Universiteit Antwerpen
Faculteit Toegepaste Ingenieurswetenschappen

Lab of 3-Network Architecture

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2024-2025

Scheduled labs for PR01

Session	Date	Subject	Evaluation	Deadline (23:59)
1	01/10/2024	Introduction to the Linux Operating System	**N/A**	**N/A**
2	08/10/2024	Using the shell & exploring the filesystem	Report	14/10/2024
3	15/10/2024	Working with text files, managing running processes and writing shell scripts	Report	22/10/2024
4	23/10/2024	Learning system administration, getting & managing software	Report	28/10/2024
5	29/10/2024	Wireshark introduction	Report	05/11/2024
6	06/11/2024	Protocols in action: TCP and UDP	Report	11/11/2024
7	12/11/2024	Ethernet and ARP	Report	19/11/2024
8	20/11/2024	Setting up a DHCP server	Report	25/11/2024
9	26/11/2024	Setting up a DNS server	Report	03/12/2024
10	04/12/2024	Network Address Translation	Report	09/12/2024
11	10/12/2024	Remote Access & Firewalls		**N/A**
12	18/12/2024		Blackboard test	

Scheduled labs for PR02

Session	Date	Subject	Evaluation	Deadline (23:59)
1	02/10/2024	Introduction to the Linux Operating System	N/A	N/A
2	09/10/2024	Using the shell & exploring the filesystem	Report	15/10/2024
3	16/10/2024	Working with text files, managing running processes and writing shell scripts	Report	22/10/2024
4	23/10/2024	Learning system administration, getting & managing software	Report	29/10/2024
5	30/10/2024	Wireshark introduction	Report	05/11/2024
6	06/11/2024	Protocols in action: TCP and UDP	Report	12/11/2024
7	13/11/2024	Ethernet and ARP	Report	19/11/2024
8	20/11/2024	Setting up a DHCP server	Report	26/11/2024
9	27/11/2024	Setting up a DNS server	Report	03/12/2024
10	04/12/2024	Network Address Translation	Report	10/12/2024
11	11/12/2024	Remote Access & Firewalls		**N/A**
12	18/12/2024		Blackboard test	

Session 10

Network Address Translation

A refresher…

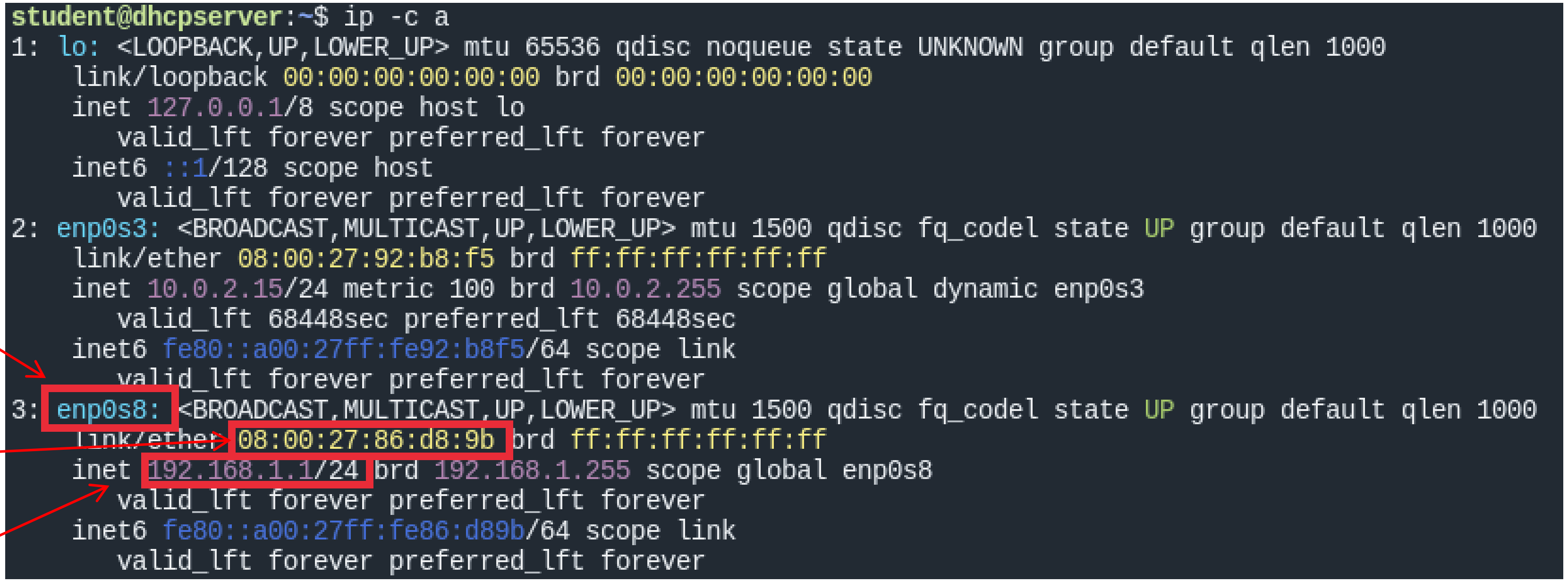
Setup of a service

General steps for setting up a “server”:

1. Install the service
2. Configure the server
3. Start the server
4. Secure the server (*This step is reserved for future sessions*)
5. Monitor the server (service status, log files, ...)

IP address

The **ip** command. An example output of
$ ip -c a   (equal to **$ ip -c address**)



```
student@dhcpserver:~$ ip -c a
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
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 08:00:27:92:b8:f5 brd ff:ff:ff:ff:ff:ff
    inet 10.0.2.15/24 metric 100 brd 10.0.2.255 scope global dynamic enp0s3
       valid_lft 68448sec preferred_lft 68448sec
    inet6 fe80::a00:27ff:fe92:b8f5/64 scope link
       valid_lft forever preferred_lft forever
3: enp0s8: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 08:00:27:86:d8:9b brd ff:ff:ff:ff:ff:ff
    inet 192.168.1.1/24 brd 192.168.1.255 scope global enp0s8
       valid_lft forever preferred_lft forever
    inet6 fe80::a00:27ff:fe86:d89b/64 scope link
       valid_lft forever preferred_lft forever
```

The internal network adapter name

MAC address

IP address

Network adapter address assignment

Assigning an IP address to a certain network adapter.
Permanently: configure the interfaces config files **(/etc/network/interfaces**)

```
dhcp-server@dhcp:~$ sudo nano /etc/network/interfaces
```

```
# This file describes the network interfaces available on your system
# and how to activate them. For more information, see interfaces(5).

source /etc/network/interfaces.d/*

# The loopback network interface
auto lo
iface lo inet loopback

# The primary network interface
allow-hotplug enp1s0
iface enp1s0 inet static
        address 192.168.1.1/24
        gateway 192.168.1.254
        # dns-* options are implemented by the resolvconf package, if installed
        dns-nameservers 192.168.1.2
        dns-search labnet.local
```

```
dhcp-server@dhcp:~$ sudo systemctl restart networking.service
```

Command list overview – Virtual Machine

Command	Explanation
sudo virt-install	Installation of virtual machine. Extra parameters needed.
sudo virsh list --all	List all VMs.
sudo virsh start <my_vm>	Start a VM. Replace <my_vm> with the name of your VM.
sudo virsh shutdown <my_vm>	Shutdown a VM. Replace <my_vm> with the name of your VM.
sudo virsh destroy <my_vm>	Forcefully shutdown a VM. Replace <my_vm> with the name of your VM.
sudo virsh undefine <my_vm>	Delete a VM. Replace <my_vm> with the name of your VM.
sudo virsh console <my_vm>	Connect to VM console. Replace <my_vm> with the name of your VM.
Qwerty: “Ctrl +]” Azerty: “Ctrl + $”	Exit the console to go back to host.

Command list overview – Networks

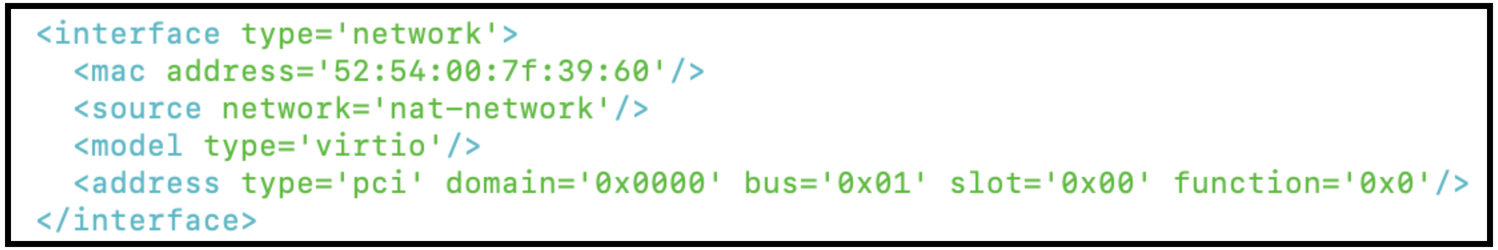
Command	Explanation
sudo virsh net-define <network.xml>	Network definition. Replace <network.xml> with the correct filename.
sudo virsh net-start <name>	Start the network. Replace <name> with the network name defined in your config.
sudo virsh net-autostart <name>	Automatic startup of a virtual network. Replace <name> with the name of your network name.
sudo virsh domiflist <vm_name>	List all attached interfaces. Replace <vm_name> with your VM name.
sudo virsh attach-interface --type network --source <name> --model virtio <vm_name> --persistent	Attach a network interface to a VM. Replace <vm_name> with the name of the VM, and <name> with your network name.
sudo virsh detach-interface <vm_name> network <mac_address>	Detach a network interface from your VM. Replace <vm_name> with the name of the VM, and <mac_address> with the mac address retrieved using domiflist.

An error was made…

- The detach-interface command edits the running state of a VM
  - Reboot possibly adds the interface again => edit the config file of the VM

sudo virsh edit dhcp

For DHCP there will be an entry looking like this, which **should not be there**:



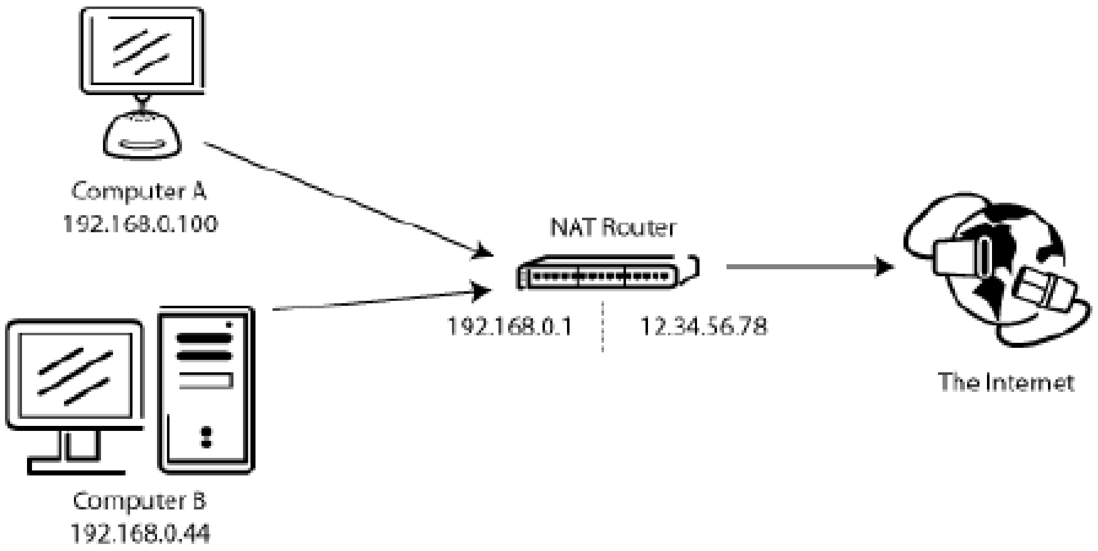
```
<interface type='network'>
  <mac address='52:54:00:7f:39:60'/>
  <source network='nat-network'/>
  <model type='virtio'/>
  <address type='pci' domain='0x0000' bus='0x01' slot='0x00' function='0x0'/>
</interface>
```

VM	Interface needed
DHCP	Internal
Cliënts	Internal
DNS	Internal
Forwarder	Internal and NAT

Setup up a router using NAT

Introduction

- **Network Address Translation (NAT)** is a networking technique used to modify the IP address information in the headers of the IP packets as they pass through a router. It enables the translation of private IP addresses, used in a local area network, into a public IP address that can be used on the internet.
- Why?
  - Limited availability of public IPs
  - Hiding internal network
  - Simple network management for households



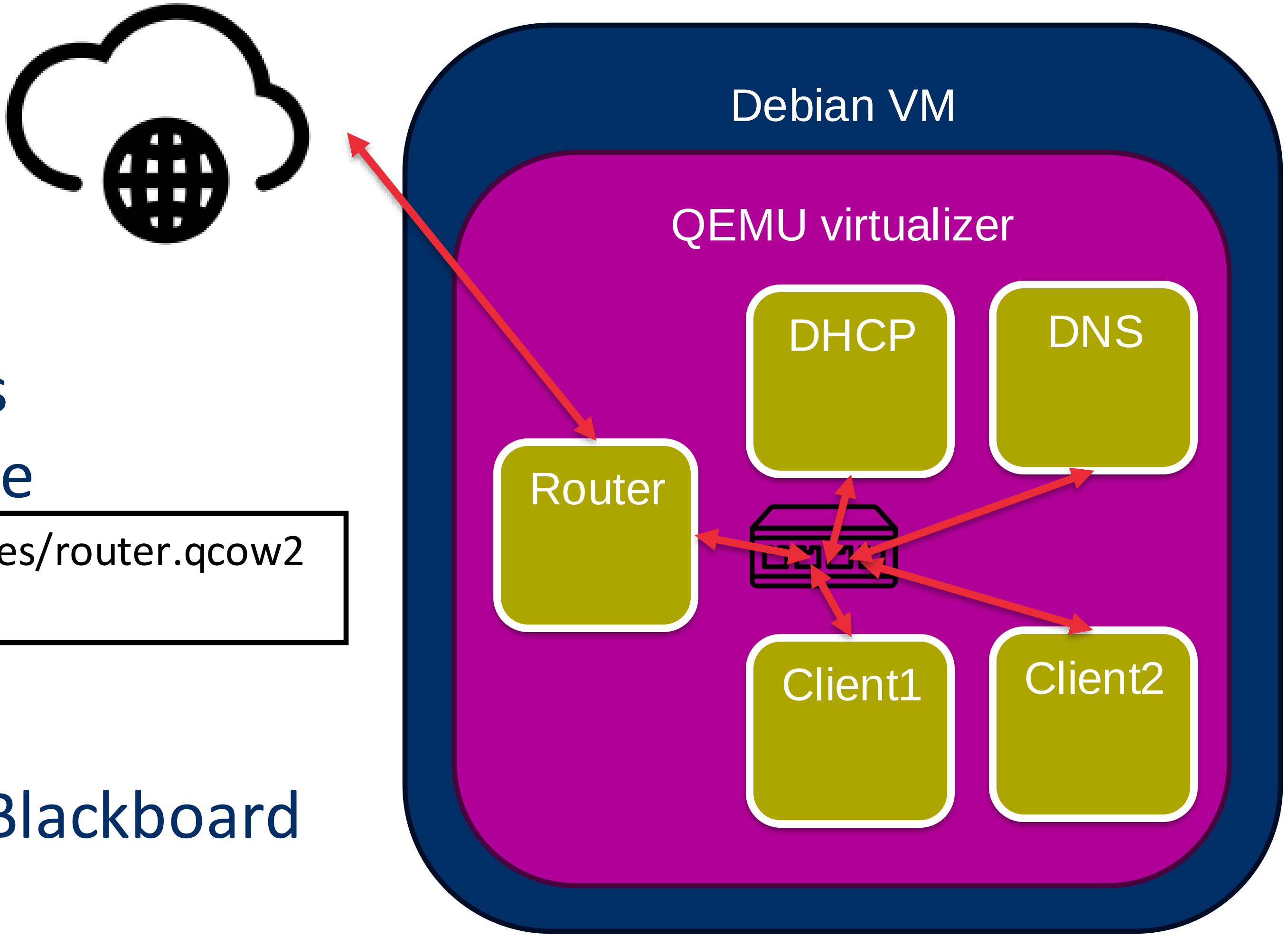
From: https://filezillapro.com/docs/v3/faq/network-address-translation-works-nat/

1. Install the service

- Install a virtual machine
  - Go to /var/lib/libvirt/images
  - Configure a virtual hard drive

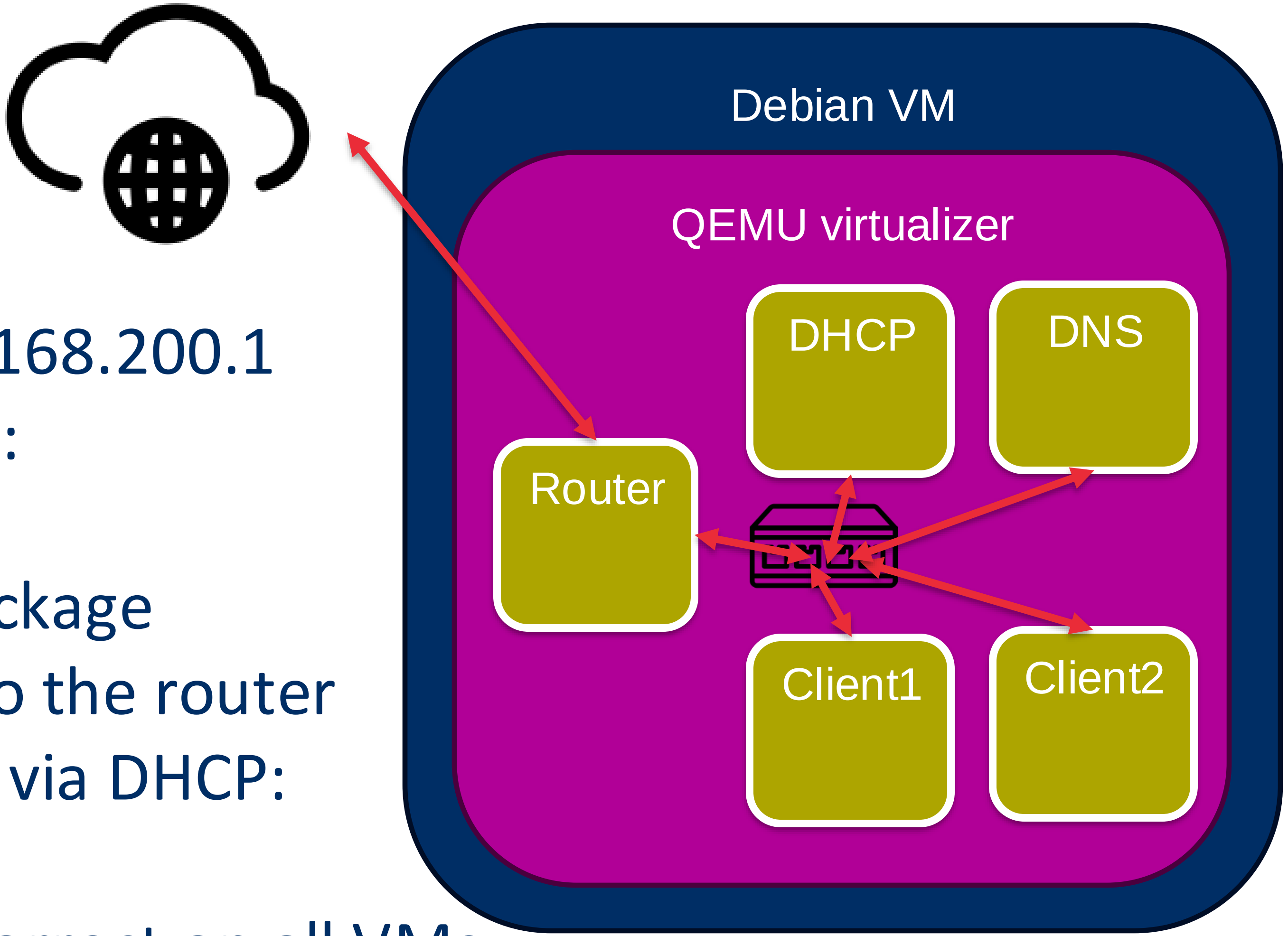
```
sudo qemu-img create -f qcow2 /var/lib/libvirt/images/router.qcow2
8G
```

  - Install VM: follow guide on Blackboard



```
sudo virt-install --name router --ram 1024 --vcpus 1                    --disk
path=/var/lib/libvirt/images/router.qcow2,format=qcow2 --os-variant debian11 --network network=nat-network --
graphics none --extra-args="console=ttyS0"                    --location
/var/lib/libvirt/images/<downloaded_image>.iso
```

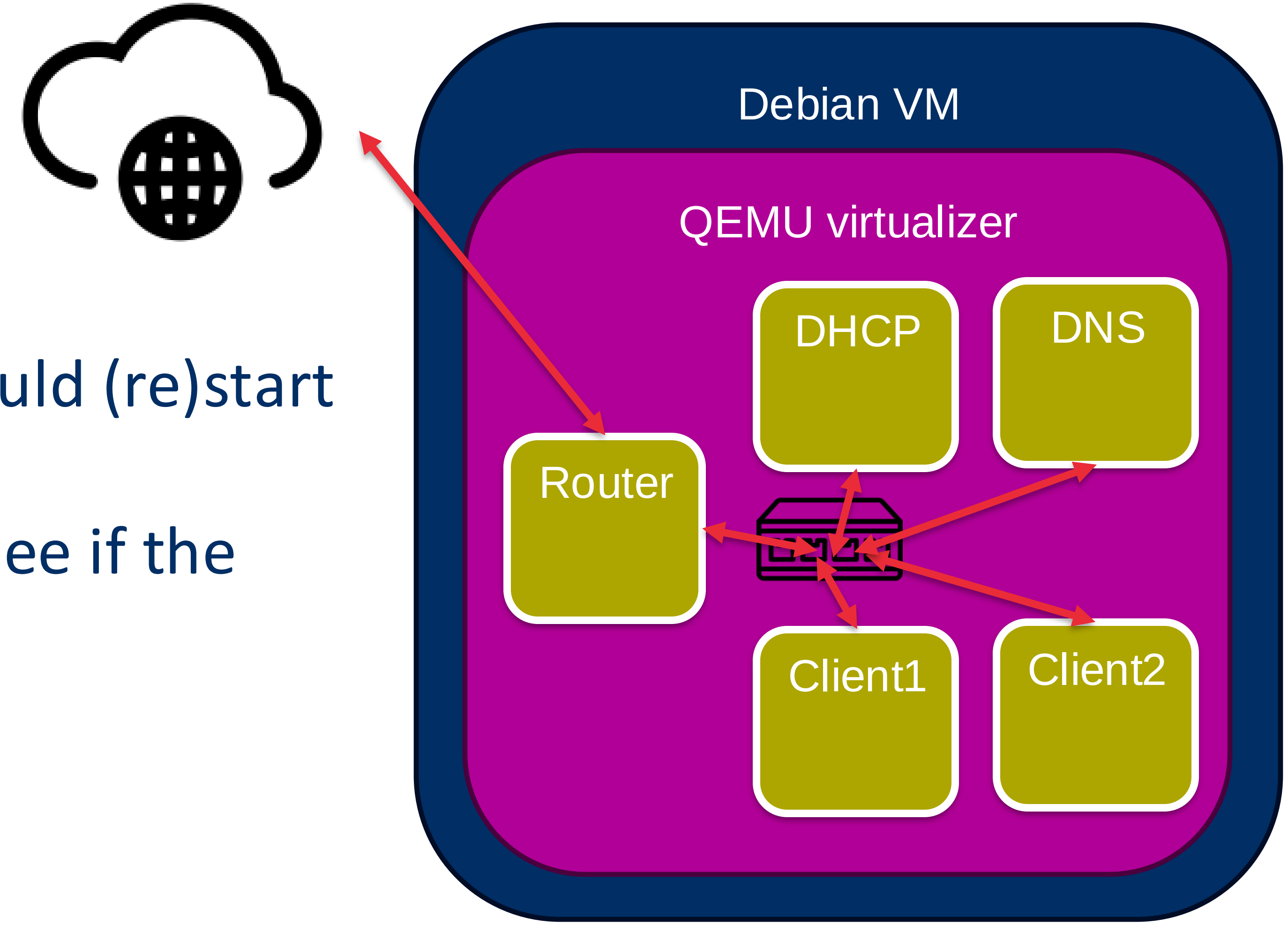
2. Configure the server



- Host- and username: router
- DNS address (temporary): 192.168.200.1
- IP address for the NAT network:
  - 192.168.200.254
- Install “**iptables-persistent**” package
- Connect the internal network to the router
- IP address for internal network via DHCP:
  - 192.168.1.254
- Make sure /etc/resolv.conf is correct on all VMs
- Enable **packet forwarding** for IPv4 in /etc/sysctl.conf
- **Configure “iptables”: NAT for outgoing traffic from LAN to internet** and make the configuration persistent.

3. Start the server

- To (re)load the config, you should (re)start the service
  - Reboot your router VM to see if the config is persistent



5. Monitor the server

- Check logs of iptables

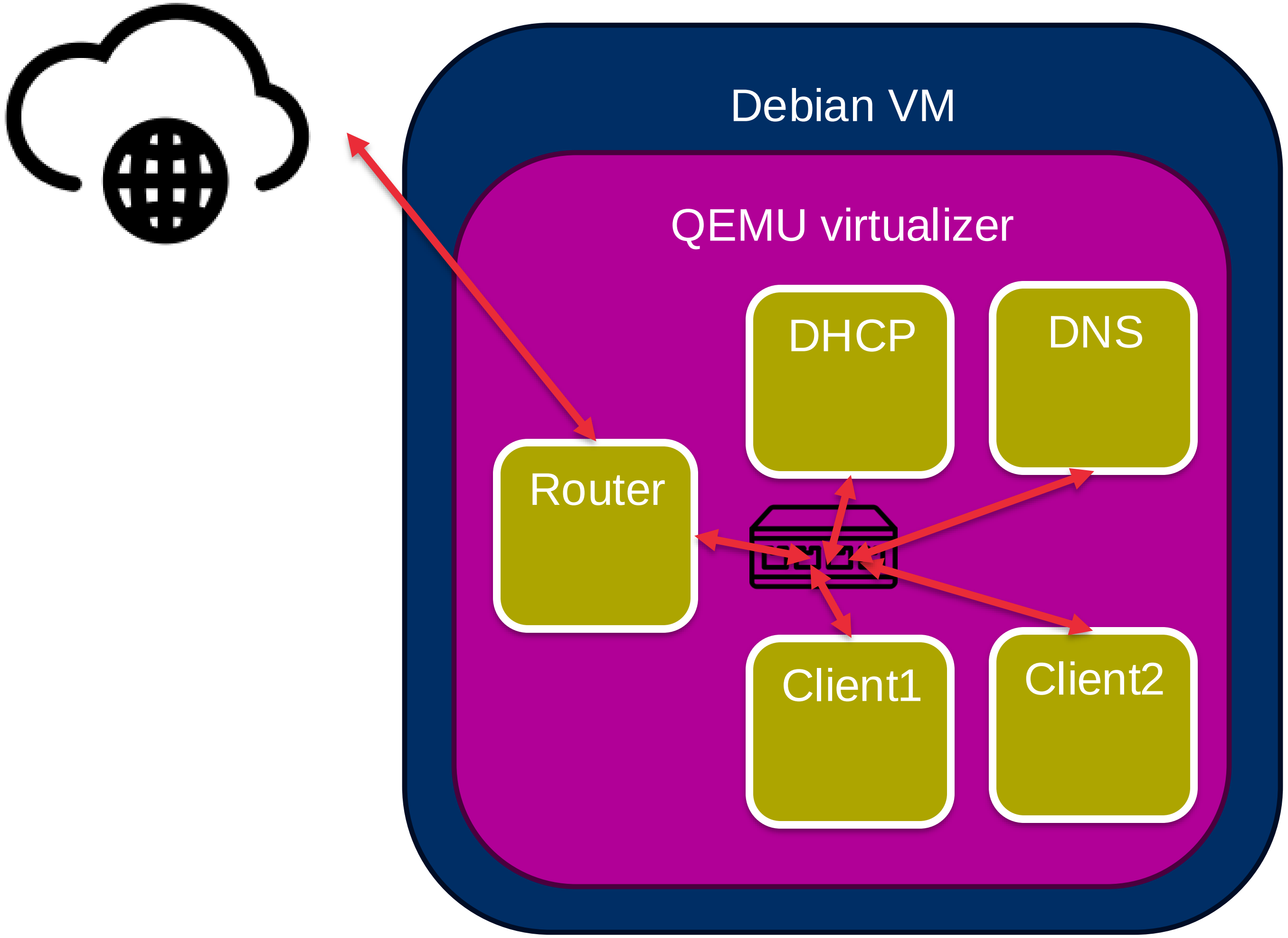
```
systemctl status iptables
```

- Check the iptables rules

```
iptables -t nat -L -n -v
```

- Check if IPv4 forwarding is on

```
sysctl net.ipv4.ip_forward
```



Tips

- Check logs of the server
- Use “ping” to check one server can reach another
- Employ “nslookup” to check if your setup works correctly
  - Install dnsutils on both clients