Network Management

Network Management

DE HOGESCHOOL
MET HET NETWERK

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Intro

- configuratie nic:
  - via GUI: is mogelijk op een desktop
    → kan problemen geven als simultaan in CLI wordt geconfigureerd
  - via CLI: varieert afhankelijk van distributie
    → we bekijken Ubuntu

/etc/network/interfaces wordt dus niet meer gebruikt!

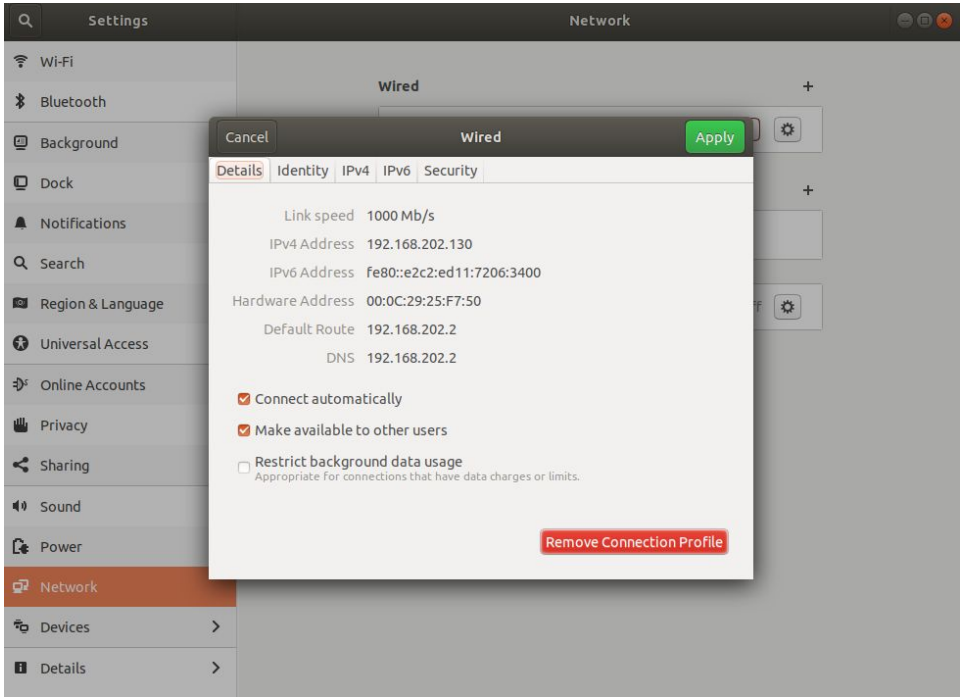
netplan

- vervangt het vroegere ifup/ifdown
  - Config in yaml file, afhankelijk van installatie:

Install Type	Renderer	File
Server ISO	systemd-networkd	/etc/netplan/01-netcfg.yaml
Cloud Image	systemd-networkd	/etc/netplan/50-cloud-init.yaml
Desktop ISO	NetworkManager	/etc/netplan/01-network-manager-all.yaml

```
student@ubuntudesktop01:~$ cd /etc/netplan/
student@ubuntudesktop01:/etc/netplan$ ls
01-network-manager-all.yaml
student@ubuntudesktop01:/etc/netplan$ cat 01-network-manager-all.yaml
# Let NetworkManager manage all devices on this system
network:
  version: 2
  renderer: NetworkManager
student@ubuntudesktop01:/etc/netplan$
```

Op de desktop



/etc/network/interfaces wordt dus niet meer gebruikt!

netplan

- vervangt het vroegere ifup/ifdown
  - Config in yaml file, afhankelijk van installatie:

Install Type	Renderer	File
Server ISO	systemd-networkd	/etc/netplan/01-netcfg.yaml
Cloud Image	systemd-networkd	/etc/netplan/50-cloud-init.yaml
Desktop ISO	NetworkManager	/etc/netplan/01-network-manager-all.yaml

1 netwerk kaart:

Renderer : NetworkManager

→ standaard op Desktop

→ voor wifi enz. via GUI

Ethernet (not wifi/bridge)

Naam: ens33 (later meer)

Geen vast ip-adres

dhcp4: ip-adres wordt via dhcp geleverd over ipv4

Op de server

```
student@ubuntuserver01:~$ cd /etc/netplan/
student@ubuntuserver01:/etc/netplan$ ls
50-cloud-init.yaml
student@ubuntuserver01:/etc/netplan$ cat 50-cloud-init.yaml
# This file is generated from information provided by
# the datasource.  Changes to it will not persist across an instance.
# To disable cloud-init's network configuration capabilities, write a fi
le
# /etc/cloud/cloud.cfg.d/99-disable-network-config.cfg with the followin
g:
# network: {config: disabled}
network:
    ethernets:
        ens33:
            addresses: []
            dhcp4: true
    version: 2
student@ubuntuserver01:/etc/netplan$
```

netplan

Beter voor een server: fixed ip (static)
gateway: alle trafic voor buiten het netwerk wordt naar de gateway (router) gestuurd

1 netwerk kaart:
- Renderer: networkd
  - → geen NetworkManager want geen GUI
- Ethernet (not wifi/bridge)
  - Naam: ens33 (later meer)
    - vaste instellingen voor
      - ip-adres met prefix
      - gateway
      - nameservers
      - search domain
    - dhcp4: geen dhcp

```
student@ubuntuserver01:~$ cat 50-cloud-init.yaml
# This file is generated from information provided by
# the datasource.  Changes to it will not persist across an instance.
# To disable cloud-init's network configuration capabilities, write a fi
le
# /etc/cloud/cloud.cfg.d/99-disable-network-config.cfg with the followin
g:
# network: {config: disabled}
network:
    version: 2
    renderer: networkd
    ethernets:
        ens33:
            addresses: [172.16.226.137/24]
            gateway4: 172.16.226.2
            nameservers:
                addresses: [172.16.226.2,8.8.8.8,8.8.4.4]
                search: [sysnet.lan]
                # dhcp4: no
                # dhcp6: no
student@ubuntuserver01:~$
```

netplan

Wijzigingen in `/etc/netplan/*.yaml` worden doorgevoerd met

sudo netplan apply

Dit maakt ook de volgende file aan

/run/systemd/network/<nr>-netplan-<nic>.network

DHCP

```
student@ubuntuserver01:~$ cat /run/systemd/network/10-netplan-ens33.network
[Match]
Name=ens33

[Network]
DHCP=ipv4

[DHCP]
UseMTU=true
RouteMetric=100
student@ubuntuserver01:~$
```

STATIC

```
student@ubuntuserver01:/etc/netplan$ cat /run/systemd/network/10-netplan-ens33.network
[Match]
Name=ens33

[Network]
Address=172.16.226.137/24
Gateway=172.16.226.2
DNS=172.16.226.2
DNS=8.8.8.8
DNS=8.8.4.4
Domains=sysnet.lan
student@ubuntuserver01:/etc/netplan$
```

netplan

Wijzigingen in `/etc/netplan/*.yaml` worden doorgevoerd met
sudo netplan apply

Dit maakt ook de nodige instellingen in volgende file
/etc/resolv.conf → hier zie je enkel nog de DNS-search
→ resolving wordt nu gedaan door systemd-resolve
→ deze instellingen vind je nu terug in
/run/systemd/resolve/resolv.conf
OF via systemd-resolve --status

```
student@ubuntuserver01:/etc/netplan$ systemd-resolve --status | tail -4
         DNS Servers: 172.16.226.2
                      8.8.8.8
                      8.8.4.4
          DNS Domain: sysnet.lan
student@ubuntuserver01:/etc/netplan$
```

network status bekijken

Je kan de huidige instellingen ook bekijken met networkctl

Op de server

```
student@ubuntuserver01:~$ networkctl
IDX LINK             TYPE               OPERATIONAL SETUP
  1 lo               loopback           carrier     unmanaged
  2 ens33            ether              routable    configured

2 links listed.
student@ubuntuserver01:~$
```

```
student@ubuntuserver01:~$ networkctl status ens33
● 2: ens33
       Link File: /lib/systemd/network/99-default.link
    Network File: /run/systemd/network/10-netplan-ens33.network
            Type: ether
           State: routable (configured)
            Path: pci-0000:02:01.0
          Driver: e1000
          Vendor: Intel Corporation
           Model: 82545EM Gigabit Ethernet Controller (Copper) (PRO/1000
      HW Address: 00:0c:29:31:8f:3d (VMware, Inc.)
         Address: 172.16.226.137
                  fe80::20c:29ff:fe31:8f3d
         Gateway: 172.16.226.2 (VMware, Inc.)
             DNS: 172.16.226.2
  Search Domains: localdomain
student@ubuntuserver01:~$
```

Benaming netwerkkaarten

```
student@ubuntuserver01:~$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN grou
p 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
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: ens33: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel stat
e UP group default qlen 1000
    link/ether 00:0c:29:9d:eb:4e brd ff:ff:ff:ff:ff:ff
    inet 172.16.226.137/24 brd 172.16.226.255 scope global dynamic ens33
       valid_lft 1030sec preferred_lft 1030sec
    inet6 fe80::20c:29ff:fe9d:eb4e/64 scope link
       valid_lft forever preferred_lft forever
student@ubuntuserver01:~$
```

In de laatste versies van ubuntu zijn de netwerkkaarten niet meer eth0, eth1, eth2, enz. genoemd

ens33: is hier de enige netwerkkaart.

→ Zou vroeger dus eth0 geweest zijn

Benaming netwerkkaarten

Vroeger werden de netwerkkaarten genummerd, in de volgorde dat de kernel deze zag tijdens het booten. Daarom kon het soms zijn dat eth0 en eth1 ineens gewisseld waren!

Nu wordt iedere netwerkkaart tijdens het booten hernoemd naar een eenduidige naam, die steeds hetzelfde is.

en -- ethernet sl -- serial line IP (slip) wl -- wlan ww -- wwan

b<number> -- BCMA bus core number ccw<name> -- CCW bus group name
o<index>[d<dev_port>] -- on-board device index number
s<slot>[f<function>][d<dev_port>] -- hotplug slot index number
x<MAC> -- MAC address

```
$ dmesg | grep -i eth

[    3.050064] e1000 0000:02:01.0 eth0: (PCI:66MHz:32-bit) 00:0c:29:05:a3:e2
[    3.050074] e1000 0000:02:01.0 eth0: Intel(R) PRO/1000 Network Connection
[    3.057410] e1000 0000:02:01.0 ens33: renamed from eth0
```

Benaming netwerkkaarten

Het hernoemen van de netwerkkaarten naar een naam die steeds hetzelfde blijft is een goed idee. Indien je echter terug wilt naar de oude namen eth0, eth1, enzovoorts, kan je dat op volgende wijze:

```
$ sudo nano /etc/default/grub
```

```
GRUB_CMDLINE_LINUX="net.ifnames=0 biosdevname=0"
```

```
$ sudo grub-mkconfig -o /boot/grub/grub.cfg
```

```
$ sudo nano /etc/network/interfaces
```

```
auto eth0
iface eth0 inet static
          address 192.168.12.12
```

```
$ sudo reboot
```

ifconfig vs ip

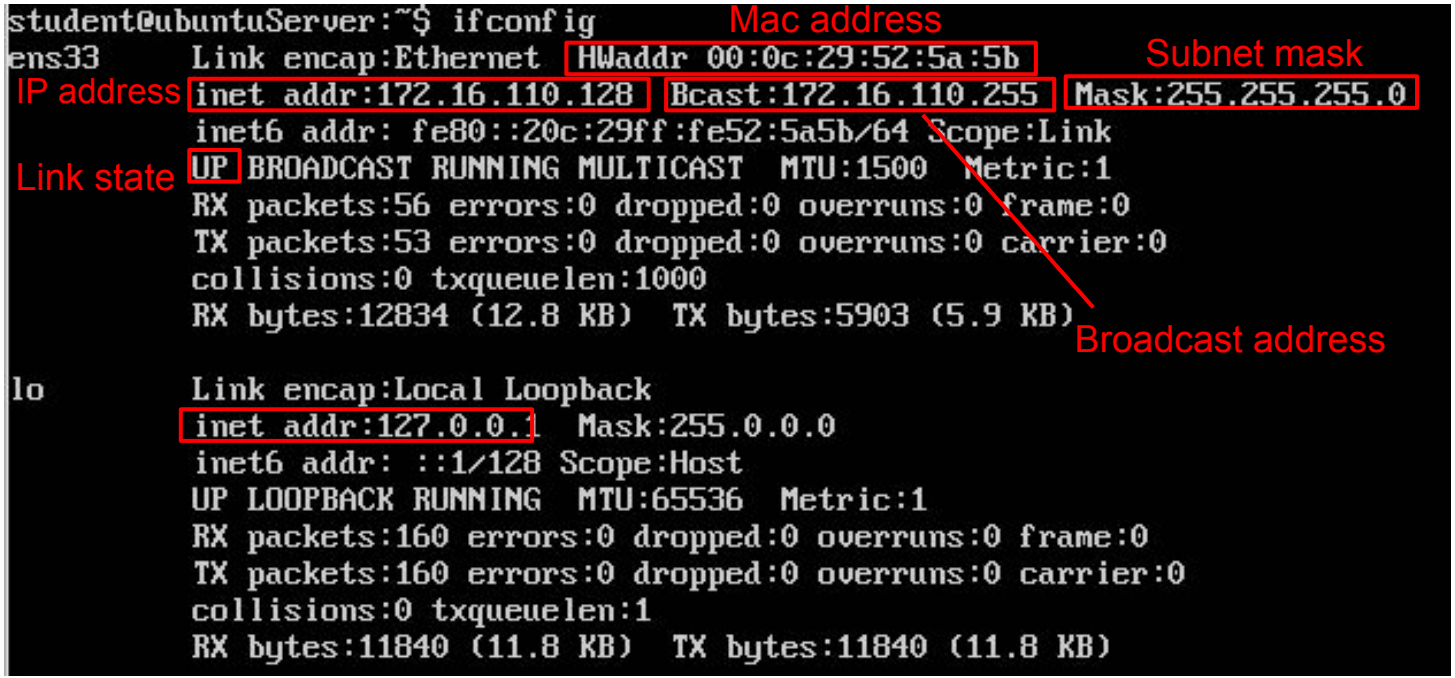
- `ifconfig` is deprecated
  - `ip` is het vervangende commando

```
student@ubuntuserver01:~$ ifconfig ens33
ens33: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 172.16.226.137  netmask 255.255.255.0  broadcast 172.16.226
.255
        inet6 fe80::20c:29ff:fe9d:eb4e  prefixlen 64  scopeid 0x20<link>
        ether 00:0c:29:9d:eb:4e  txqueuelen 1000  (Ethernet)
        RX packets 315  bytes 354570 (354.5 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 198  bytes 14947 (14.9 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

student@ubuntuserver01:~$ ip a s ens33
2: ens33: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel stat
e UP group default qlen 1000
    link/ether 00:0c:29:9d:eb:4e brd ff:ff:ff:ff:ff:ff
    inet 172.16.226.137/24 brd 172.16.226.255 scope global dynamic ens33
       valid_lft 1782sec preferred_lft 1782sec
    inet6 fe80::20c:29ff:fe9d:eb4e/64 scope link
       valid_lft forever preferred_lft forever
student@ubuntuserver01:~$
```

ifconfig - deprecated

- informatie opvragen en wijzigingen aanbrengen
  - informatie opvragen zonder arguments: alle nic's




```
student@ubuntuServer:~$ ifconfig
ens33     Link encap:Ethernet  HWaddr 00:0c:29:52:5a:5b
          inet addr:172.16.110.128  Bcast:172.16.110.255  Mask:255.255.255.0
          inet6 addr: fe80::20c:29ff:fe52:5a5b/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:56 errors:0 dropped:0 overruns:0 frame:0
          TX packets:53 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:12834 (12.8 KB)  TX bytes:5903 (5.9 KB)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:160 errors:0 dropped:0 overruns:0 frame:0
          TX packets:160 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1
          RX bytes:11840 (11.8 KB)  TX bytes:11840 (11.8 KB)
```

ip address

- informatie opvragen en wijzigingen aanbrengen
  - informatie opvragen zonder arguments: alle nic's

```
student@ubuntuServer:~$ ip address
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1
    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
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: ens33: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 10
00
    link/ether 00:0c:29:52:5a:5b brd ff:ff:ff:ff:ff:ff
    inet 172.16.110.128/24 brd 172.16.110.255 scope global ens33
       valid_lft forever preferred_lft forever
    inet6 fe80::20c:29ff:fe52:5a5b/64 scope link
       valid_lft forever preferred_lft forever
```

Mac address

Link state

Broadcast address

IP address

prefix

Of `ip addr` of `ip address show` of `ip a` of `ip a s`

ip address show <nic>

- informatie opvragen en wijzigingen aanbrengen
  - informatie opvragen met arguments: 1 specifieke nic

```
student@ubuntuServer:~$ ip a s dev ens33
2: ens33: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 10
00
    link/ether 00:0c:29:52:5a:5b brd ff:ff:ff:ff:ff:ff
    inet 172.16.110.128/24 brd 172.16.110.255 scope global ens33
       valid_lft forever preferred_lft forever
    inet6 fe80::20c:29ff:fe52:5a5b/64 scope link
       valid_lft forever preferred_lft forever
```

`ip a s ens33` of `ip a s dev ens33`

ip addr show up

```
student@ubuntuServer:~$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1
    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
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: ens33: <BROADCAST,MULTICAST> mtu 1500 qdisc pfifo_fast state DOWN group default qlen 1000
    link/ether 00:0c:29:52:5a:5b brd ff:ff:ff:ff:ff:ff
    inet 172.16.110.128/24 brd 172.16.110.255 scope global ens33
       valid_lft forever preferred_lft forever
```

```
student@ubuntuServer:~$ ip a s up
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1
    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
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
```

'ip a s up' toont enkel de actieve linken

(‘down’ bestaat niet als argument)

ip link up en ip link down

disablen van een nic

```
ip link set ens33 down
```

enablen van een nic

```
ip link set ens33 up
```

→ Dit leest de netplan-yaml file opnieuw uit

herstarten van de networkservice

```
sudo netplan apply
```

OF

```
sudo systemctl restart NetworkManager
```
(op Desktop)

```
sudo systemctl restart systemd-networkd
```
(op Server)

configuratie uit yaml-file in /etc/netplan wordt opnieuw toegepast

setting up IP address

Tijdelijke wijziging

```
student@ubuntuServer:~$ ip a s ens33 | grep 172
    inet 172.16.110.100/24 brd 172.16.110.255 scope global ens33
student@ubuntuServer:~$ sudo ip addr del 172.16.110.100/24 dev ens33
student@ubuntuServer:~$ ip a s ens33 | grep 172
student@ubuntuServer:~$ sudo ip addr add 172.16.110.101/24 dev ens33
student@ubuntuServer:~$ ip a s ens33 | grep 172
    inet 172.16.110.101/24 scope global ens33
```

geen output=geen ip

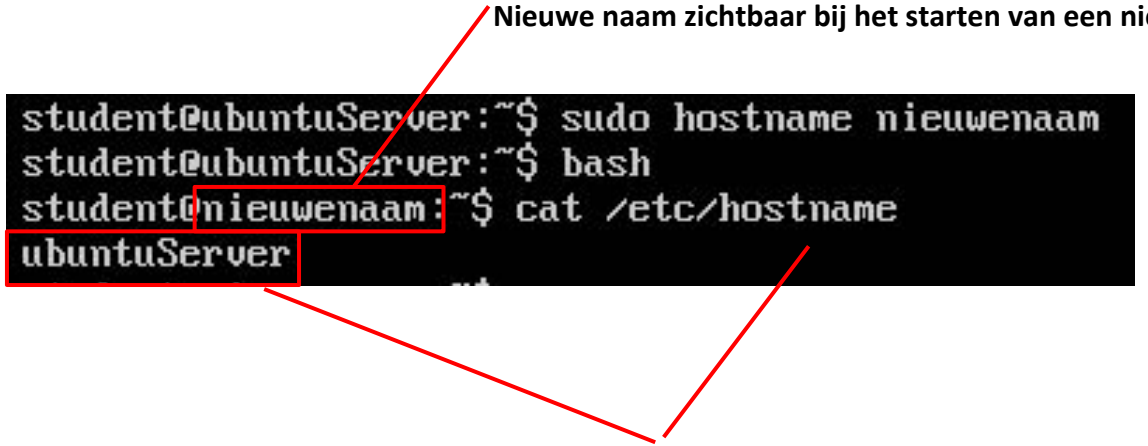
`ip addr del 172.16.110.100/24 dev ens 33`	om 1 IP van de nic te verwijderen
`ip addr flush dev ens33`	om alle IPs van de nic te verwijderen
`ip addr add 172.16.110.101/24 dev ens33`	om 1 IP van de nic toe te voegen

ip link up → leest de yaml-file opnieuw uit !

```
student@ubuntuServer:~$ sudo ip link set ens33 down && sudo ip link set ens33 up
student@ubuntuServer:~$ ip a s ens33 | grep 172
    inet 172.16.110.100/24 brd 172.16.110.255 scope global ens33
```

hostname

Tijdelijke wijziging



hostnames mogen bestaan uit 64 letters, cijfers, (punten en) koppeltekens, maar niet eindigen met een koppelteken.

hostnamectl

Permanente wijziging

```
student@ubuntuServer:~$ cat /etc/hostname
ubuntuServer
student@ubuntuServer:~$ sudo hostnamectl set-hostname nieuwenaam
sudo: unable to resolve host nieuwenaam
student@ubuntuServer:~$ cat /etc/hostname
nieuwenaam
student@ubuntuServer:~$ bash
student@nieuwenaam:~$
```

/etc/hostname is aangepast, dus bij het starten van een nieuwe shell en het herstarten van de PC in de toekomst blijft de nieuwe naam behouden.

ENKEL ALS: in de file /etc/cloud/cloud.cfg => preserve_hostname: true

Default:

```
student@ubuntuserver01:~$ cat /etc/cloud/cloud.cfg | grep preserve_hostname
preserve_hostname: false
```

Je kan natuurlijk ook gewoon de file "/etc/hostname" aanpassen met vi of nano.

/etc/hosts

Aanpassen van /etc/hosts voor name-resolving (voor sudo)

- sudo doet voor ieder commando een name-resolving voor de hostname
  - Daarom is het belangrijk dat je de file /etc/hosts ook aanpast
    - anders heb je een lange timeout voordat een sudo commando wordt uitgevoerd

```
student@ubuntuServer:~$ cat /etc/hostname
ubuntuServer
student@ubuntuServer:~$ cat /etc/hosts
127.0.0.1       localhost
127.0.1.1       ubuntuServer

# The following lines are desirable for IPv6 capable hosts
::1     localhost ip6-localhost ip6-loopback
ff02::1 ip6-allnodes
ff02::2 ip6-allrouters
```

arp - deprecated

Toon alle entries

```
student@ubuntuserver01:~$ arp -a
_gateway (192.168.202.2) at 00:50:56:ec:9d:b4 [ether] on ens33
? (192.168.202.130) at 00:0c:29:25:f7:50 [ether] on ens33
```

```
student@ubuntuserver01:~$ ip a s dev ens33
2: ens33: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP g
    link/ether 00:0c:29:a8:0c:fb brd ff:ff:ff:ff:ff:ff
    inet 192.168.202.10/24 brd 192.168.202.255 scope global ens33
```

```
student@ubuntuserver01:~$ ping 192.168.202.132
PING 192.168.202.132 (192.168.202.132) 56(84) bytes of data.
64 bytes from 192.168.202.132: icmp_seq=1 ttl=64 time=0.403 ms
```

```
student@ubuntuserver01:~$ arp -a
? (192.168.202.132) at 00:0c:29:76:2f:ad [ether] on ens33
_gateway (192.168.202.2) at 00:50:56:ec:9d:b4 [ether] on ens33
? (192.168.202.130) at 00:0c:29:25:f7:50 [ether] on ens33
```

arp - deprecated

```
student@ubuntuserver01:~$ arp -a
? (192.168.202.132) at 00:0c:29:76:2f:ad [ether] on ens33
_gateway (192.168.202.2) at 00:50:56:ec:9d:b4 [ether] on ens33
? (192.168.202.130) at 00:0c:29:25:f7:50 [ether] on ens33
```

Delete entry

```
student@ubuntuserver01:~$ sudo arp -d 192.168.202.132
student@ubuntuserver01:~$ arp -a
_gateway (192.168.202.2) at 00:50:56:ec:9d:b4 [ether] on ens33
? (192.168.202.130) at 00:0c:29:25:f7:50 [ether] on ens33
```

```
student@ubuntuserver01:~$ ping 192.168.202.133
PING 192.168.202.133 (192.168.202.133) 56(84) bytes of data.
From 192.168.202.10 icmp_seq=1 Destination Host Unreachable
```

ping naar onbestaand IP

```
student@ubuntuserver01:~$ arp -a
? (192.168.202.133) at <incomplete> on ens33
_gateway (192.168.202.2) at 00:50:56:ec:9d:b4 [ether] on ens33
? (192.168.202.130) at 00:0c:29:25:f7:50 [ether] on ens33
```

ip neighbor (arp-tabel)

```
IP-NEIGHBOUR(8)                    Linux                    IP-NEIGHBOUR(8)

NAME
       ip-neighbour - neighbour/arp tables management.

SYNOPSIS
       ip [ OPTIONS ] neigh  { COMMAND | help }

       ip neigh { add | del | change | replace } { ADDR [ lladdr LLADDR ] [
              nud STATE ] | proxy ADDR } [ dev DEV ]

       ip neigh { show | flush } [ proxy ] [ to PREFIX ] [ dev DEV ] [ nud
              STATE ]

       STATE := { permanent | noarp | stale | reachable | none | incomplete |
              delay | probe | failed }

DESCRIPTION
       The ip neigh command manipulates neighbour objects that establish bind-
       ings between protocol addresses and link layer addresses for hosts
       sharing the same link.  Neighbour entries are organized into tables.
       The IPv4 neighbour table is also known by another name - the ARP table.
```

ip neighbor (of ip n)

Toon alle entries

```
student@ubuntuserver01:~$ ip n show
192.168.202.133 dev ens33  FAILED
192.168.202.2 dev ens33 lladdr 00:50:56:ec:9d:b4 STALE
192.168.202.130 dev ens33 lladdr 00:0c:29:25:f7:50 DELAY
```

192.168.202.133 ping host unreachable

192.168.202.130 Connectie via ssh

```
student@ubuntuserver02:~$ ip a s ens33
2: ens33: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP grou
    link/ether 00:0c:29:76:2f:ad brd ff:ff:ff:ff:ff:ff
    inet 192.168.202.132/24 brd 192.168.202.255 scope global dynamic ens33
```

```
student@ubuntuserver01:~$ ping 192.168.202.132
PING 192.168.202.132 (192.168.202.132) 56(84) bytes of data.
64 bytes from 192.168.202.132: icmp_seq=1 ttl=64 time=0.547 ms
```

```
student@ubuntuserver01:~$ ip n show
192.168.202.132 dev ens33 lladdr 00:0c:29:76:2f:ad STALE
192.168.202.133 dev ens33  FAILED
192.168.202.2 dev ens33 lladdr 00:50:56:ec:9d:b4 STALE
192.168.202.130 dev ens33 lladdr 00:0c:29:25:f7:50 DELAY
```

Delete ent

```
student@ubuntuserver01:~$ sudo ip n del 192.168.202.132 dev ens33
student@ubuntuserver01:~$ ip n show
192.168.202.133 dev ens33  FAILED
192.168.202.2 dev ens33 lladdr 00:50:56:ec:9d:b4 DELAY
192.168.202.130 dev ens33 lladdr 00:0c:29:25:f7:50 REACHABLE
```

route - deprecated

```
student@ubuntuserver01:~$ route
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
default         _gateway        0.0.0.0         UG    0      0        0 ens33
192.168.202.0   0.0.0.0         255.255.255.0   U     0      0        0 ens33
student@ubuntuserver01:~$ netstat -r
Kernel IP routing table
Destination     Gateway         Genmask         Flags   MSS Window  irtt Iface
default         _gateway        0.0.0.0         UG        0 0          0 ens33
192.168.202.0   0.0.0.0         255.255.255.0   U         0 0          0 ens33
```

Tijdelijk wijzigingen routering: (vb. default gateway)

```
sudo route add default gw 192.168.202.xx
(man route)
```

ip route

```
IP-ROUTE(8)                         Linux                         IP-ROUTE(8)

NAME
       ip-route - routing table management

SYNOPSIS
       ip [ ip-OPTIONS ] route  { COMMAND | help }

       ip route { list | flush } SELECTOR

       ip route get ADDRESS [ from ADDRESS iif STRING  ] [ oif STRING ] [ tos
              TOS ]

       ip route { add | del | change | append | replace } ROUTE

       SELECTOR := [ root PREFIX ] [ match PREFIX ] [ exact PREFIX ] [ table
              TABLE_ID ] [ proto RTPROTO ] [ type TYPE ] [ scope SCOPE ]

DESCRIPTION
       ip route is used to manipulate entries in the kernel routing tables.

       Route types:

              unicast - the route entry describes real paths to the destina-
```

ip route (of ip r)

```
student@ubuntuserver01:~$ ip route
default via 192.168.202.2 dev ens33 proto static
192.168.202.0/24 dev ens33 proto kernel scope link src 192.168.202.10
```

Of `ip r show` of `ip r list`

Tijdelijk wijzigingen routering: (vb. default gateway)

```
sudo ip route add default via 192.168.14.xx
```

ping

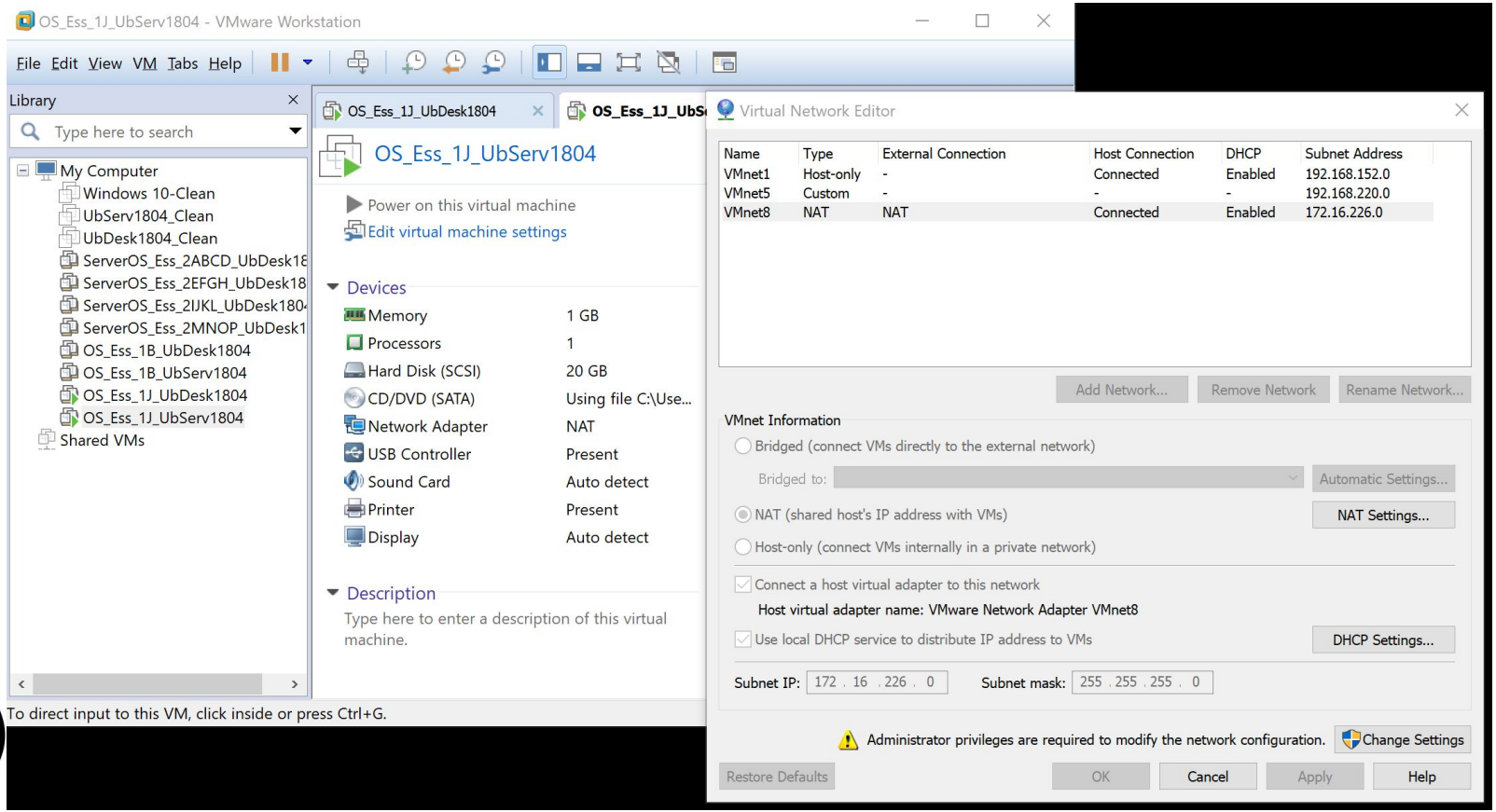
Met ping wordt vaak de TCP/IP configuratie getest.

(ook traceroute, dig)

```
student@ubuntuserver01:~$ ping 192.168.202.132
PING 192.168.202.132 (192.168.202.132) 56(84) bytes of data.
64 bytes from 192.168.202.132: icmp_seq=1 ttl=64 time=0.711 ms
64 bytes from 192.168.202.132: icmp_seq=2 ttl=64 time=0.830 ms
64 bytes from 192.168.202.132: icmp_seq=3 ttl=64 time=0.871 ms
^C
--- 192.168.202.132 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2030ms
rtt min/avg/max/mdev = 0.711/0.804/0.871/0.067 ms
```

Ctrl-C

VMware: NAT-instelling in Workstation



VMware: NAT-instellingen op de host

interface vmnet8

NAT router en DNS Server

ip = 172.16.226.**2**

DHCP Server

ip = 172.16.226.**254**

```
PS C:\Users\gertv> Get-NetIPConfiguration *VMnet8


InterfaceAlias       : VMware Network Adapter VMnet8
InterfaceIndex       : 15
InterfaceDescription : VMware Virtual Ethernet Adapter for VMnet8
IPv4Address          : 172.16.226.1
IPv6DefaultGateway   :
IPv4DefaultGateway   :
DNSServer            : fec0:0:0:ffff::1
                       fec0:0:0:ffff::2
                       fec0:0:0:ffff::3



PS C:\Users\gertv>
```

VMware: NAT-instelling in de VM

Desktop: Een lease wordt aangevraagd door de NetworkManager bij het opstarten of herstarten van het netwerk van deze netwerkkaart.

```
student@ubuntudesktop01:~$ tail -16 /var/lib/NetworkManager/dhclient-e6c4d070-9d
3e-3144-837c-92a3594e9379-ens33.lease
lease {
  interface "ens33";
  fixed-address 172.16.226.148;
  option subnet-mask 255.255.255.0;
  option routers 172.16.226.2;
  option dhcp-lease-time 1800;
  option dhcp-message-type 5;
  option domain-name-servers 172.16.226.2;
  option dhcp-server-identifier 172.16.226.254;
  option broadcast-address 172.16.226.255;
  option netbios-name-servers 172.16.226.2;
  option domain-name "localdomain";
  renew 3 2018/10/03 18:31:20;
  rebind 3 2018/10/03 18:43:52;
  expire 3 2018/10/03 18:47:37;
}
student@ubuntudesktop01:~$
```

VMware: NAT-instelling in de VM

Server: Een lease wordt aangevraagd door de networkd bij het opstarten of herstarten van het netwerk van deze netwerkkaart.

```
student@ubuntuserver01:~$ cat /var/run/systemd/netif/leases/2
# This is private data. Do not parse.
ADDRESS=172.16.226.137
NETMASK=255.255.255.0
ROUTER=172.16.226.2
SERVER_ADDRESS=172.16.226.254
NEXT_SERVER=172.16.226.254
T1=900
T2=1575
LIFETIME=1800
DNS=172.16.226.2
DOMAINNAME=localdomain
CLIENTID=ff2b9434c100020000ab11e422c0dcbce95e73
student@ubuntuserver01:~$
```

```
student@ubuntuserver01:~$ networkctl
IDX LINK             TYPE               OPERATIONAL SETUP
  1 lo               loopback           carrier     unmanaged
  2 ens33            ether              routable    configured

2 links listed.
student@ubuntuserver01:~$
```

VMware: NAT

Default GW

```
student@ubserv:~$ route
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
default         172.16.226.2    0.0.0.0         UG    0      0        0 ens33
172.16.226.0    *               255.255.255.0   U     0      0        0 ens33
```

DNS

```
student@ubserv:~$ dig www.pxl.be

; <<>> DiG 9.10.3-P4-Ubuntu <<>> www.pxl.be
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 18360
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; MBZ: 0005 , udp: 4000
;; QUESTION SECTION:
;www.pxl.be.                    IN      A

;; ANSWER SECTION:
www.pxl.be.             5       IN      A       192.168.4.20

;; Query time: 4 msec
;; SERVER: 172.16.226.2#53(172.16.226.2)
;; WHEN: Fri Oct 06 15:30:13 CEST 2017
;; MSG SIZE  rcvd: 55
```

DNS - poort 53

ifconfig vs ip

COMPARING NET-TOOLS VS. IPROUTE PACKAGE COMMANDS	
NET-TOOLS COMMANDS	**IPROUTE COMMANDS**
arp -a	ip neigh
arp -v	ip -s neigh
arp -s 192.168.1.1 1:2:3:4:5:6	ip neigh add 192.168.1.1 lladdr 1:2:3:4:5:6 dev eth1
arp -i eth1 -d 192.168.1.1	ip neigh del 192.168.1.1 dev eth1
ifconfig -a	ip addr
ifconfig eth0 down	ip link set eth0 down
ifconfig eth0 up	ip link set eth0 up
ifconfig eth0 192.168.1.1	ip addr add 192.168.1.1/24 dev eth0
ifconfig eth0 netmask 255.255.255.0	ip addr add 192.168.1.1/24 dev eth0
ifconfig eth0 mtu 9000	ip link set eth0 mtu 9000
ifconfig eth0:0 192.168.1.2	ip addr add 192.168.1.2/24 dev eth0
netstat	ss
netstat -neopa	ss -neopa
netstat -g	ip maddr
route	ip route
route add -net 192.168.1.0 netmask 255.255.255.0 dev eth0	ip route add 192.168.1.0/24 dev eth0
route add default gw 192.168.1.1	ip route add default via 192.168.1.1