Screenshot of the Cockpit **Networking** page showing `192.168.50.1/24` on enp0s8.

QUESTIONS 19 AND 20

19. In the Cockpit logs of `sshd`, find the line that records your SSH login from Part 7. Which address does srv1 see as the source of the connection, and why is it not your laptop's Wi-Fi address?
20. Give one advantage of Cockpit and one reason why this module still asks you to work mainly on the command line.

Part 9 Troubleshooting challenge in pairs

20 min

Take a snapshot of client1 first (**before challenge**). Then work with your neighbour: student A creates **one** fault on their own client1 while student B looks away, then B sits at A's laptop and finds the fault **using commands only** (no VirtualBox settings window, until the cause is found). Then swap roles with another fault.

#	Fault to create (student A)	How to undo it
a	In VirtualBox, rename client1's internal network to `Labnet`	Rename it back to `labnet`
b	`sudo nmcli connection down labnet`	`sudo nmcli connection up labnet`
c	`sudo nmcli connection modify labnet ipv4.addresses 192.168.51.10/24`, then `up`	Same command with `192.168.50.10/24`, then `up`
d	In VirtualBox, untick **Cable Connected** in the advanced settings of client1's adapter	Tick it again

Student B starts from the symptom (`ping -c 3 192.168.50.1` fails) and uses `ip -br address`, `ip route`, `nmcli device status` and `nmcli connection show`. If you are stuck, restore the snapshot **before challenge**.

QUESTION 21

For each fault you diagnosed, write a short table: the symptom, the commands you ran and what they showed, the cause, and the fix. Which faults could you identify from inside client1, and which one could you only suspect?

If something goes wrong

Symptom	Likely cause	What to do
The VM does not start: "VT-x/AMD-V is not available" or similar	Virtualization is disabled in the laptop's firmware, or used by Hyper-V on Windows	Enable Intel VT-x / AMD-V (SVM) in the BIOS/UEFI; ask the teacher about Hyper-V
The installer starts again after installation	The ISO is still in the virtual drive	Settings ▸ Storage: remove the ISO, then restart
"Login incorrect" with the right password	Keyboard layout (AZERTY vs QWERTY)	Type the password in the user field to see what the keyboard produces
`ping fedoraproject.org` fails on srv1	Adapter 1 is not NAT, or a gateway was added on labnet	Check VirtualBox settings; `ip route` must show one default route via 10.0.2.2
client1 cannot ping srv1	Different internal network names, or a connection not activated	Compare `labnet` spelling on both VMs; run `ip -br address` on both
`Error: unknown connection 'labnet'`	The connection was never created, or its name is misspelt	`nmcli connection show` lists the real names
`ssh`: "Connection refused" on port 2222	Port forwarding rule missing or on the wrong adapter	Check Adapter 1 (NAT) ▸ Port Forwarding; srv1 must be running
ssh still asks for the password after copying the key	Wrong permissions on `~/.ssh` on srv1	On srv1: `chmod 700 ~/.ssh`, `chmod 600 ~/.ssh/authorized_keys`, `restorecon -R ~/.ssh`
"Permission denied"	The command changes the system and needs root rights	Run it again with `sudo` in front

Before you leave

- Shut both VMs down with `sudo poweroff` (do not close the window: that is like pulling the power cable).
- Keep both VMs and their snapshots: the next practical (DHCP) starts from them. You can remove the port forwarding rules or keep them; they are useful for the next sessions. srv1 will become the DHCP server, and client1 will switch to an automatic address.
- Your report contains the answers to questions 1 to 21, the output of each checkpoint command (checkpoints 1 to 6) and your challenge table, with your name and group on the first page.

References: Fedora Project, Download Fedora Server 44 (released 28 April 2026); Oracle VirtualBox 7.2 User Guide, Virtual Networking (NAT port forwarding); NetworkManager, nmcli reference manual; OpenSSH manual pages (ssh, ssh-keygen, scp); Cockpit Project, Running Cockpit; Masterclass 01 slides of this module.