

# Computer Networks Lab

## Network Configuration in Linux

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# Introduction

In the last Lab Exercise you did the following things:

- **Set up a Linux Operating System**
- **Install Wireshark and work with the Command-Line**
- **Inspect some basic Networking Protocols and Technologies**

# Introduction

In this Lab Exercise you will learn the following things:

- **How to set up a network (with Linux)**
- **How to enable switching and/or forwarding with Linux**
- **Some more advanced Command-Line Fun ;-)**

## After this Lab Exercise

After you solved this Lab Exercise you are able to make basic network configuration on Linux Systems. This is a pivotal task for any Computer Scientist. So if you understood the task in this Lab Exercise you have mastered some fundamental and important skills in Computer Networks!



## Lab Exercise 2 Network

**The Network in Lab Exercise 2 consists of:**

- 1 Virtual Machine for the Gateway (`mastervm`)
- 3 Virtual Machines for the Clients (`clone[1-3]`)
- 1 Bridged Interface between the Host OS and the Gateway
- Internal Network connections from the Gateway to each client

**The Goal:** Configure the Gateway and the Clients in such a way that a connection can be established between the Gateway, the Clients and the Internet!

Before we dive in

Before we discuss the solutions we need to learn more about the files and tools necessary for the network configuration

# The interfaces File

The File `/etc/network/interfaces` includes the following parameters:

- Information about the interfaces
- The configuration of the Interface
- Information about the IP-Address, Subnetmask, Gateway

Important Interfaces [1]:

- `lo` – Loopback Address for development purposes
- `eth0` – Wired (Ethernet) Interface
- `wlan0` – Wireless (WiFi) Interface
- `enp0s3` – Wired Interface in Virtualbox

# Interfaces File

```
1 # Example Interfaces File
2
3 auto lo
4 iface lo inet loopback
5
6 # WAN Interface
7 auto enp0s3
8 iface enp0s3 inet dhcp
9
10 # LAN 1
11 auto enp0s8
12 iface enp0s8 inet static
13     address 192.168.1.1
14     netmask 255.255.255.0
15     broadcast 192.168.1.255
```

Listing 1: Interfaces File

# Tools for configuration

An important tool for the configuration of networks in Linux is `ifconfig` [2]

`ifconfig` is used to configure the interfaces of the machine

Examples for the use of `ifconfig`:

- Setting the IP-Address for interface `eth0`
  - `sudo ifconfig eth0 172.16.0.1 netmask 255.240.0.0`
- Setting the IP-Address for interface `wlan0`
  - `sudo ifconfig wlan0 192.168.0.1 netmask 255.255.255.0`
- Starting up interface `eth1`:
  - `sudo ifconfig eth1 up`

# Tools for configuration

In order to save changes made to the `interfaces` file you need to restart the network interfaces!

There are two ways to do that

## Restart a specific Interface:

- `ifdown <INTERFACE>`
- `ifup <INTERFACE>`

or

## Restart all networking interfaces

- `/etc/init.d/networking restart`

# Configuring Networks

**Solution 1:** Install `bridge-utils` [3] and configure a Switch on the Gateway!

**Solution 2:** Install `iptables` and configure IP-Forwarding [4] and NAT-Masquerading [5] on the Gateway!

# Solution 1 – bridge-utils (1/3)

The following steps need to be carried out:

- Install bridge-utils on mastervm:
  - `sudo apt-get install -y bridge-utils`
- List the Interfaces and add a Bridge on mastervm:
  - `sudo brctl show`
  - `sudo brctl addbr bridgelan1`
- Add Network Interfaces to the Logical Bridge:
  - `sudo brctl addif bridgelan1 enp0s3`

# Solution 1 – bridge-utils (2/3)

The following steps need to be carried out:

- Set network configurations for the Interfaces on mastervm:
  - `sudo ifconfig bridgelan1 192.168.1.10 netmask 255.255.255.0 up`
  - `sudo ifconfig enp0s8 192.168.1.11 netmask 255.255.255.0`
- Make the necessary configurations on the Clones aswell:
  - `sudo ifconfig enp0s3 192.168.1.12 netmask 255.255.255.0`
- Finally include this in `/etc/network/interfaces` on the clone1:

```
auto enp0s3
iface enp0s3 inet static
address 192.168.1.12
netmask 255.255.255.0
gateway 192.168.1.11
dns-nameservers 8.8.4.4 8.8.8.8
```

## Solution 1 – bridge-utils (3/3)

The steps listed configure a bridged network between `mastervm` and `clone1`!

**Please Note:** The previously shown steps are an example and maybe you need to adjust your files!

### Accessing Files on the Command-Line

In order to access files on the Command-Line you need to use an Editor. The oldest Editor available on every Linux System is `vi`. A more userfriendly Editor is `nano`. Make sure that you have root access to the file in order to save the changes!

# Solution 2 – IP-Forwarding and NAT-Masquerading (1/4)

The following steps need to be carried out:

- Install iptables on mastervm:
  - `sudo apt-get install -y iptables`
- Configure iptables on mastervm
- Configure the interfaces on mastervm
- Configure the interfaces on clone [1-3]

## Solution 2 – IP-Forwarding and NAT-Masquerading (2/4)

Configure iptables on mastervm:

- This rule forwards packets to the WAN-interface:
  - `iptables -A FORWARD -o enp0s3 -s 0.0.0.0/0 -m conntrack --ctstate NEW -j ACCEPT`
- This rule forwards established packets to the WAN-interface:
  - `iptables -A FORWARD -m conntrack --ctstate ESTABLISHED,RELATED -j ACCEPT`
- This rule sets the POSTROUTING<sup>1</sup> rules for the WAN-interface:
  - `iptables -t nat -A POSTROUTING -o enp0s3 -j MASQUERADE`
- Enable iptables:
  - `sysctl -w net.ipv4.ip_forward=1`

---

<sup>1</sup>More on iptables and Rule Chains in the next Lab Exercise!

## Solution 2 – IP-Forwarding and NAT-Masquerading (3/4)

Configure the file `/etc/network/interfaces` on `mastervm` e.g.:

```
# WAN Interface
auto enp0s3
iface enp0s3 inet dhcp

# LAN 1
auto enp0s8
iface enp0s8 inet static
address 192.168.1.1
netmask 255.255.255.0
broadcast 192.168.1.255
```

## Solution 2 – IP-Forwarding and NAT-Masquerading (4/4)

Configure the file `/etc/network/interfaces` on `clone1` e.g.:

```
auto enp0s3
iface enp0s3 inet static
address 192.168.1.10
netmask 255.255.255.0
broadcast 192.168.1.255
gateway 192.168.1.1
```

# Lab Exercise 2

This slide set gives you a brief overview of the tools and technologies discussed in Lab exercise sheet 2.

Hopefully this slide set gives you the ability to solve the tasks of exercise sheet 2!

## Lab Exercise 2

Have fun solving the Exercise Sheet and if you have questions, don't be afraid to ask ;-)

- [1] Debian network configuration. [accessed: November 20, 2018]. [Online]. Available: <https://wiki.debian.org/NetworkConfiguration>
- [2] `ifconfig` man page. [accessed: November 20, 2018]. [Online]. Available: <https://linux.die.net/man/8/ifconfig>
- [3] Debian bridge network connections. [accessed: November 20, 2018]. [Online]. Available: <https://wiki.debian.org/BridgeNetworkConnections>
- [4] Redhat – `forward` and `nat` rules. [accessed: November 20, 2018]. [Online]. Available: [https://access.redhat.com/documentation/en-US/Red\\_Hat\\_Enterprise\\_Linux/4/html/Security\\_Guide/s1-firewall-iptables-fwd.html](https://access.redhat.com/documentation/en-US/Red_Hat_Enterprise_Linux/4/html/Security_Guide/s1-firewall-iptables-fwd.html)
- [5] Nat - network address translation. [accessed: November 20, 2018]. [Online]. Available: [https://www.karlsruh.net/en/computer/nat\\_tutorial](https://www.karlsruh.net/en/computer/nat_tutorial)