IK1203 VT20 - Networks and Communication

Lab 2 Network Services

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Task 1

Lab Preparation

This lab will give hands-on experience working with Virtual Machines and setting up Internet services and servers. You will learn how to set up a Linux virtual machine, configure a small virtual network, and test basic network services.

Note 1: You need to complete the preparatory Canvas quiz for this lab before coming to the lab session. It is important that you can demonstrate that you read the lab manual already and are familiar with the required concepts. You cannot start the lab session without passing the quiz in advance.

Note 2: Please come to the lab on time, for the session that you are registered in Canvas.

Note 3: Before coming to the lab session, download Virtual Box software and the virtual machine image file for the lab to your laptop. Installing Virtual Box on your laptop and setting up virtual machines is also highly recommended (Task 2).

1.1 Learning Objectives

Upon completion of this lab, you will be able to demonstrate the following:

- Installation and configuration of virtual machines using VirtualBox.
- Operation of a DHCP server in a network.
- Operation of a DNS server in a network.

1.2 Introduction

This section provides introductory information about the DHCP and DNS servers, which might be helpful to pass the quiz on Canvas.

1.2.1 DHCP Servers

Dynamic IP address assignment methods are often classified as being either stateful or stateless. In stateful address assignment, there is a server that keeps track of the IP addresses that are currently in use, and of the IP addresses that could be assigned to new hosts. The Dynamic Host Configuration Protocol (DHCP) is an example of a protocol for stateful address assignment. In contrast, with stateless address assignment, it is up to each individual host to find an appropriate address to use, for example with the help of a router that announces a network prefix that the hosts should use for constructing addresses. There are many examples of stateless address assignment protocols, such as Appletalk, IPX, CLNP and IPv6. We will, however, not look into stateless address assignment methods any further in this lab.

1.2.2 DNS Servers

When we are using the Internet, it is much more convenient for us humans to use names, like www.google.com, instead of IP addresses, such as 173.194.71.147. In order to do so, we rely on the Domain Name System (DNS) service. DNS is a directory service that maps human readable names to IP addresses (and vice versa). It is a distributed and hierarchical service.

In order for a computer to use DNS, it is configured with the IP address of a *resolving* name server (sometimes called the “default” or “local” name server). The computer sends its DNS queries to the resolving name server, which will find out the answer to the query on behalf of the computer. The resolving name server has a cache with answers to recent queries, so in some cases the resolving name server already has the answer. For other queries, the resolving name server may have to ask other servers – root name servers, Top-Level Domain (TLD) name servers, and authoritative name servers, for instance.

1.2.3 Querying DNS Servers

“Dig”, (Domain Information Groper) is a powerful tool to query DNS servers. It is particularly useful for troubleshooting. You are required to show the output of several dig commands to the Lab Instructors in order for them to verify your configuration. First, let us try to decipher the output of the dig command. When you pass a domain name to the dig command, by default the result is that it will display the A record (the IP address) for the domain name, as shown below. Figure 1.1 shows the output of the dig command for the domain name “www.google.com”.

```
student@laptop:~$ dig www.google.com

; <<>> DiG 9.11.3-1ubuntu1.3-Ubuntu <<>> www.google.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 51317
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 4, ADDITIONAL: 9

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4096
; COOKIE: 6a5b31197458c00204abb6c45c458e671e6fffe9bd39a151 (good)
;; QUESTION SECTION:
;www.google.com.                                  IN          A

;; ANSWER SECTION:
www.google.com.         271         IN            A           216.58.207.228

;; AUTHORITY SECTION:
google.com.             96266       IN            NS          ns4.google.com.
google.com.             96266       IN            NS          ns1.google.com.
google.com.             96266       IN            NS          ns3.google.com.
google.com.             96266       IN            NS          ns2.google.com.

;; ADDITIONAL SECTION:
ns1.google.com.         262282      IN            A           216.239.32.10
ns2.google.com.         262162      IN            A           216.239.34.10
ns3.google.com.         87251       IN            A           216.239.36.10
ns4.google.com.         98509       IN            A           216.239.38.10
ns1.google.com.         262282      IN            AAAA        2001:4860:4802:32::a
ns2.google.com.         262162      IN            AAAA        2001:4860:4802:34::a
ns3.google.com.         98509       IN            AAAA        2001:4860:4802:36::a
ns4.google.com.         98509       IN            AAAA        2001:4860:4802:38::a

;; Query time: 0 msec
;; SERVER: 130.237.72.201#53(130.237.72.201)
;; WHEN: Mon Jan 21 10:18:31 CET 2019
;; MSG SIZE  rcvd: 335
```

Figure 1.1: Output of dig for “www.google.com”

The dig command output has the following sections:

Header: The dig version number, current dig options, some details about the DNS query and response, and more.

QUESTION SECTION: This shows the query made by dig (i.e., this is your input). Since the command was “dig www.google.com”, and the default record type that dig asks for is an A record, the query was for the A record of the www.google.com domain name.

ANSWER SECTION: This is the answer dig received from the resolving name server (i.e., this is the answer to the query). In this case, the answer is the A records for www.google.com, so here is the IP address we were asking for. (You may get different answers if you run this query several times. Google, like many other large Internet sites, probably have some load sharing going on, and may direct you to different IP addresses depending on where you are, the current load on their servers, and who knows what...)

AUTHORITY SECTION: This information is also included in the DNS response. It contains the authoritative name servers for the domain in question. Basically, these are the available name servers of google.com. In this example, google.com has four name servers.

ADDITIONAL SECTION: These are so called “glue records”. This section gives the IP addresses of the authoritative name servers listed in the AUTHORITY SECTION (in this case A records with IPv4 addresses and AAAA records with IPv6 addresses). That this information is included in the response helps to improve the efficiency of DNS. Next time the resolving name server needs to make a query for a name in the google.com domain, the resolving name server already knows which authoritative name servers to ask, without having to first query root servers and TLD server.

Stats Section: This section, found at the bottom of the output, shows statistics including how much time it took to execute this query. It also shows from which name server the answer came, so here you can see the IP address of the resolving name server (130.237.72.201).

1.2.4 DNS Server Configuration

In this lab, we will configure the DNS server for our network. We will use the Berkeley Internet Name Daemon (BIND) software, which is the reference implementation for DNS in Linux. We will set up a “Master” name server in BIND. A name server maintains a “zone”, which is a part of the domain name space, and the name server is an authoritative name server for the names in the zone. For example, if our domain is “example.com” our zone is “example.com.” If we have a sub-domain under this domain, for instance, “eng.example.com”, then this would be another zone “eng.example.com.” It should be noted that our domain-name “example” is also a sub-domain of the global top-level domain “.com.” Zones are described in zone files (sometimes called master files and normally located in the directory /var/named). Please note that a “master” is typically a name server that gets its zone data from a local file, as opposed to a “slave” which gets its zone data from an external (networked) source (often the “master”, but not always). That a name server is a master server is declared by including “type master” in the zone declaration section of the BIND configuration file (which is called “named.conf“ and located in /var/named), as shown below:

```
zone "example.com" {
    type master;
    file "pri.example.com";
};
```

Figure 1.2: example.com fragment from the BIND configuration file named.conf

A minimal zone file for “example.com” is shown below:

```
$TTL    86400
$ORIGIN example.com.
@       IN      SOA     ns1.example.com. root.example.com. (
                        1               ; Serial
                        604800          ; Refresh
                        86400           ; Retry
                        2419200         ; Expire
                        86400 )         ; Negative Cache TTL
        IN      NS                      ns1.example.com.
        IN      MX 10 mail.example.com.
```

```
ns1    IN     A                      192.168.100.1
www IN     A                         192.168.100.2
mail  IN    CNAME                    www.example.com.
```

Figure 1.3: zone file fragment for example.com

1.2.5 Reverse Mapping Overview

A typical DNS query would be in the form of "what is the IP address of host www in domain example.com". There are times, however, when we want to find out the name of the host with a certain IP address. This is called "reversed mapping". This is useful for diagnostic purposes; frequently these days it is also used for security purposes to trace a hacker or spammer. Indeed, most modern mailing systems use reverse mapping to provide simple, first-cut, authentication using a dual look-up process – IP to name and name to IP. It is not mandatory to have IPv4 reverse mapping for all addresses. However, as indicated by the mail example, it is essential for SMTP hosts that send mail, either as Mail Transfer Agent (MTA) or a Mail User Agent (MUA).

Reverse mapping is done through regular DNS lookups. Since DNS queries consist of translating a domain name to a DNS record, we need to have a way of representing IP addresses as domain names. For this, we use the special zone "IN-ADDR.ARPA." An IPv4 address is converted to a domain name by first reversing the address, and then appending "IN-ADDR.ARPA." So the domain name corresponding to IPv4 address 130.237.28.40 is "40.28.237.130.IN-ADDR.ARPA". The record type for reverse mappings is called "PTR". (For IPv6 addresses, the special zone is "IP6.ARPA.")

So a zone file for reverse mapping of IPv4 addresses consists of names in the IN-ADDR.ARPA domain and PTR records. For example, the following is a zone file with reverse mapping for two IPv4 addresses, 192.168.100.1 and 192.168.100.2.

```
$TTL             86400 ; 24 hours, could have been written as 24h or 1d
$ORIGIN 100.168.192.IN-ADDR.ARPA.
@  1D  IN         SOA ns1.example.com.           root.example.com. (
                                                 2002022401 ; serial
                                                 3H ; refresh
                                                 15 ; retry
                                                 1w ; expire
                                                 3h ; minimum
                                                 )
    IN          NS               ns1.example.com.
    IN          NS               ns2.example.com.
1   IN          PTR              ns1.example.com.
2   IN          PTR              www.example.com.
```

Figure 1.4: reverse zone file fragment for example.com

1.2.6 The Resolver

The resolving name server is part of the IP configuration of a computer (typically this comes from DHCP). Where this information is stored depends on the operating system, a common place is the file **resolv.conf**, which is used to configure the DNS resolver library. The file is a plain-text file usually created by the network administrator or by applications that manage the configuration tasks of the system. The **resolvconf** program is one such program on Linux and other Unix machines which manages the **resolv.conf** file.

In most Unix-like operating systems and others that implement the BIND DNS resolver library, the **resolv.conf** configuration file contains information that determines the operational parameters of the DNS resolver. The **resolv.conf** file contains the IP addresses of name servers that are available to the host in question. This is specified with the "nameserver" directive, for example:

```
nameserver 192.16.1.254
```

Here, you will set up our own DNS server, so this entry should be the IP address of the computer with your server.

Task 2

Virtual Machine Installation

You will install two virtual machines using VirtualBox and configure Internet services on these machines. At the end of these steps, you should be able to start the two virtual machines and connect them in the way shown in Figure 2.1.

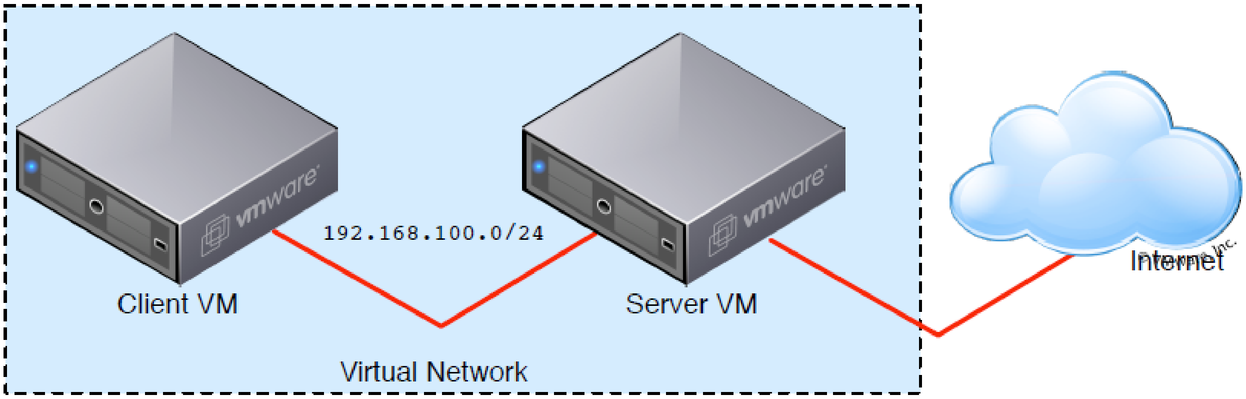


Figure 2.1: Virtual Machine Topology

2.1 Preparing your System

You will need at least 1GB memory and 16GB of free space on your computer's hard disk drive. You will also need to download the following software.

- A VirtualBox (latest edition) distribution for your platform of choice.
- An virtual machine image (Ubuntu 14.04)

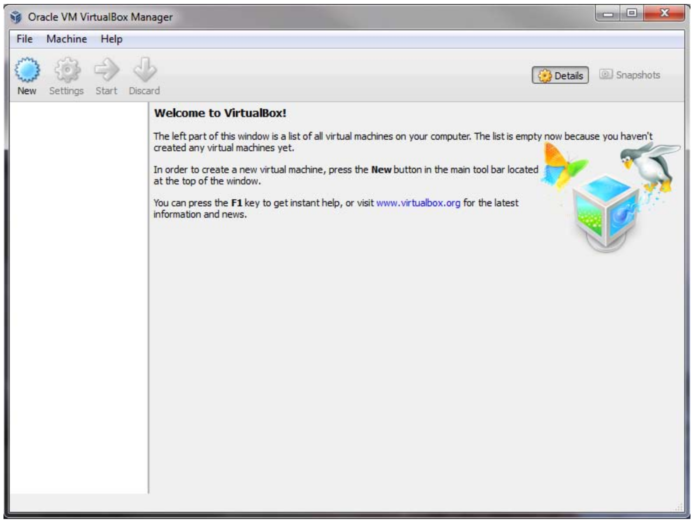
Note: It is mandatory to download VirtualBox as well as the virtual machine image before the lab session. Install VirtualBox and configure the virtual machines before the lab session to speed up the process.

2.1.1 VirtualBox Installation

To Install VirtualBox, perform the following steps:

1. Download the latest release of VirtualBox for your operating system from https://www.virtualbox.org/wiki/Downloads
2. Run the installation wizard (just accept the default options).

When the installation of VirtualBox is complete, run the application. You should see a main window similar to what is shown in Figure 2.2.



Welcome to VirtualBox!

The left part of this window is a list of all virtual machines on your computer. The list is empty now because you haven't created any virtual machines yet.

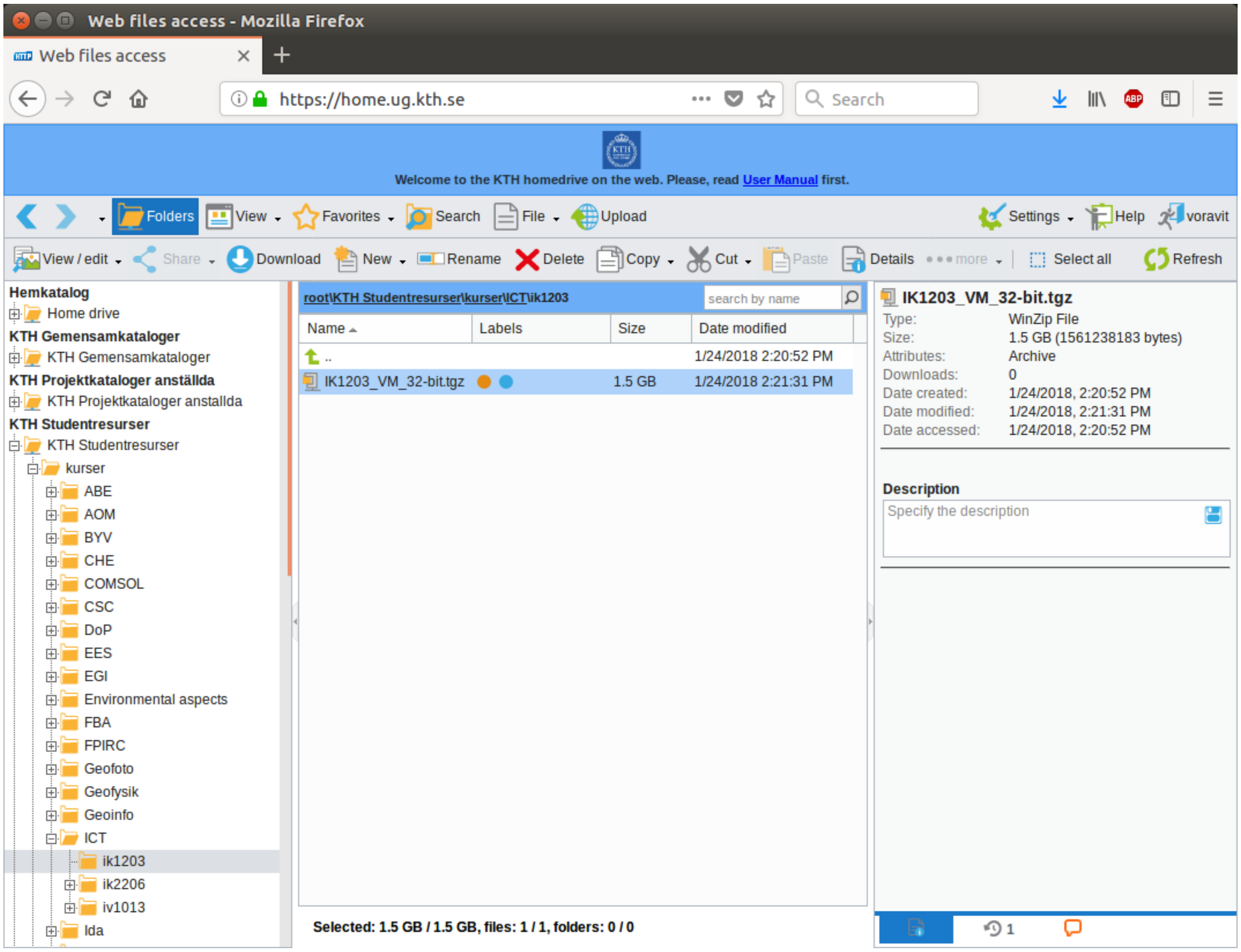
In order to create a new virtual machine, press the **New** button in the main tool bar located at the top of the window.

You can press the **F1** key to get instant help, or visit www.virtualbox.org for the latest information and news.

Figure 2.2: VirtualBox Main Window

2.1.2 Setting up the VM

Download the Ubuntu 14.04 image from https://home.ug.kth.se following the path as shown in the Figure 2.3.



Welcome to the KTH homedrive on the web. Please, read User Manual first.

root\KTH Studentresurser\kurser\ICT\ik1203

Name	Labels	Size	Date modified
..			1/24/2018 2:20:52 PM
IK1203_VM_32-bit.tgz	● ●	1.5 GB	1/24/2018 2:21:31 PM

Selected: 1.5 GB / 1.5 GB, files: 1 / 1, folders: 0 / 0

IK1203_VM_32-bit.tgz

Type:	WinZip File
Size:	1.5 GB (1561238183 bytes)
Attributes:	Archive
Downloads:	0
Date created:	1/24/2018, 2:20:52 PM
Date modified:	1/24/2018, 2:21:31 PM
Date accessed:	1/24/2018, 2:20:52 PM

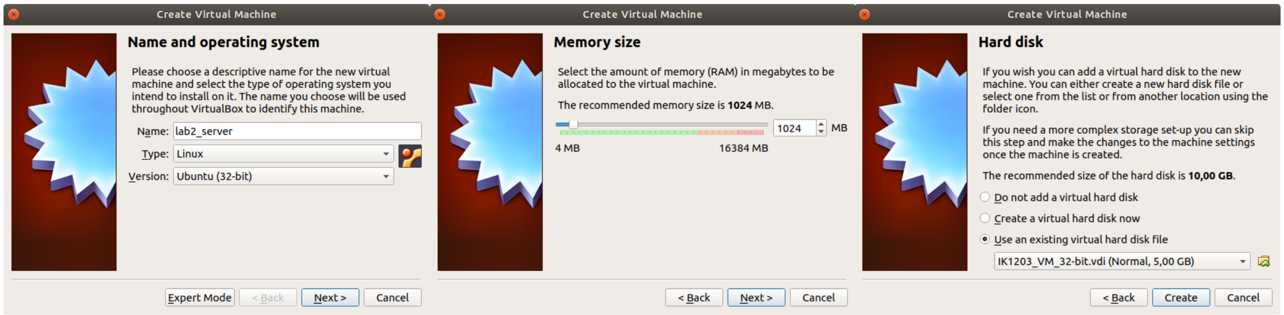
Figure 2.3: Location of Ubuntu 14.04 image (KTH Studentresurser→ kurser→ICT→ik1203)

Unzip the image to get an uncompressed file “IK1203_VM_32-bit.vdi”.

Follow these instructions to set up the virtual machine:

1. Click the **New** icon in the VirtualBox main window. This brings up the dialog depicted in Figure 2.4(a).
2. In this dialog, enter the following parameters:
   - **Name:** lab2_server
   - **Type:** Linux
   - **Version:** Ubuntu (32-bit)
3. Click **next** to proceed with the virtual machine creation. At this point, a folder “lab2_server” should be created inside the “VirtualBox VMs” folder on your home directory. Now, move the file “IK1203_VM_32-bit.vdi” into “lab2_server” folder.
4. In the next dialog (shown in Figure 2.4(b)) you will have the option of selecting the memory size to allocate to your virtual machine. Leave the default option and click next to continue.
5. In the following dialog (shown in Figure 2.4(c)) you will be asked to create a hard drive for your virtual machine. Select the “**Use an existing virtual hard disk file**” option and select the file “IK1203_VM_32-bit.vdi”. Click **create** to continue.
6. Right click on the lab2_server image that you have just created in VirtualBox. Choose **Clone**.
7. Change the name to lab2_client, then continue.
8. Choose **Linked clone** as clone type, then continue.

If you have followed all of the instructions correctly, you should be returned to the main window. On the left side, you should see the two new virtual machines that you have created.



Name and operating system

Please choose a descriptive name for the new virtual machine and select the type of operating system you intend to install on it. The name you choose will be used throughout VirtualBox to identify this machine.

Name: lab2_server

Type: Linux

Version: Ubuntu (32-bit)

(a) create Virtual Machine Dialog

Memory size

Select the amount of memory (RAM) in megabytes to be allocated to the virtual machine.

The recommended memory size is **1024** MB.

1024 MB

4 MB 16384 MB

(b) Select Memory Size Dialog

Hard disk

If you wish you can add a virtual hard disk to the new machine. You can either create a new hard disk file or select one from the list or from another location using the folder icon.

If you need a more complex storage set-up you can skip this step and make the changes to the machine settings once the machine is created.

The recommended size of the hard disk is **10,00 GB**.

○ Do not add a virtual hard disk

○ Create a virtual hard disk now

● Use an existing virtual hard disk file

IK1203_VM_32-bit.vdi (Normal, 5,00 GB)

(c) Create Hard Drive Dialog

Figure 2.4: Create Virtual Machine Dialogs

2.2 Virtual Machine Configuration

Before starting the newly created virtual machines, we will configure them so that they are arranged as described in our topology in Figure 2.1. Let us first configure the server VM.

2.2.1 Server Virtual Machine Configuration

To configure the server VM, do the following:

1. Select the server VM in the VirtualBox Manager window and click the **Settings** icon in the toolbar. This displays the Virtual Machine settings dialog.

2. Select the **Network** settings, and under **Adapter 1** change the attachment point to **NAT (**if it is not selected already).

3. Expand the **Advanced** tab and make sure the **Cable connected** option is checked.

4. Next, under the **Adapter 2** tab, check the **Enable Network Adapter** checkbox.

5. Change the attachment point for this adapter from **Not Attached** to **Internal Network**. Make sure the **Name** is **intnet**.

6. Expand the **Advanced** tab and also make sure the **Cable connected** option is checked for this network adapter.

2.2.2 Client Virtual Machine Configuration

Let us proceed to make similar changes to the Client VM.

1. Select the client VM in the VirtualBox Manager window and click the **Settings** icon in the toolbar. This displays the Virtual Machine settings dialog.

2. Select the **Network** settings, and under **Adapter 1** change the attachment point from **NAT** to **Internal Network**. Also make sure that the **Name** is **intnet**. Note that **Adapter 2** in the next tab should not be used (The checkbox "Enable Network Adapter" should not be checked!)

3. Expand the **Advanced** tab and make sure the **Cable connected** option is checked.

Task 3

DHCP Server Configuration

Congratulations, now you can start the virtual machines!
Start both server and client VMs by selecting them and click **Start**. Login with this username and password:

Username: student
Password: lab_IK1203

Note: if you suffer from a 'login loop', where the virtual machines return to the input password interface even after you type the correct password, one possible cause is that the virtualization option is not enabled in your BIOS.
Solution: Enter the BIOS interface before entering your system (Search in google 'YOUR-LAPTOP-Series' + BIOS to find the approach, usually by pressing F2/F8/F10 after you start the laptop). Then find the hardware accelerated virtualization option in BIOS and enable it. Save the changes and restart your laptop.

By default, there is no IP address assigned for **eth1** on server VM and **eth0** on client VM. Start the Terminal in both server and client VM and proceed with the following steps:

3.1 Networking the Server VM

To configure the network for network your **Server** Virtual Machine, do the following:

1. List all of the available interfaces on the VM, using the "ifconfig" command.
2. If **eth0** is not listed in your listing above, initiate a dhcp client request for it. This is the NAT-enabled interface. Confirm that an IP address has been assigned. Check that the assigned address is **not** in the range of 192.168.100.0/24 network, which will be used later on. (Hint: the command for doing this follows the same syntax as you have answered in one of the questions on Canvas quiz. You need to configure your interface with **sudo** in the beginning of command in order to get the root user privileges)
3. Assign the static IP address **192.168.100.1/24** to the network adapter **eth1**. In this case, the IP address needs to be assigned manually. Click the Network Manager icon in the toolbar at the top (a symbol with two arrows or the wifi symbol), go to Edit Connection. Select Wired connection 1 and Edit. In the Ethernet tab, select interface **eth1** in the Device MAC address, then change to the IPv4 Settings tab and change the Method to Manual. Click on Add and add the Address 192.168.100.1 and Netmask 24. Then save the changes and restart the server virtual machine. After rebooting, use "ifconfig" in the terminal to verify that **eth1** interface has been assigned the correct IP address 192.168.100.1.
4. Check that you have Internet reachability by pinging www.google.com. If it fails, there is something wrong with your configuration, and you may need to ask the lab assistants for some help.
5. List all of the available interfaces on the VM again using "ifconfig" to make sure that **eth0** and **eth1** are properly configured.

In order to simplify the configuration of our server, we will use the Webmin web-interface. This will make the configuration of our network services a lot simpler. Webmin is running as a web server on the server virtual machine, and can be accessed using the Firefox browser in the server VM to visit https://localhost:10000. Once you get to Webmin, login using the student user credentials as given at the beginning of this section.

3.2 DHCP Server Configuration

Before we configure the DHCP server, let us confirm that the IP address has been properly assigned to **eth1**. (An incorrect IP address assignment on this interface will cause the DHCP server to fail.) To confirm the configuration of **eth1** using Webmin:

1. In Webmin, go to **Networking → Network Configuration → Network Interfaces**.
2. Confirm that **eth1** has the correct IP address settings (192.168.100.1). If not, click the device and configure it accordingly.

To configure a DHCP Server using Webmin:

1. Select **Servers → DHCP Server → add a new subnet**.
2. In the form that appears, enter the following information:
   (a) **Subnet Description**: Client subnet
   (b) **Network Address**: 192.168.100.0
   (c) **Netmask**: 255.255.255.0
   (d) **Address ranges**: 192.168.100.100 - 192.168.100.200
3. Leave everything else the same and click **create**
4. Check if the DHCP server listens for incoming queries on **eth1** interface. You can check it (and change if necessary) using **Edit Network Interface** button.
5. If everything was entered correctly, you can start the DHCP server by clicking the **Start Server** button at the bottom of the page.

3.3 Networking the Client VM

Now that we have configured the DHCP server correctly, we need to test it to see if our configuration works as expected. To do this, start the client VM, if you have not already done so.

1. List all available interfaces on the VM using “ifconfig”.
2. Initiate a DHCP client request on **eth0**. It should get an IP address from the DHCP server running in the server VM, within the address range 192.168.100.100 – 192.168.100.200
3. Confirm that the IP address has been correctly assigned. If there are problems, consult the lab assistants.
4. Look at the information contained in the files **/etc/dhcp/dhcpd.conf** located in the server VM and **/var/lib/dhcp/dhclient.leases** located in the client VM, and be prepared to explain them to the lab assistants. (Hint: you can use the “gedit” text editor to open these files)

Task 4

DNS Server Configuration

4.1 Set up the resolver Using Webmin

1. In Webmin on the server VM, go to **Networking →Network Configuration →Hostname and DNS Client**
2. Under DNS servers, you should already have some IP addresses specified. Webmin allows you to specify a Primary, Secondary and Tertiary DNS Server. Shift the existing entries down making them Secondary and Tertiary. Add the IP address **192.168.100.1** at the top of the list making it Primary.
3. In the search domains, select **listed** and enter **mylabdomain.com** in the text field.

If you cannot save the changes in Webmin, try the following:

Inside the server VM, enter the command sudo gedit /etc/resolv.conf and modify the file to look like this:

```
nameserver 192.168.100.1
nameserver 127.0.1.1
search mylabdomain.com it.kth.se
```

Then save the file and you should be able to see the changes after refreshing the Webmin page by going to **Networking →Network Configuration →Hostname and DNS Client**

4.2 DNS Server Configuration

In Webmin, go to Servers. Then click on "**BIND DNS Server**".

4.2.1 Creating a Master Zone

1. Click on "**Create master zone**"
2. Enter **mylabdomain.com** into the **Domain name / network** box.
3. For the master server, type in **ns1.mylabdomain.com** name as well.
4. Check the **Add NS record for master server?** box, if it is not already checked.
5. Enter **root@mylabdomain.com** in the **Email address** field.
6. Click **Create**

You will then be redirected to the **Edit Master Zone** page for the domain you have just created. This page can be used to add different types of DNS Records. We will now proceed to create records for our domain. First type of records we want to add is **A Records** (Address Records). To add **A Records** do the following:

4.2.2 Creating A Records (Address Records)

1. From the **Edit Master Zone** Page.
2. Click on **Address**
3. Leave the **Name** field blank, and type in **192.168.100.1** in the **Address** field.

4. Click **Create**.
5. Now add another A Record, type in **www** for the **name**, and type in **192.168.100.1** in the **Address** field.
6. Click **Create**.
7. Let's recall that we used **ns1.mylabdomain.com** when we created the zone. We also need to add an A Record for this. Type in **ns1** for the **name**, and type **192.168.100.1** in the **Address** field.
8. Click **Create**.
9. At the bottom, click **Return to Record Types**.

This is the bulk of setting up DNS through Webmin for our domain. We will need to start BIND in order to see the effects of our configuration. It is however, good practice to check that we have configured BIND correctly. From the **Edit Master Zone** Page, click the **Check Records** button at the bottom of the page. If no errors are reported, you can proceed with the lab instructions. If any errors are reported, ask the lab assistants to help you. In order to start BIND, click the **Start BIND** at the top right corner of the page.

Run the following dig command inside the terminal window of server VM and see the response:

```
dig @localhost mylabdomain.com
```

Make sure the answer in the ANSWER section is correct. Now, enter a dig command to find the Name Server (NS) record for your domain. This can be done by adding NS at the end of command given above. Observe the difference between two replies from the DNS.

4.2.3 Creating MX Records (Mail Exchange Records)

Create a Mail Exchange (MX) record with the following parameters:

- **Name**: mylabdomain.com
- **Mail Server**: mail.mylabdomain.com
- **Priority**: 1

Also add an address (A) record for **mail**, as you have done previously for **www** and **ns1**. Now, use dig command to find the MX record.

Note: Always click **Start BIND** in the top right corner after making any changes to the DNS server.

4.2.4 Modifying DHCP server configuration

Modify the DHCP server configuration in order to tell the client VM that it can now use the DNS server. Go to the DHCP server previously created, press **Edit Client Options** button and enter the following parameters:

- **Domain name**: mylabdomain.com
- **DNS servers**: 192.168.100.1

Click **Apply Changes** button in order for the changes in DHCP server to take effect.

4.2.5 Querying DNS server from client

From the client VM, force the **eth0** network interface to acquire an IP address (as done in Section 3.3). This time, the **/etc/resolv.conf** file should be updated with the IP address of name server. Check this by entering the following in terminal window of client VM:

```
gedit /etc/resolv.conf
```

Once the client has been properly configured, attempt to query the DNS server from client using the following commands:

```
dig mylabdomain.com
```

```
ping mylabdomain.com
```

Note: Before trying this, make sure that **eth1** interface on the server VM has the correct IP address 192.168.100.1

4.2.6 Adding a Reverse Mapping zone

Now, create a new zone in the DNS server in order to perform reverse lookups for 192.168.100.1. Create a new Master zone with the following parameters:

- **Zone Type**: Reverse
- **Domain name/Network**: 192.168.100.1
- **Master Server**: ns1.mylabdomain.com (Check the option "Add NS record for master server?")
- **Email**: root@mylabdomain.com

Add a reverse address record with the following parameters:

- **Address**: 192.168.100.1
- **Hostname**: mylabdomain.com

In the client VM, enter the following dig command to look up for the reverse record:

```
dig -x 192.168.100.1
```

Congratulations!!
This concludes the lab.

Appendix

This lab instruction has been through many iterations of updates by the following people:
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