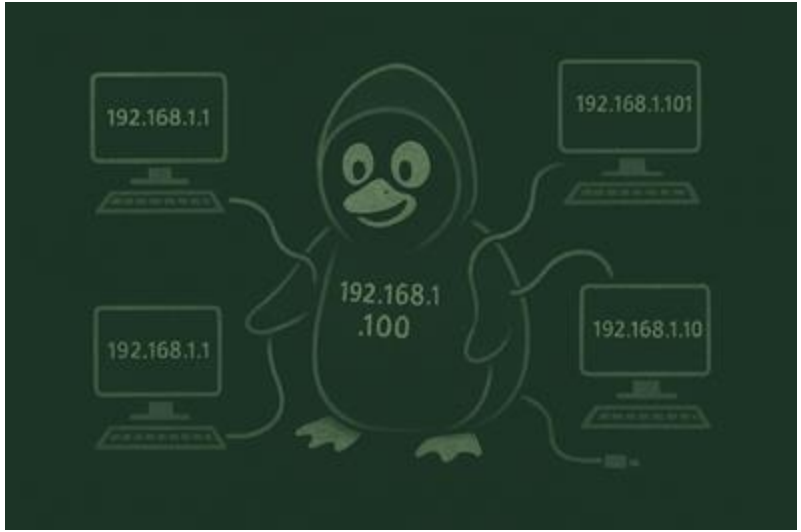
Operating System fundamentals

More about networks



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Course text

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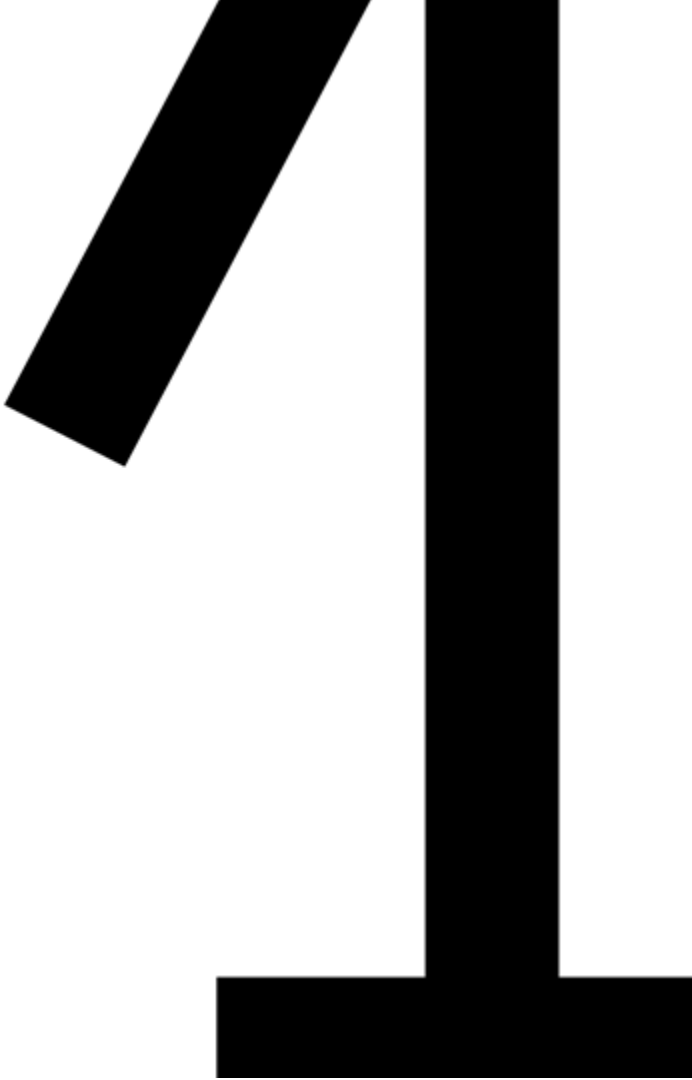
  - More networking
    - Identify and read Network Interface information
    - Manage network configuration on linux
    - DNS and hosts file
    - Networking with virtual machines
    - Basic firewall configuration
    - Other useful networking commands

Recap



Recap

- every network adapter gets an IP address
  - 2 versions
- IP addresses can be found through a DNS server
- the command "**ip a**" (short for "**ip address show**") shows all adapters and their information
- servers run services who listen to certain ports (22=ssh, 80=http, 443=https, …)
- you can check if a server is active with **ping**
- you can make a connection with a server with **ssh**

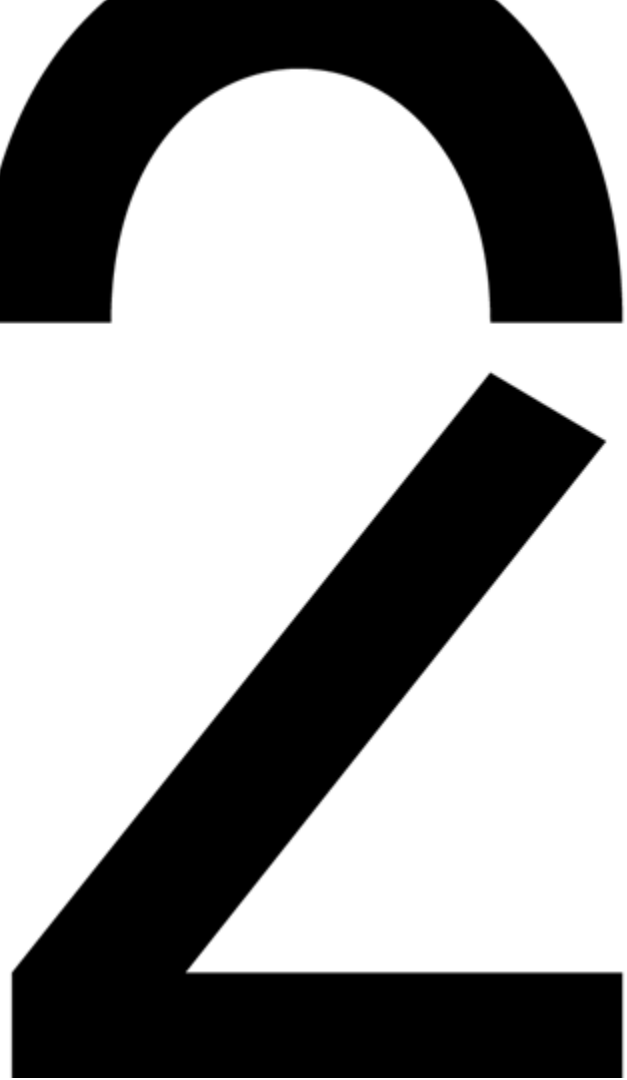
Network information

- Every network connection is called a link in Linux
- They get a name
  - ethernet adapters: start with “eth” of “en”
  - wireless adapters (wifi): start with “wl”, “wlan”
  - wireless WAN adapters (4G, G5): start with “ww”
  - de loopback adapter: starts with “lo”
  - VPN links: start with “tun”
- Links also have:
  - a MAC address
  - at least one IP address (when active)
  - a network mask
  - a default gateway
  - a DNS server address

Network information

```
[linus@vbox:~]$ ip address show
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default
qlen 1000
  link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
  inet 127.0.0.1/8 scope host lo
  valid_lft forever preferred_lft forever
2: enp0s3: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc fq_codel state DOWN
group default qlen 1000
  link/ether 84:69:93:6b:98:e9 brd ff:ff:ff:ff:ff:ff
3: wwan0: <POINTOPOINT,NOARP> mtu 1500 qdisc noop state DOWN group default qlen
1000
  link/none
4: wlp0s2: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP
group default qlen 1000
  link/ether 08:8e:90:09:fa:0b brd ff:ff:ff:ff:ff:ff
  inet 192.168.0.184/24 brd 192.168.0.255 scope global dynamic noprefixroute
wlp0s20f3
  valid_lft 3023sec preferred_lft 3023sec
  inet6 2a02:1810:3f97:6000:628b:e1bf:74ad:b659/64 scope global temporary
dynamic
  valid_lft 215980sec preferred_lft 19840sec
5: Tun1: <POINTOPOINT,MULTICAST,NOARP,UP,LOWER_UP> mtu 1412 qdisc fq_codel state
DOWN mode DEFAULT group default qlen 500
  link/non
```

Network configuration on Linux



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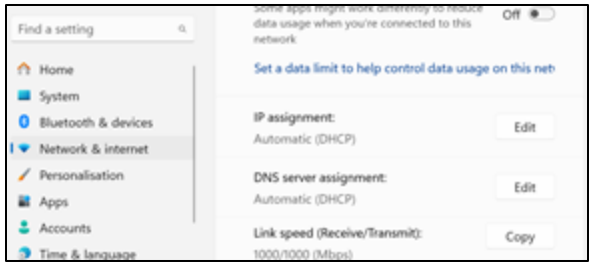
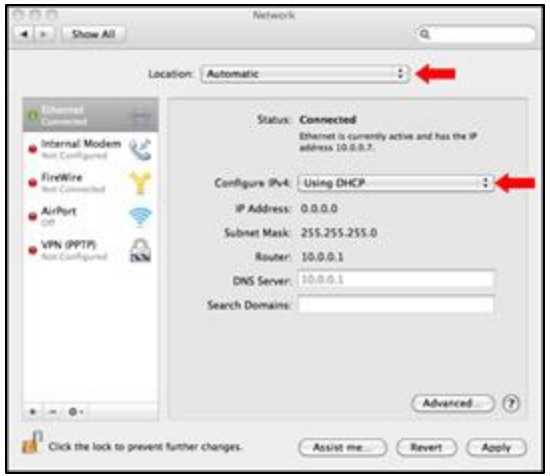
DHCP

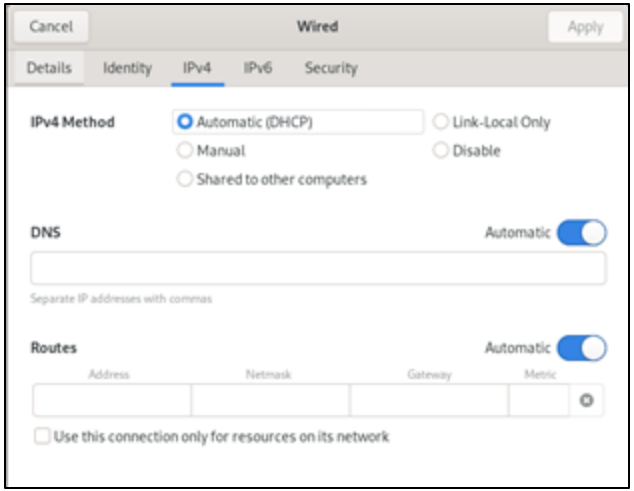
- You can assign a fixed IP number to a link but in most cases it is assigned a number by a DHCP server
- The DHCP server is built in a lot of network equipment (like a router)
- DHCP is supported by most systems (not exclusively Linux)

Network configuration via GUI

- example GUI configuration in Windows, Linux, MacOS

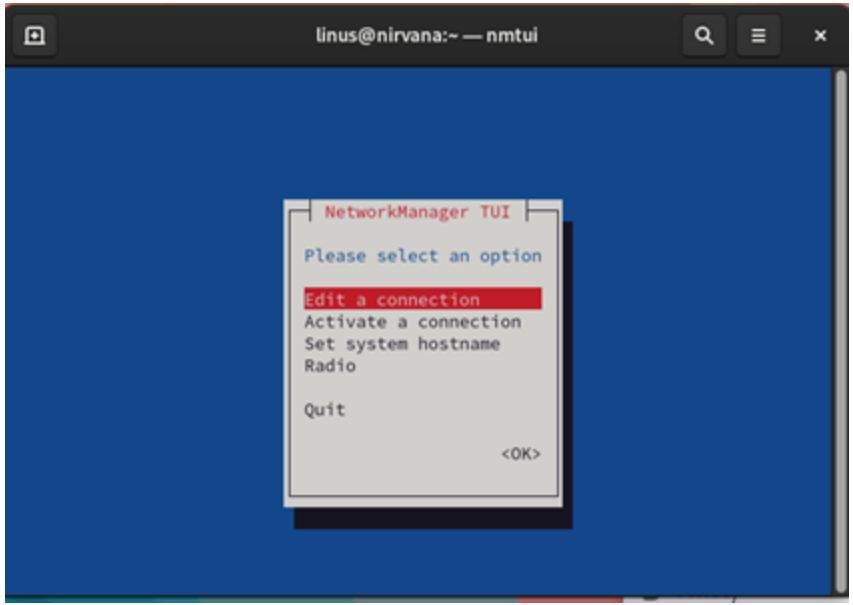






Network configuration via the command line

- You can get a semi-graphical interface in a text terminal with **nmtui**:



Netwerk configuration via the command line

- If you want to configure a network through a script, you can use the **nmcli** command
- **nmcli** -> shows all links with info
- **nmcli con show** -> shows short list of links
- **nmcli con up** <naam> -> activates link
- **nmcli con down** <naam>-> de-activates link
- nmcli con add -> adds a new link
- nmcli con del -> removes a link

Network configuration via files

- All network information can be found in
  /etc/NetworkManager/system-connections
- Take a look at: /etc/NetworkManager/system-connections/enp0s3.nmconnection
- If you change these files, you need to reload the configuration with "**nmcli con reload**" and re-activate the link with "**nmcli con up** name"

DNS and hosts file

DNS

- DNS servers allow to use a name in stead of an IP number

  ping www.kdg.be -> ping 185.135.13.159

- You can find a list of DNS servers in **/etc/resolv.conf**
- You can add your own names in these files:
  - **/etc/hosts** (Linux en MacOS)
  - C:\Windows\System32\drivers\etc\hosts (Windows)
  - e.g.: “10.134.176.151 inf101”
  - e.g.: “10.134.176.155 inf105”

Looking up IP addresses

- You can use **nslookup** to find an IP address
- example:

```
[user@server ~]$ nslookup www.kdg.be
Server:             10.0.2.3
Address:     10.0.2.3#53

Non-authoritative answer:
Name:  www.kdg.be
Address: 185.135.13.159
Name:  www.kdg.be
Address: 2a06:efc0:0:102::94
[user@server ~]$
```

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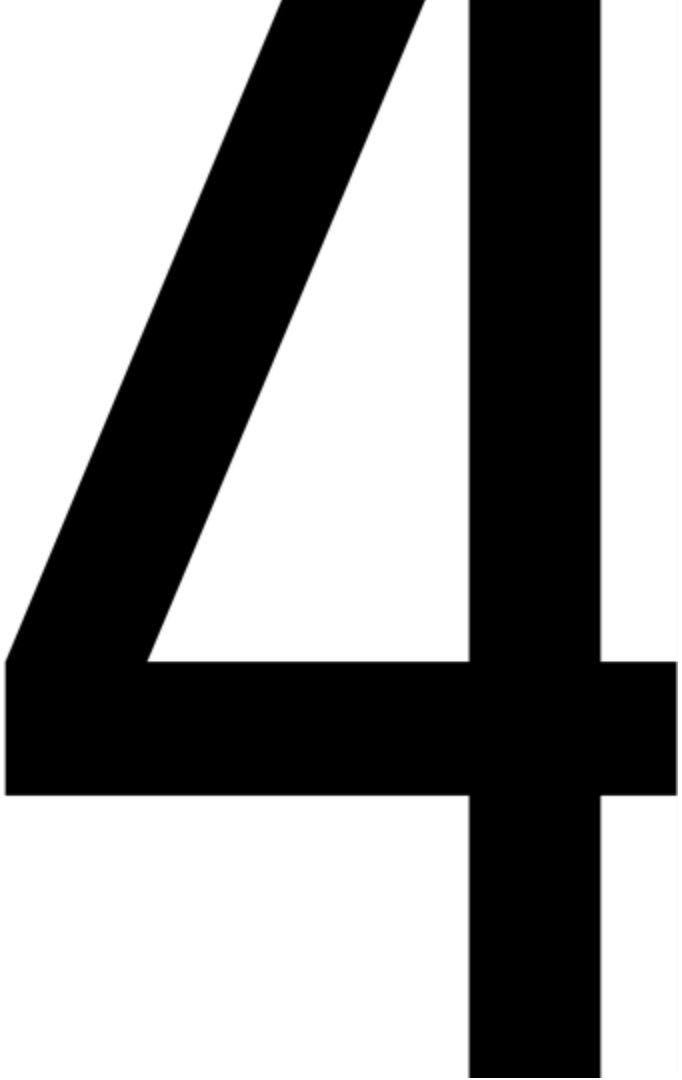
Networking with virtual machines



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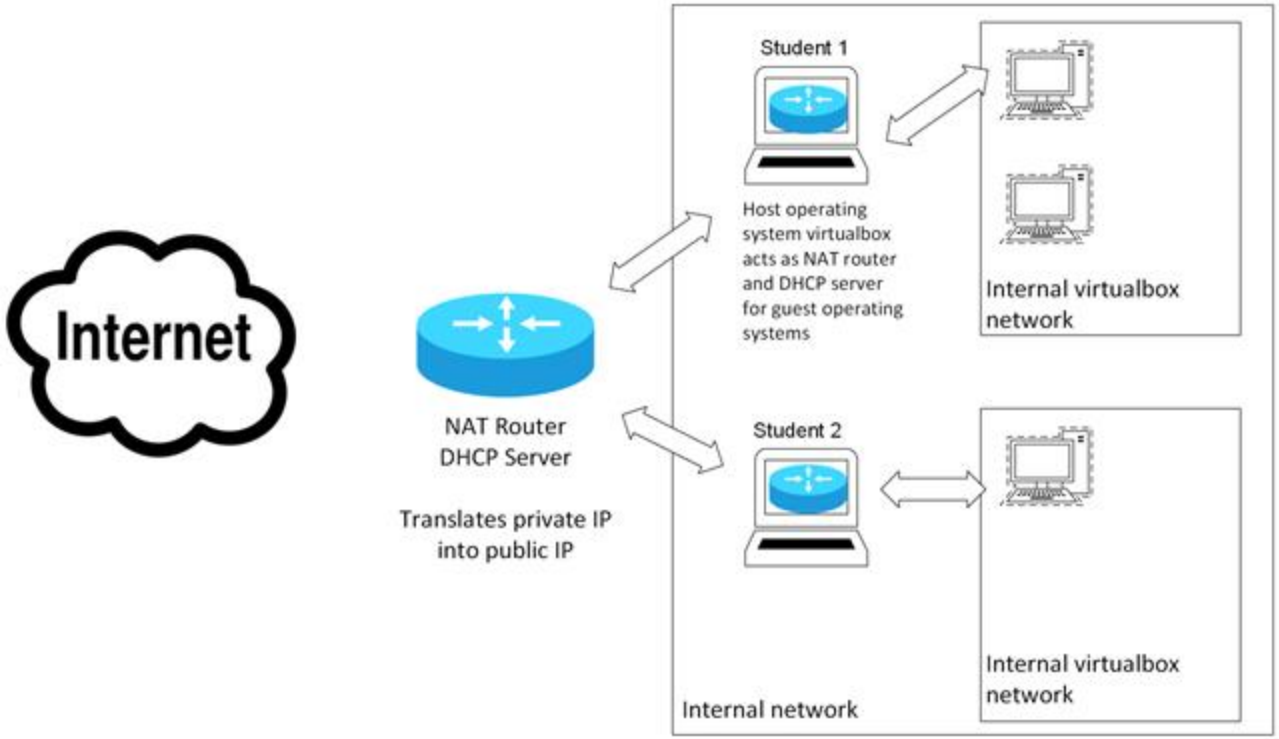
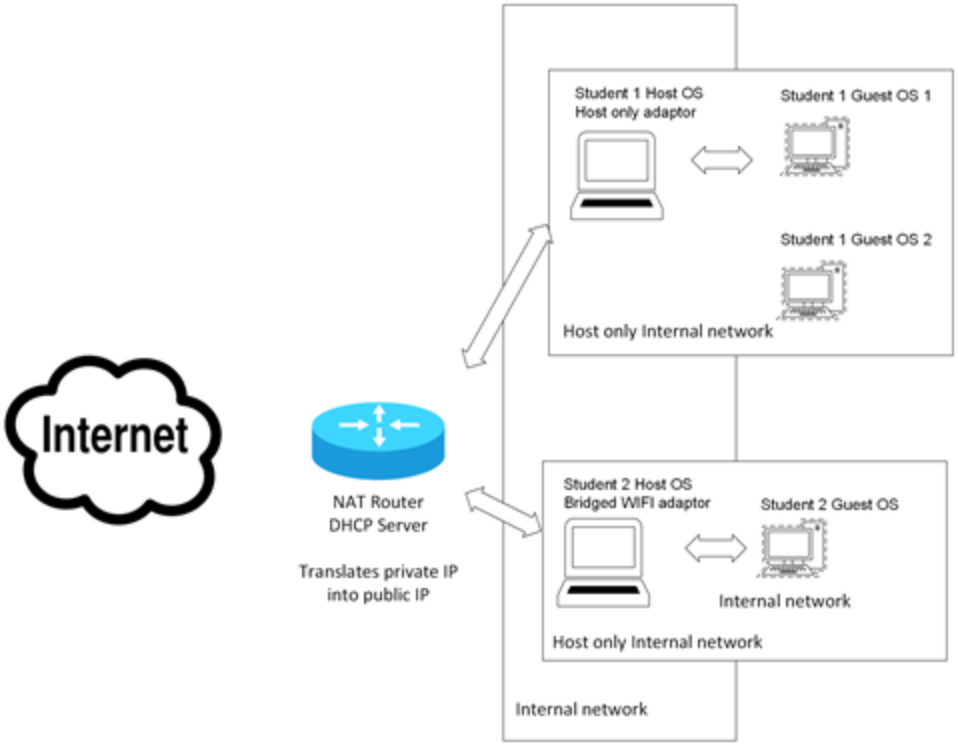
Virtual networks

- A hypervisor (like VirtualBox) also creates a virtual network
- the VM's are connected through a "wired" connection
- there are different modes for the connections:
  - NAT
  - host only
  - bridged
  - …

NAT


Internet
NAT Router
DHCP Server
Translates private IP
into public IP
Student 1
Host operating
system virtualbox
acts as NAT router
and DHCP server
for guest operating
systems
Internal virtualbox
network
Student 2
Internal virtualbox
network
Internal network

Host only


Internet
NAT Router
DHCP Server
Translates private IP
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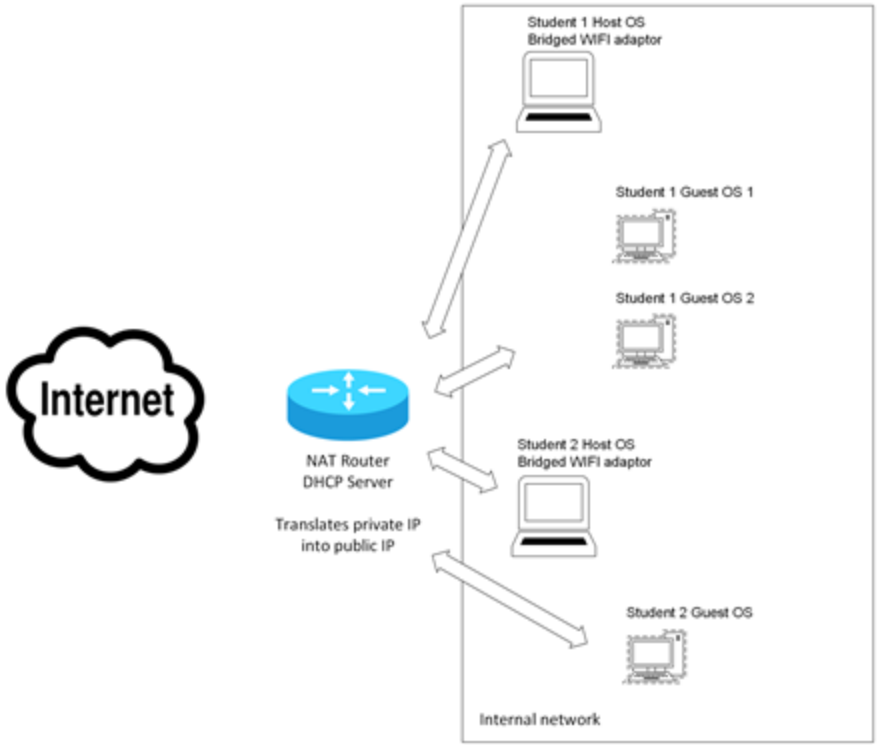
Student 1 Host OS
Host only adaptor
Student 1 Guest OS 1
Student 1 Guest OS 2
Host only Internal network
Student 2 Host OS
Bridged WIFI adaptor
Student 2 Guest OS
Internal network
Host only Internal network
Internal network

Bridged


Internet
NAT Router
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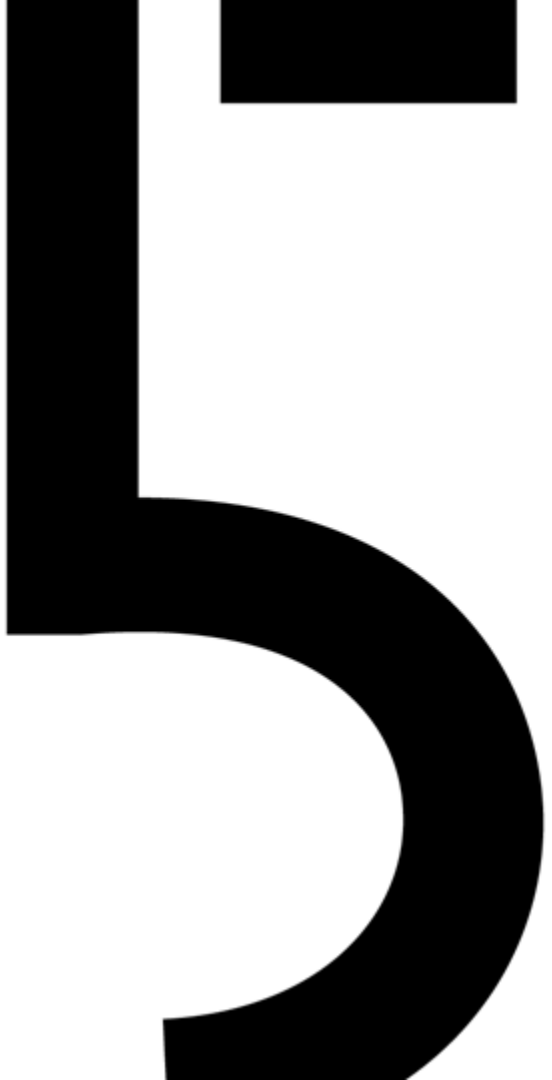
Student 1 Host OS
Bridged WIFI adaptor
Student 1 Guest OS 1
Student 1 Guest OS 2
Student 2 Host OS
Bridged WIFI adaptor
Student 2 Guest OS
Internal network

Basic firewall configuration



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Firewall

- A firewall can be used to block or let through data through certain ports on your computer
- you can query and configure the state of the firewall with "**firewall-cmd**":
  - show firewall state: sudo **firewall-cmd --state**
  - show information: sudo **firewall-cmd --list-all**
  - add a service:
    - sudo **firewall-cmd --add-service**=http --permanent
    - sudo **firewall-cmd --add-port**=80/tcp --permanent
  - restart service: sudo **firewall-cmd --reload**

Exercise

- Show the information of your firewall
- What is that “cockpit”?
- Can you turn it on?
- Use a browser and go to http://localhost:9090

Other interesting commands

Extra commands

- **ss -tuln**
  - shows on which ports something is listening
  - start the httpd service and see if you can see the difference
- **tcpdump -i** enp0s3
  - shows all network traffic that passes through a certain link
- **tracepath** www.kdg.be
  - shows all routers in between this and the remote machine
- **mtr** www.kdg.be
  - shows interactive report of all routers in between this and the remote machine

Exercises

Exercises

- KdG
  - 18.3.1
  - 18.3.2
  - 18.3.3
  - 18.3.4
  - 18.3.5
- RedHat
  - ch11s04

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