Practicum Module II

Identification of Network Hardware

Dynamic and Static IP Configuration

Competencies:

- ❖ Students are able to identify network devices on a computer with Linux and Windows operating systems.
- ❖ Students are able to configure hosts to connect to DHCP servers
- ❖ Students are able to change the IP address of a host

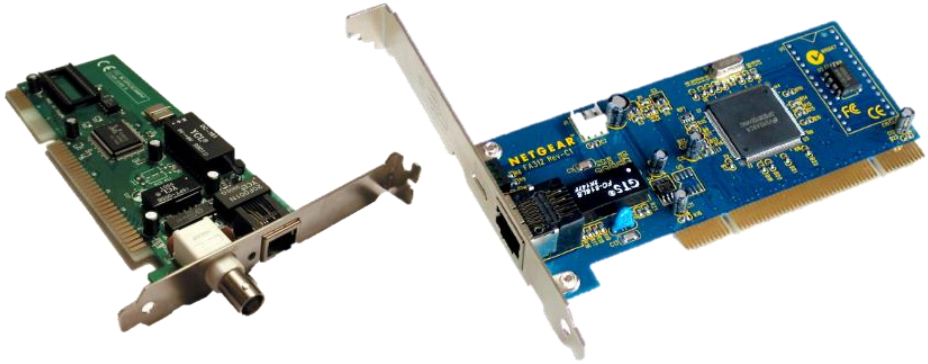
Tools and Materials:

- Software Simulator GNS3
- Stable Internet Connection
- Connect to a VPN Server

Theory review:

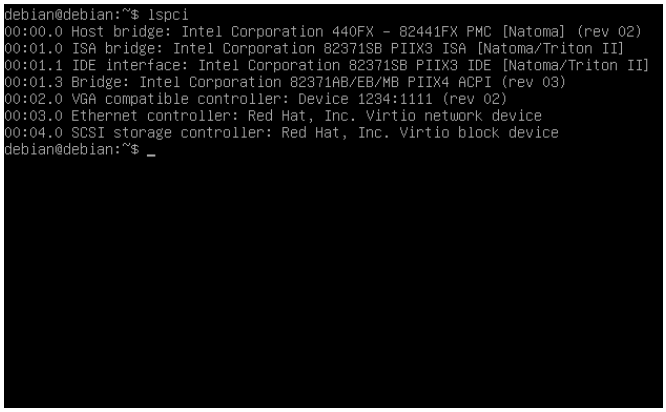
1. Network Hardware Identification

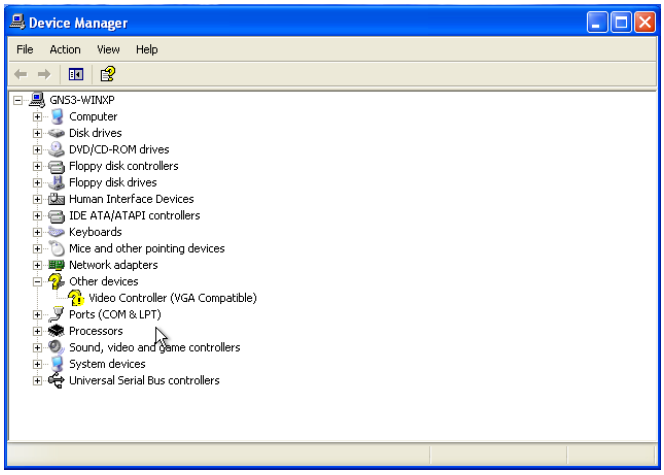
To be connected to a network, a network device must have at least one Network Interface Card (NIC). NIC itself can be shaped like a card attached to a PCI slot from a computer, or in another form (can be through a USB or On-Board slot on a computer). In the modern era as it is today, a NIC is already packaged into a single chip package commonly called embedded IC. So that the NIC device that was once very clearly visible, becomes like it is not visible on a computer.



Although it is not physically visible on a computer, it can be seen in the list of devices installed in an operating system. On microsoft windows-based operating systems, the NIC can be seen in the Device Manager. While on UNIX-based operating systems such as Linux for

example, the NIC can be seen by using the lshw command on the terminal. But first you have to install the lshw package. If the NIC is attached to a PCI slot, you can detect the NIC by using the lspci command on the terminal. Whereas if the NIC is attached to a usb slot, you can detect the NIC by using the lsusb command on the terminal.





2. Network Device IP Address Settings

To connect to a network, a host must have a unique identifier address on that network. In tcp /IP networks the address commonly used is an IP address or commonly called an IP address. In determining ip address there are two mechanisms that can be used, namely:

- Static IP assignment (manual)
- Dynamic IP assignment (automatic through service)

A. Static IP assignment

Static IP addresses are adequate for small or stable networks (designed), but become difficult and error-prone as the network grows and the number of hosts increases. At static addressing, the administrator assigns the number and subnet mask to each host on the network. This setting applies to either PCs, routers, or other network equipment (mobile phones, etc.). Every network interface connected to a network requires this addressing information.

Administrators also need to provide default gateway locations and DNS servers for each host in the network. This setting is required for access to its off-network. Whenever a change is made (e.g. default gateway change) then each IP addressing configuration on each host must be updated. That's why static IP addressing becomes complicated as the network configuration changes or evolves.

So it can be concluded that:

- With static IP addressing, administrators provide a complete IP addressing configuration for each host on the network.
- Each time changes are made, the IP addressing configuration on each host must be updated.

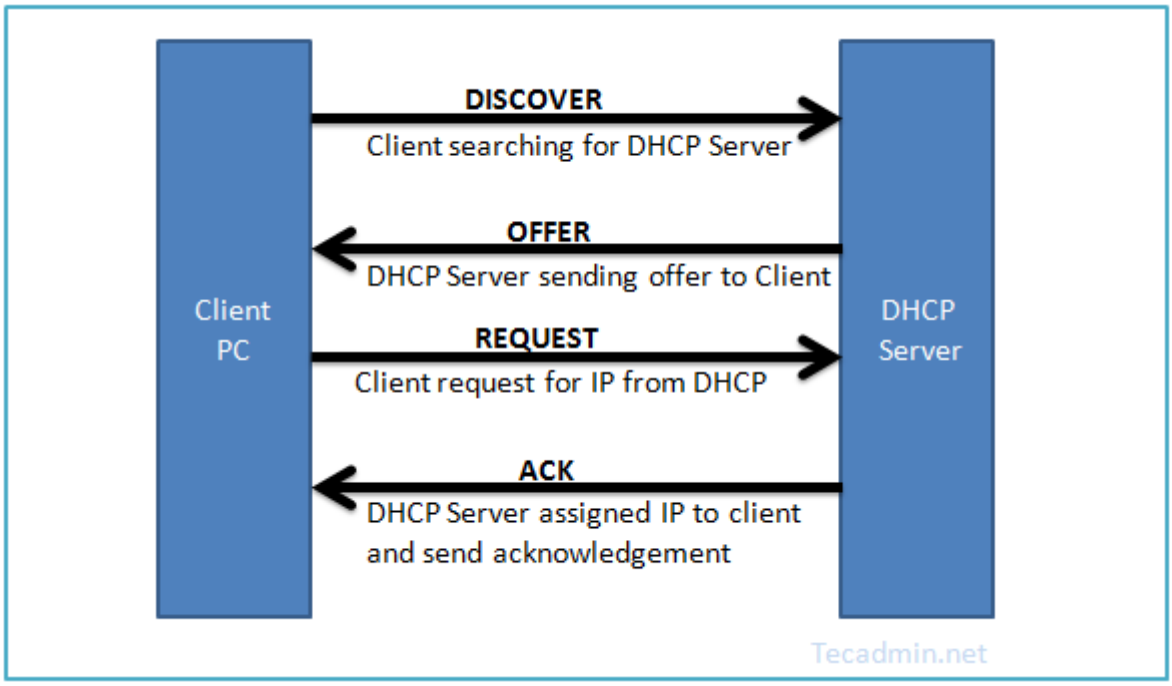
B. Dynamic IP assignment

DHCP (Dynamic Configuration Protocol) is a protocol that automatically assigns ip numbers to the computer that requests them. The computer that provides the IP number is referred to as ***the DHCP server***, while the computer that requests the IP number is referred to as ***the DHCP Client***. Thus the administrator no longer needs to manually provide the IP number at the time of TCP/IP configuration, but simply by providing reference to the DHCP Server.

When both DHCP clients are turned on, the computer requests the DHCP-Server to get the IP number. DHCP responds by providing an IP number that is in the DHCP database. DHCP Server after providing the IP number, the server lends the existing IP number to dhcp-client and cross out the IP number from the pool list. The IP number is assigned along with the subnet mask and default gateway. If no more IP numbers can be assigned, then the client cannot initialize TCP/IP, by itself unable to connect to the network.

After a certain period of time, the use of dhcp client is declared complete. And if the client does not renew the request again, then the IP number is returned to DHCP Server and then the server can provide the IP number to other clients in need. The length of this period can be determined in minutes, hours, months or forever. The term is called *the leased period.*

How DHCP works:



The sequence of information exchange processes in DHCP is known by the abbreviation D-O-R-A.

- Discover
- **O**ffer
- Request
- **A**cknowledge

DHCP Discover – A process by which clients broadcast to their network (local subnet) to find a DHCP server. Broadcast messages are conducted using IP Address 255.255.255.255 as destination IP Address and source IP Address is 0.0.0.0.

DHCP Offering - Is a message that is a response from DHCP discover performed by DHCP server to client. DHCP offer is a process by which a DHCP server sends a unicast "offering", i.e. an IP address to the host/client. If we dissect the packet sent in this DHCP offer, it will be seen that this package contains a network configuration setting for the host who sent the DHCP Discover message.

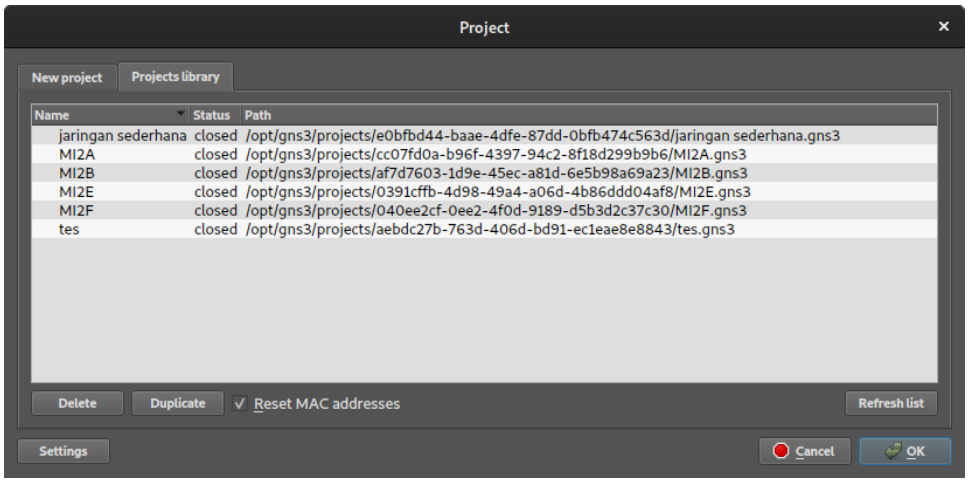
DHCP Request - A message sent by the host/ client that indicates that the host has received an offering or network configuration in the DHCP offer process. This also indicates that the IP Address has been borrowed and for a while can no longer be used by others until the lease time runs out.

DHCP Acknowledge - Is a condition in which a DHCP server sends a unicast message to a host/client. DHCP Acknowledge contains a statement from the DHCP server that at that time the client / host has authorization and authority to use the IP Address that has been offered when the DHCP offer process in their network.

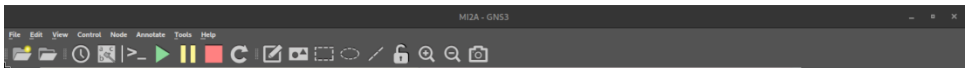
The order of the above process is shortened to DORA (Discover, Offering, Request, Acknowledge). The sequence is the default process sequence of how a host/client gets ip addressing from a DHCP server in a network.

PRACTICUM PREPARATION

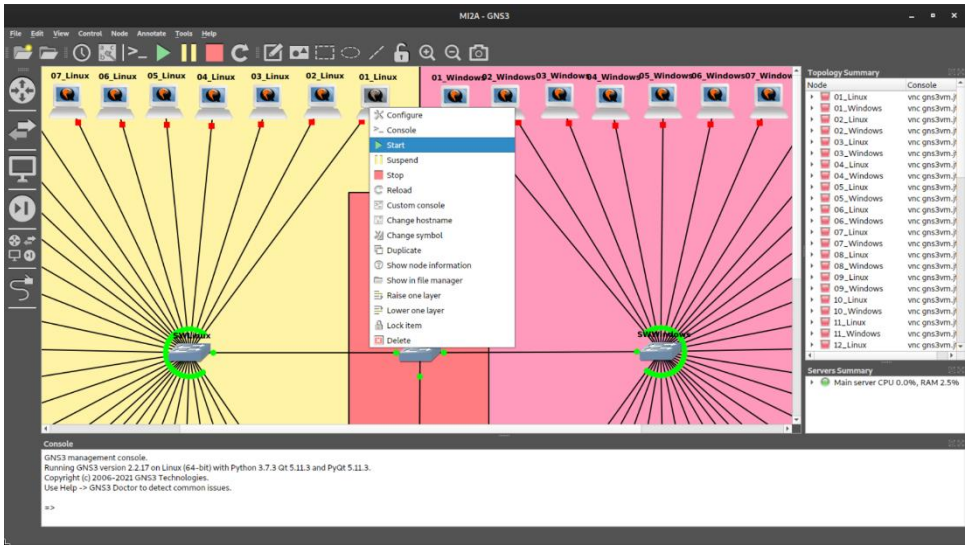
1. Connect your computer to the internet network.
2. Connect your computer to the Information Technology Department's VPN server using the OpenVPN Connect app. Use the profile, username and password you've obtained at previous meetings.
3. Once connected to an OpenVPN server, open the GNS3 app on your computer.
4. In the initial view of the GNS3 application window, select the Project library tab. Then select the project that has been set up for your class (e.g. Jarkom_TI2I). Then remove the check mark on the Reset MAC Address option. Then press the OK button.



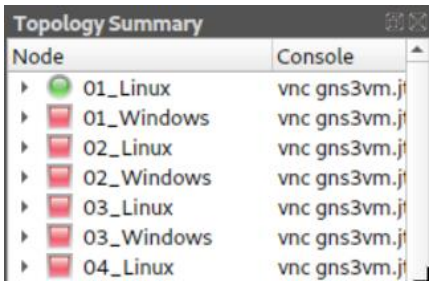
5. Then after the project opens in the main window of the GNS3 application, you can adjust the zoom on the project display as you see fit by pressing the positive magnifying glass button (to enlarge) or the negarif magnifying glass button (to minimize) on the toolbar at the top of the window.



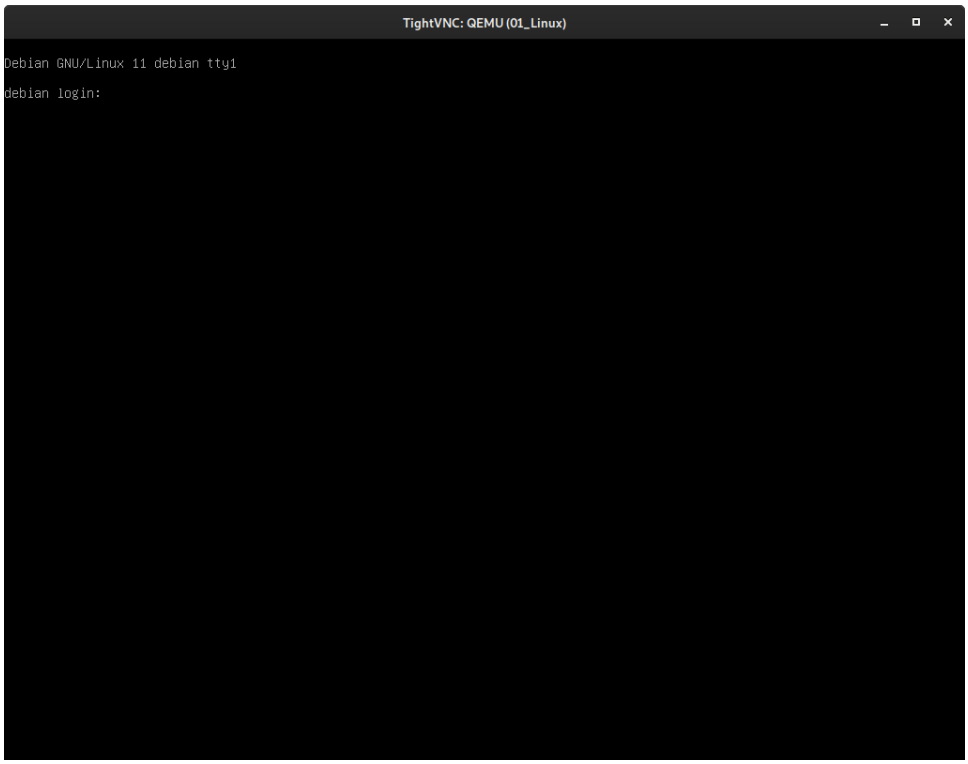
6. Then you can turn on the computer you are going to use. Right-click on the logo of the computer you want to use, then select the Start option.



7. Wait a while and you can check the status of your computer on or off in the Topology Summary sidebar to the right of the window.



8. Once your computer is on, access your computer by double-clicking (2x) on your computer logo. Then a new window will appear, which is the appearance of your computer like the picture below.



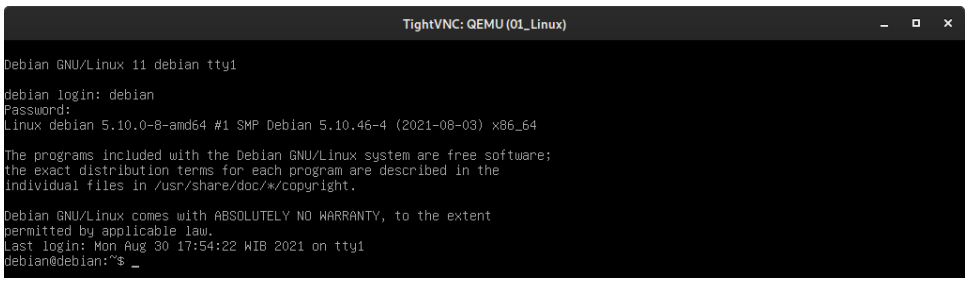
9. You can use the computer for practicum according to the next steps.

PRACTICUM STEPS

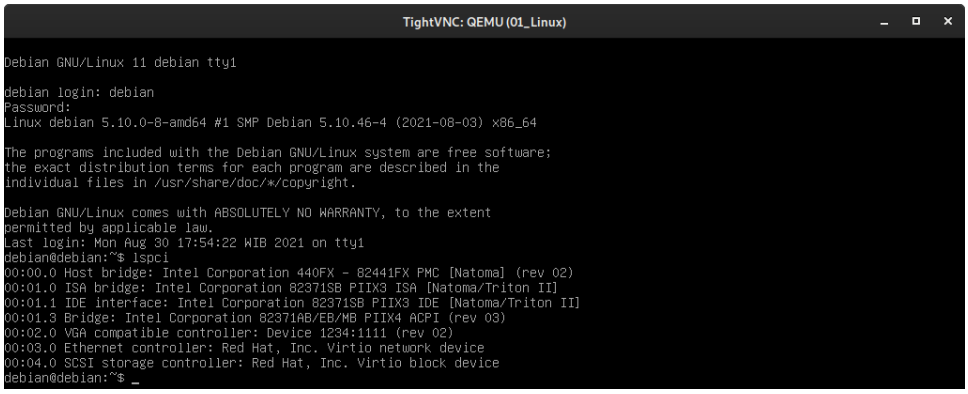
A. Network Hardware Identification

a) Identification of Linux Operating System

1. Access your Linux computer to an open class project.
2. Login to the operating system using a username and password that is "debian".



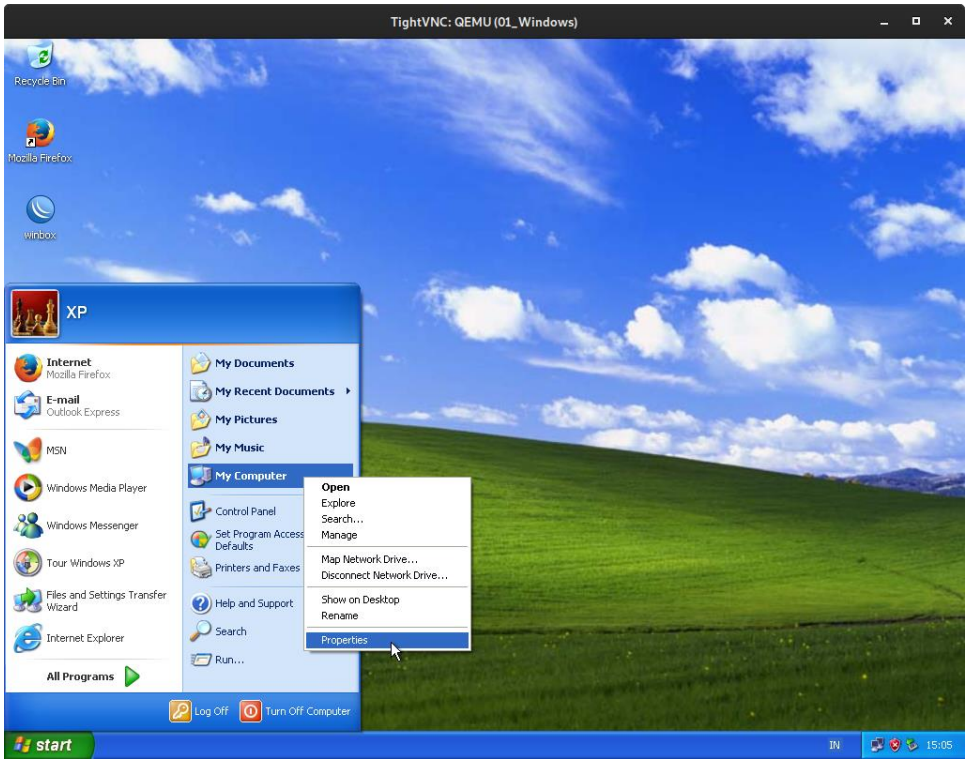
3. After successfully entering the operating system, run the lspci command. And pay attention to the output of the command.



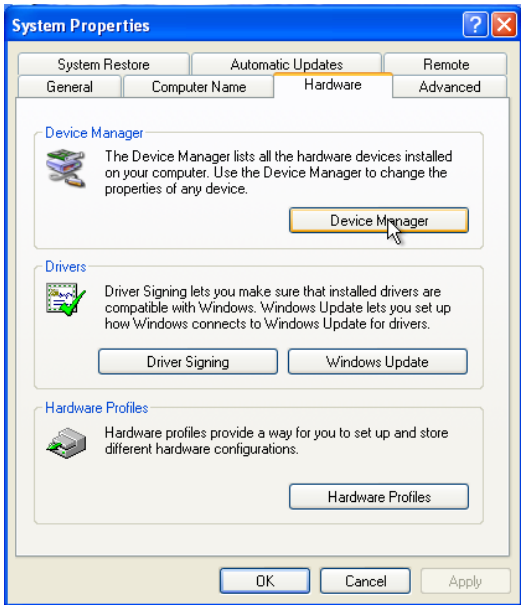
4. From the output of the command it is seen that there is a NIC with an Ethernet Controller identifier. This means that your computer has a NIC attached to the PCI slot i.e. Ethernet. In addition, it is also seen that your NIC is made by a vendor called Red Hat Inc. The type of NICs installed in your computer are virtio network devices.

b) Identification of Windows Operating System

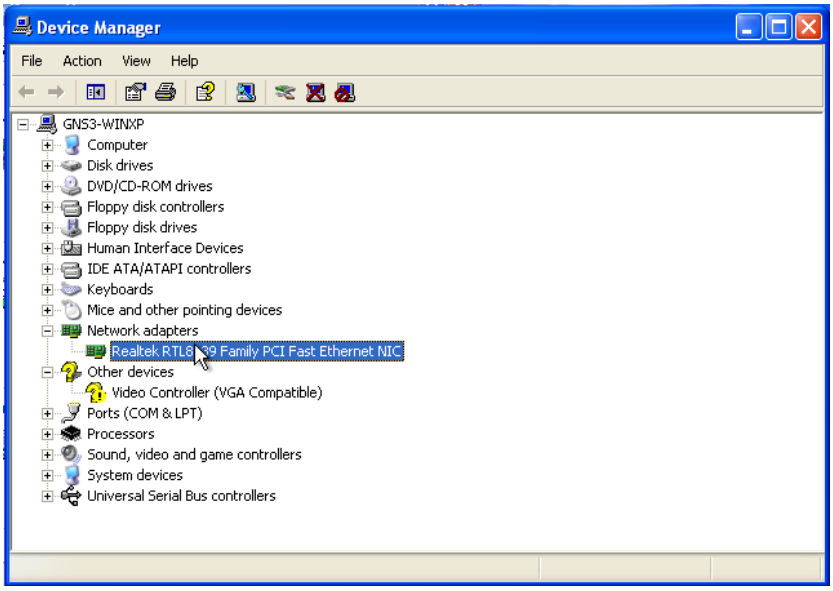
1. Access your windows computer to an open class project.
2. On your computer view, select the Start menu. Right-click on the My Computer menu and select the Properties option.



3. Then in the System Properties window, select the Hardware tab. Then press the Device Manager button.



4. In the device manager window, you can find your NIC in the Network Adapters section.



5. Based on the above view, your computer has an NIC attached to the PCI slot. Your NIC is issued by the vendor Realtek. Your type of NIC is RTL8139.

B. SETTING IP Address Dynamically

a) Settings on The Linux Operating System

1. To configure the IP address on the Linux operating system, you must first know the alias name for the NIC that has been installed on your computer. To view it, run the ip a command on your linux terminal.

```
debian@debian:~$ ip 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: ens3: <BROADCAST,MULTICAST> mtu 1500 qdisc noop state DOWN group default qlen 1000
    link/ether 0c:b9:b6:e4:e6:00 brd ff:ff:ff:ff:ff:ff
    altname enp0s3
debian@debian:~$ _
```

2. From the picture above, it appears that the alias name of the NIC on your computer is ens3. This alias name varies on each computer, and there can be more than 1 alias name if there is more than one NIC installed on the computer. Pay close attention to the alias name and record the name.
3. In the debian linux operating system you are currently using, the IP address settings of each NIC are contained in the "interfaces" file contained in the directory "/etc/network/". So to provide settings on each existing NIC, you have to change the contents of the file according to your needs.
4. To open and change the file, you can use the "nano" text editor that has been installed on your debian linux computer.
5. File "interfaces" cannot be arbitrarily changed by users who do not have privileges to the file. Generally the file should only be edited by a super user account or commonly called root. To change the file using a regular user (non-root), you can take advantage of the "sudo" utility application that is currently installed on your Linux computer.

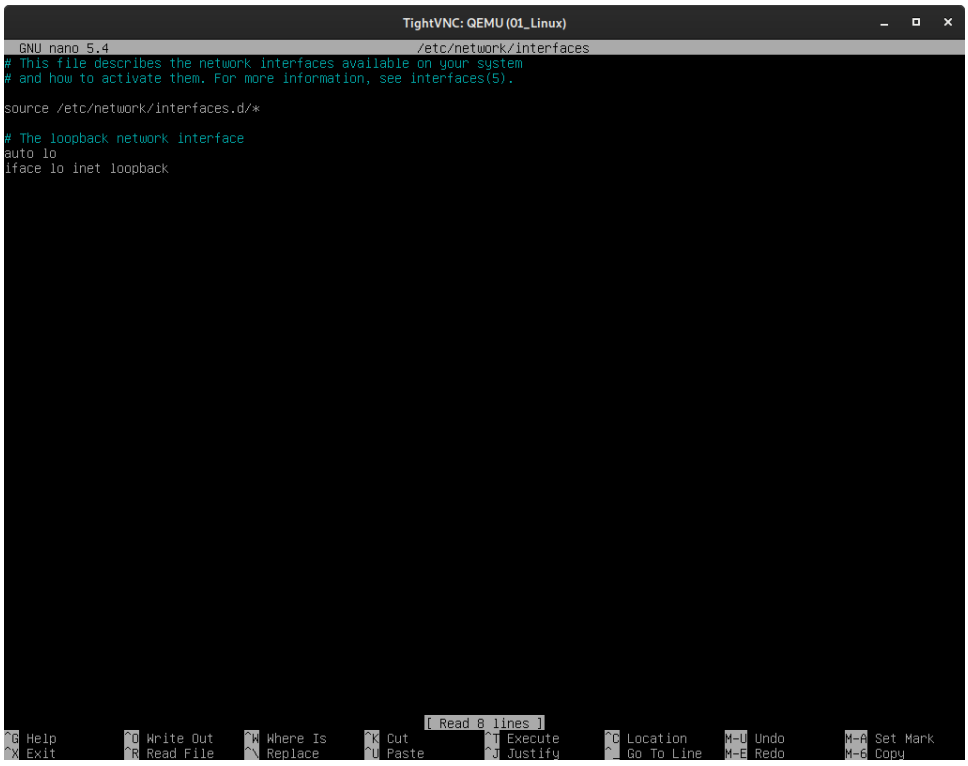
6. So it can be concluded that you can change the contents of the "interface" file using the combined command "sudo nano /etc/network/interfaces".

```
debian@debian:~$ sudo nano /etc/network/interfaces
```

7. When executing the above command, you will be asked to enter the password of your user. Please enter the password of your user.

```
We trust you have received the usual lecture from the local System
Administrator. It usually boils down to these three things:

    #1) Respect the privacy of others.
    #2) Think before you type.
    #3) With great power comes great responsibility.

[sudo] password for debian:
```

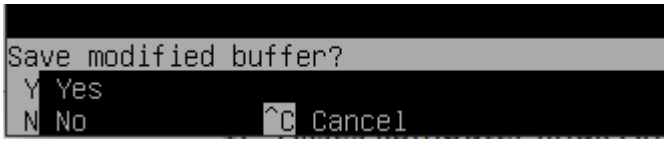
8. Then the file interfaces will open in the nano text editor like the image below.



9. In the nano text editor, there is no NIC setting installed on your computer. Add its NIC settings by adding the regulatory line at the end of the file.

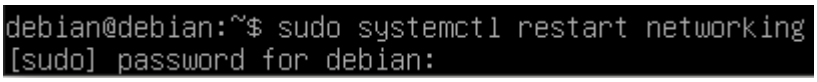
```
# The loopback network interface
auto lo
iface lo inet loopback

auto ens3
iface ens3 inet dhcp
```

10. The "auto" option in front of the alias name of the NIC means that the operating system will not allow manually made status changes (using the ifup and ifdown commands) by the user (i.e. you) in the event of turning the NIC on or off.
11. The "dhcp" option on the "iface ens3 inet" line is an option used to automatically assign IP addresses (obtained from DHCP servers) to defined NICs (NIC/ens3 interfaces).
12. After making changes to the "interfaces" file. Save and exit the nanotext editor using the key combination ctrl+x. Then you will be confirmed to make storage of the changes you have made. Just type the letter Y and then press the enter key on your keyboard.

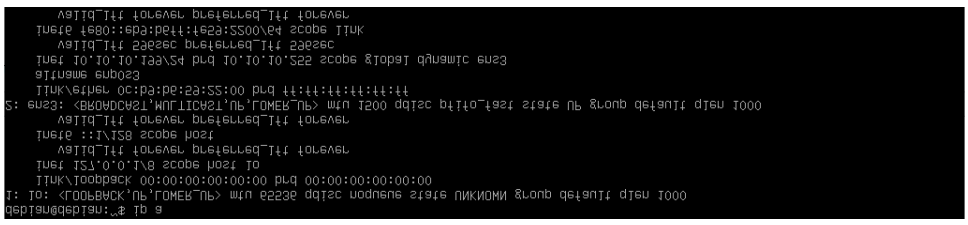


13. You'll be reconfirmed to save your changes to a file. Make sure the directory and file name listed are correct. If it's correct, press once more the enter key on your keyboard, and you'll exit the "nano" text editor.

14. Once you exit the "nano" text editor and return to the shell, reload your network service using the "systemctl restart networking" command. Don't forget to add the "sudo" command at the beginning of the command because the user you are currently using is a user with full access rights (non-root user). And enter your user password when you are asked to enter the password.



15. Wait a few moments until the terminal is back on.
16. Once the terminal is back on, run the "ip a" command to see if the NIC/Interface with the alias ens3 (which you have configured) has obtained the ip address and other network settings automatically from the DHCP server.



17. It is seen in the display above that the NIC /interface "ens3" has obtained the ip address automatically.
18. In addition to ip addresses obtained automatically from dhcp servers, your linux computer also gets the gateway address settings automatically. To view it, you can use the "ip route" command in full user access mode (root).

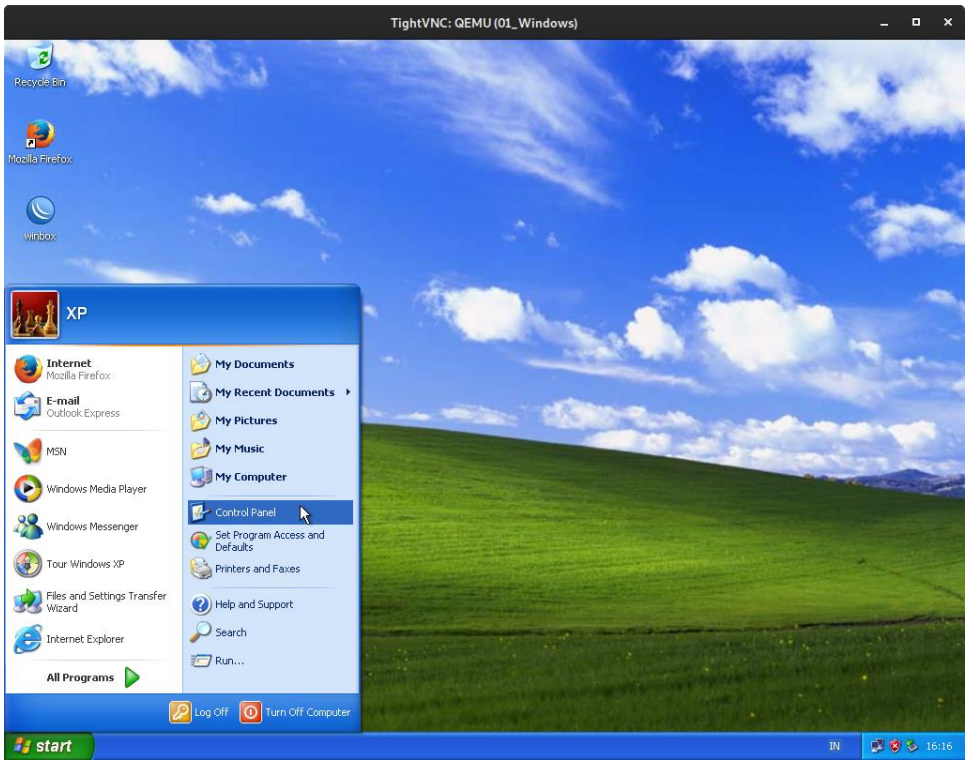
```
debian@debian:~$ sudo ip route
default via 10.10.10.1 dev ens3
10.10.10.0/24 dev ens3 proto kernel scope link src 10.10.10.199
```

19. In addition to getting IP addressing and gateway settings automatically, your computer also gets the dns address settings of the server automatically obtained from the DHCP server. To check it, you can see the contents of the "resolv.conf" file contained in the "/etc/" directory. You can use the "paint" command to view the contents of a file without making any changes to it.

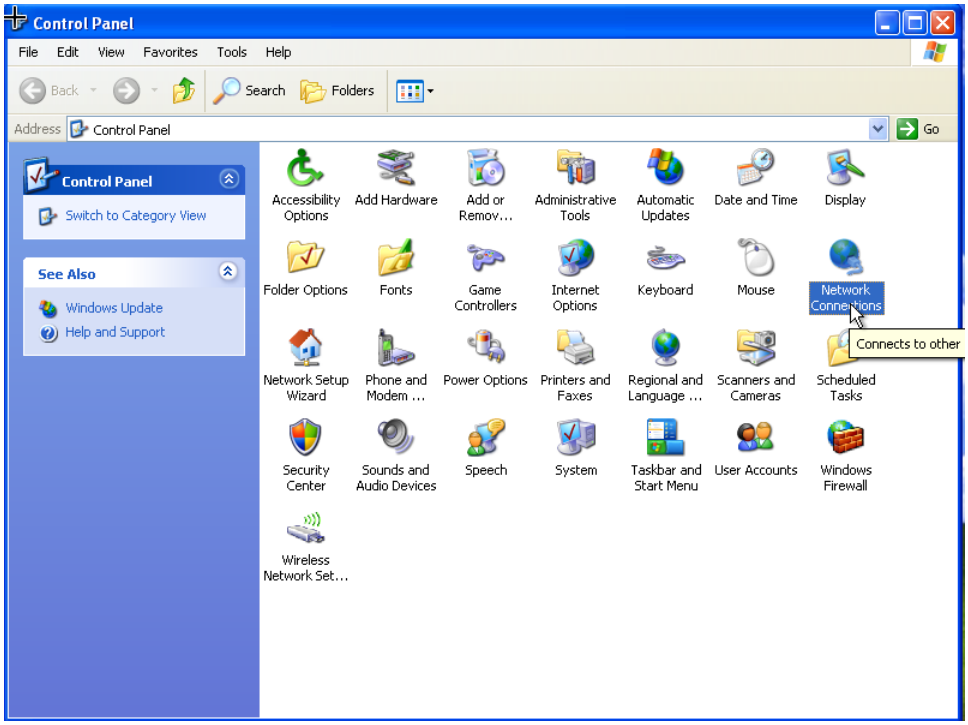
```
debian@debian:~$ cat /etc/resolv.conf
nameserver 10.10.10.1
```

b) Settings on Windows Operating System

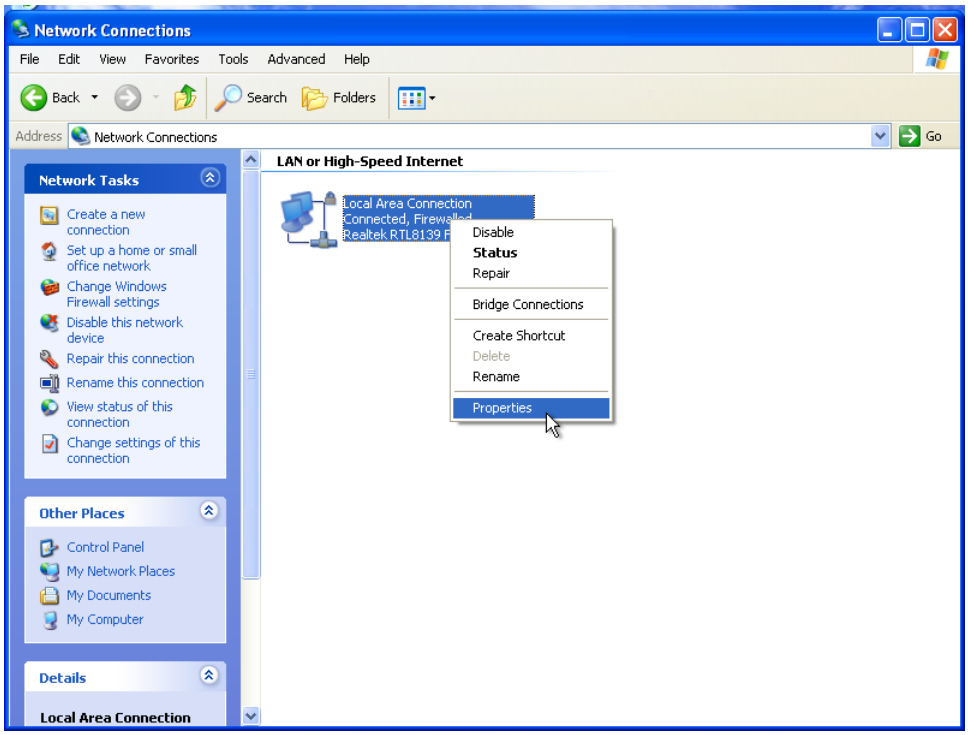
1. Access your windows computer to an open class project.
2. In the initial view of your computer, select the Start menu and then select the Control Panel menu.



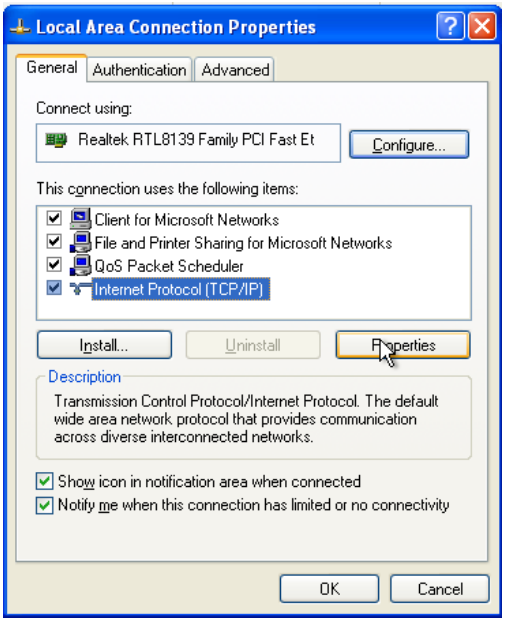
3. In the Control Panel window, select the Network Connections menu.



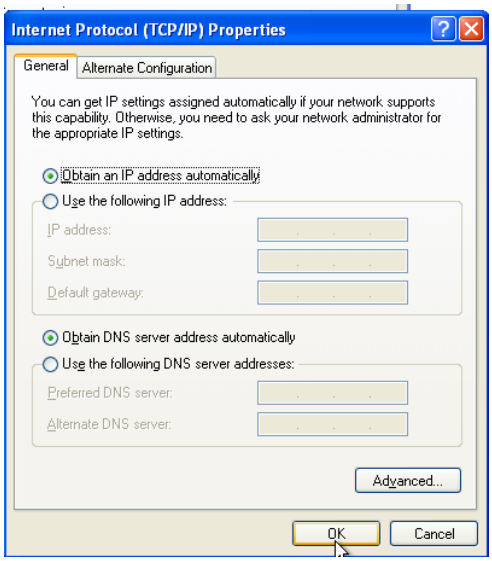
4. By default there will be one NIC / network interface setting on your computer, namely "Local Area Connection". Right-click on the settings logo and select the Properties option.



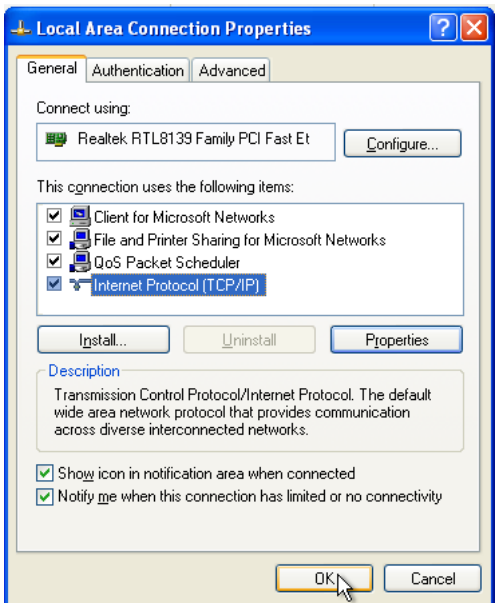
5. A "Local Area Connections" setting window will appear. Select the "Internet Protocol (TCP/IP)" option but do not let the check mark on the option disappear. Then click the properties button.



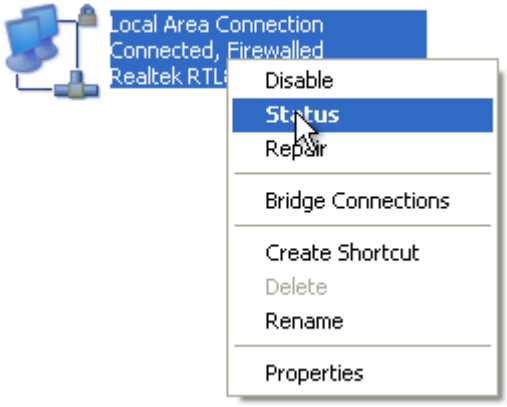
6. In the window "Internet Protocol (TCP/IP) Properties" select the "General" tab and select the option "Obtain an IP address automatically" to get the IP and Gateway address settings automatically. Also select the option "Obtain DNS server address automatically" to get the server's DNS address automatically. Then press the OK button to save the settings.



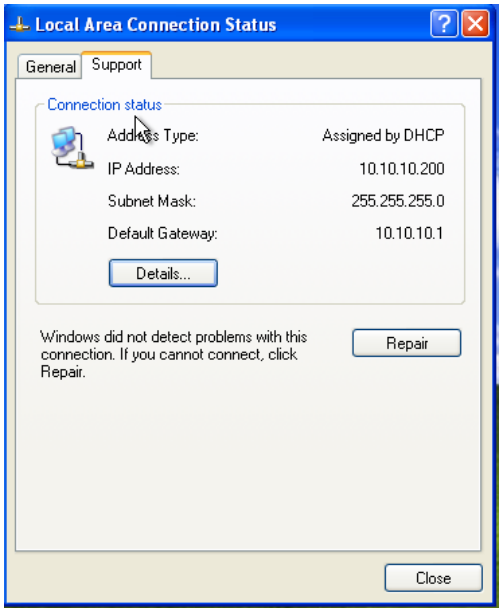
7. Please, press the OK button back in the "Local Area Connection Properties" window to save and exit the settings window.



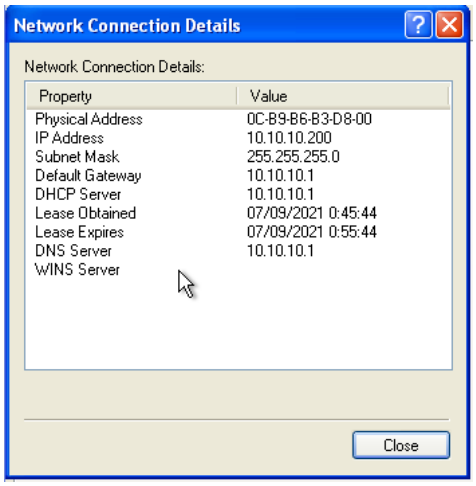
8. To see the IP, gateway and DNS addresses obtained automatically from the DHCP server, you can right-click on the "Local Area Connection" logo and then select the Status option.



9. In the "Local Area Connection Status" window, select the "Support" tab. Then the details of the IP address and gateway obtained will automatically appear there.



10. To get more complete information, about the dns server address for example, you can press the "Details" button. Then the DNS address and settings details will appear applied to your windows computer.



C. Static IP Address Settings

a) **Settings on The Linux** Operating System

1. To statically configure an IP address, you need to know the addressing that is in the network where your computer is connected. The addressing includes usable IP addresses, subnet masks of those IP addresses , gateway addresses and DNS server addresses. An IP address is used as your computer's identifier in a network. The subnet mask serves as your marker including which network (more details will be discussed in the addressing chapter). The gateway address is used as a path to exit your network when your computer needs communication to a computer outside your network. A DNS server address is a place to ask and translate a domain address into an IP address.
2. In this practicum, your Linux operating system will get an IP address setting based on the following terms:

- IP Address : 10.10.10.<10 + no_absen> → Example: 10.10.10.11 for absence No. 1
- Subnet mask : 255.255.255.0
- Gateway Address : 10.10.10.1
- DNS server address: 10.10.10.1

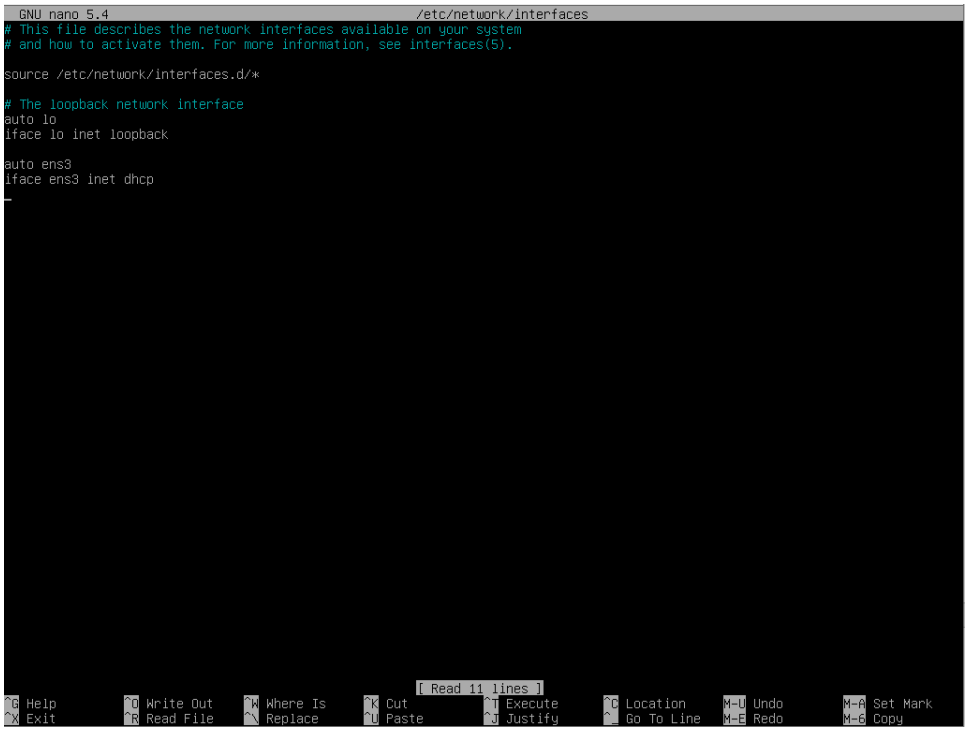
3. To statically configure an IP address, reopen the "interfaces" file contained in the "/etc/network/" directory. And change the contents of the file according to your needs.
4. To open and change the file, you can use the "nano" text editor that has been installed on your debian linux computer.
5. File "interfaces" cannot be arbitrarily changed by users who do not have privileges to the file. Generally the file should only be edited by a super user account or commonly called root. To change the file using a regular user (non-root), you can take advantage of the "sudo" utility application that is currently installed on your Linux computer.
6. So it can be concluded that you can change the contents of the "interface" file using the combined command "sudo nano /etc/network/interfaces".

```
debian@debian:~$ sudo nano /etc/network/interfaces
```

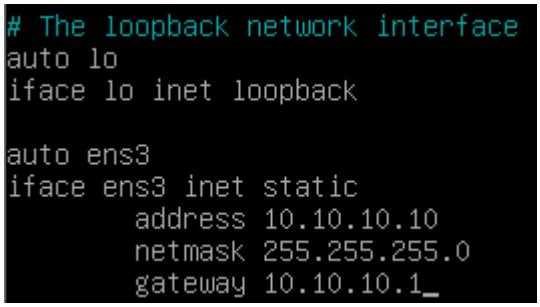
7. When executing the above command, you will be asked to enter the password of your user. Please enter the password of your user.

```
We trust you have received the usual lecture from the local System
Administrator. It usually boils down to these three things:

    #1) Respect the privacy of others.
    #2) Think before you type.
    #3) With great power comes great responsibility.

[sudo] password for debian:
```

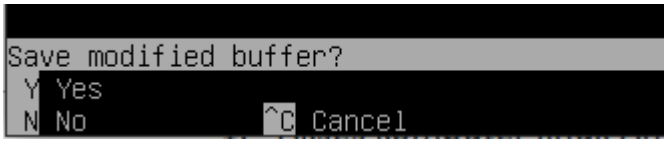
8. Then the file interfaces will open in the nano text editor like the image below.



9. Replace the "dhcp" opsi on the "iface ens3 inet" line with the "static" option to staticly assign IP address settings to the defined NIC (NIC/interface ens3).
10. Add some additional commands like the image below but adjust the addresses to the allocation of addresses that have been provided for your computer (which has been listed in step No. 2).



11. After making changes to the "interfaces" file. Save and exit the nanotext editor using the key combination ctrl+x. Then you will be confirmed to make storage of the changes you have made. Just type the letter Y and then press the enter key on your keyboard.



12. You'll be reconfirmed to save your changes to a file. Make sure the directory and file name listed are correct. If it's correct, press once more the enter key on your keyboard, and you'll exit the "nano" text editor.

13. Once you exit the "nano" text editor and return to the shell, reload your network service using the "systemctl restart networking" command. Don't forget to add the "sudo" command at the beginning of the command because the user you are currently using is a user with full access rights (non-root user). And enter your user password when you are asked to enter the password.

```
debian@debian:~$ sudo systemctl restart networking
[sudo] password for debian:
```

14. Wait a few moments until the terminal is back on.
15. Once the terminal is back on, run the "ip a" command to see if the NIC/Interface with the alias ens3 (which you have configured) has obtained the ip address and other network settings automatically from the DHCP server.

```
debian@debian:~$ ip 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: ens3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 0c:b9:b6:59:22:00 brd ff:ff:ff:ff:ff:ff
    altname enp0s3
    inet 10.10.10.10/24 brd 10.10.10.255 scope global ens3
       valid_lft forever preferred_lft forever
    inet6 fe80::eb9:b6ff:fe59:2200/64 scope link
       valid_lft forever preferred_lft forever
```

16. It is seen in the display above that the NIC / interface "ens3" has obtained the ip address in accordance with the static configuration that has been done.
17. Check the gateway address settings on your linux computer to make sure that the gateway address settings are in accordance with your static IP settings. To view it, you can use the "ip route" command in full user access mode (root).

```
debian@debian:~$ sudo ip route
default via 10.10.10.1 dev ens3 onlink
10.10.10.0/24 dev ens3 proto kernel scope link src 10.10.10.10
```

18. In addition to configuring ip addresses static, you also need to set the DNS address of the server statically. To set it up, open the "resolv.conf" file contained in the "/etc/" directory using the nano editor. And don't forget to add the sudo command at the beginning of your command because the file can only be changed by the user with full access rights (root).

```
debian@debian:~$ sudo nano /etc/resolv.conf
```

19. Then it will open a nano text editor that contains like the image below.

20. Change the address next to the "nameserver" with the IP address of the DNS server that has been allocated to you (as per step No. 2).
21. Save and exit nano editors like steps No. 11 and 12.
22. The results of changes you make by using the "paint" command followed by the directory and file name to see the contents of a file without making changes to the file.

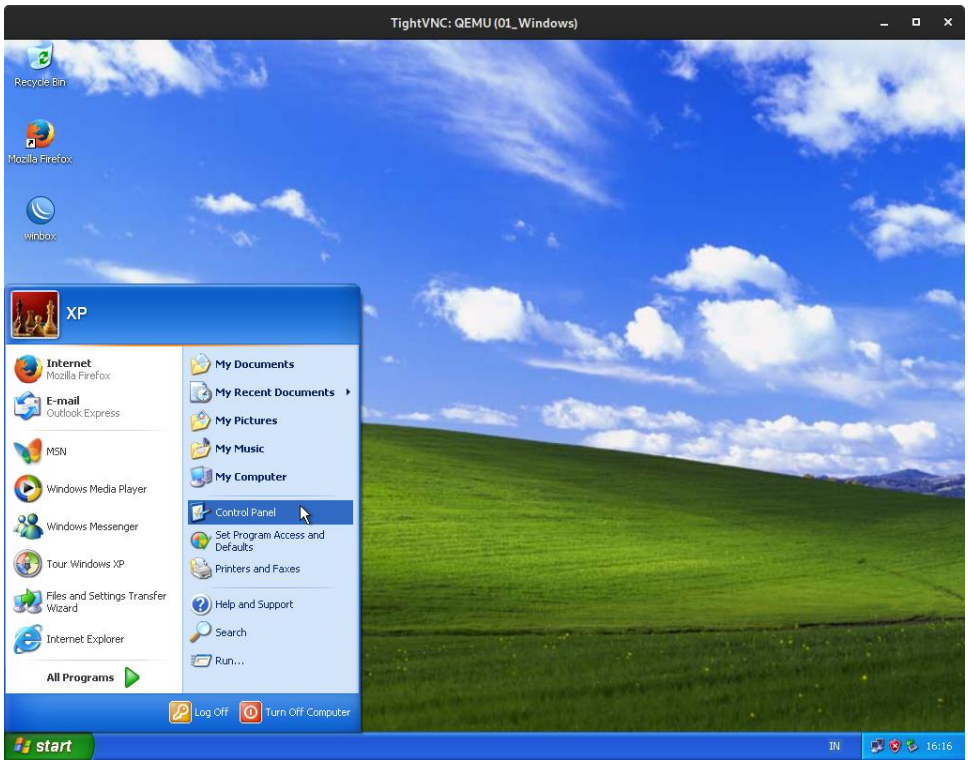
```
debian@debian:~$ cat /etc/resolv.conf
nameserver 10.10.10.1
```

b) Settings on Windows Operating System

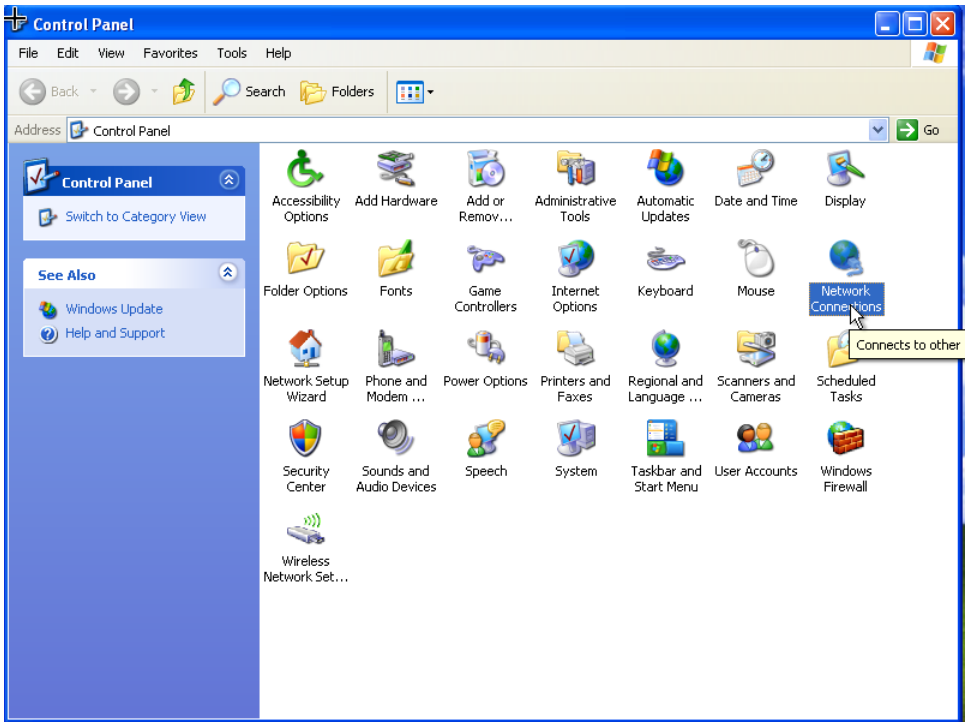
1. To statically configure an IP address, you need to know the addressing that is in the network where your computer is connected. The addressing includes usable IP addresses, subnet masks of those IP addresses, gateway addresses and DNS server addresses. An IP address is used as your computer's identifier in a network. Subnet mask serves as your marker including which network (more details will be discussed in the addressing chapter). The gateway address is used as a path to exit your network when your computer needs communication to a computer outside your network. A DNS server address is a place to ask and translate a domain address into an IP address.
2. In this practicum, your Linux operating system will get an IP address setting based on the following terms:
    - IP Address : 10.10.10.<40 + no_absen> → Example: 10.10.10.11 for absence No. 1
    - Subnet mask : 255.255.255.0
    - Gateway Address : 10.10.10.1

- DNS server address: 10.10.10.1

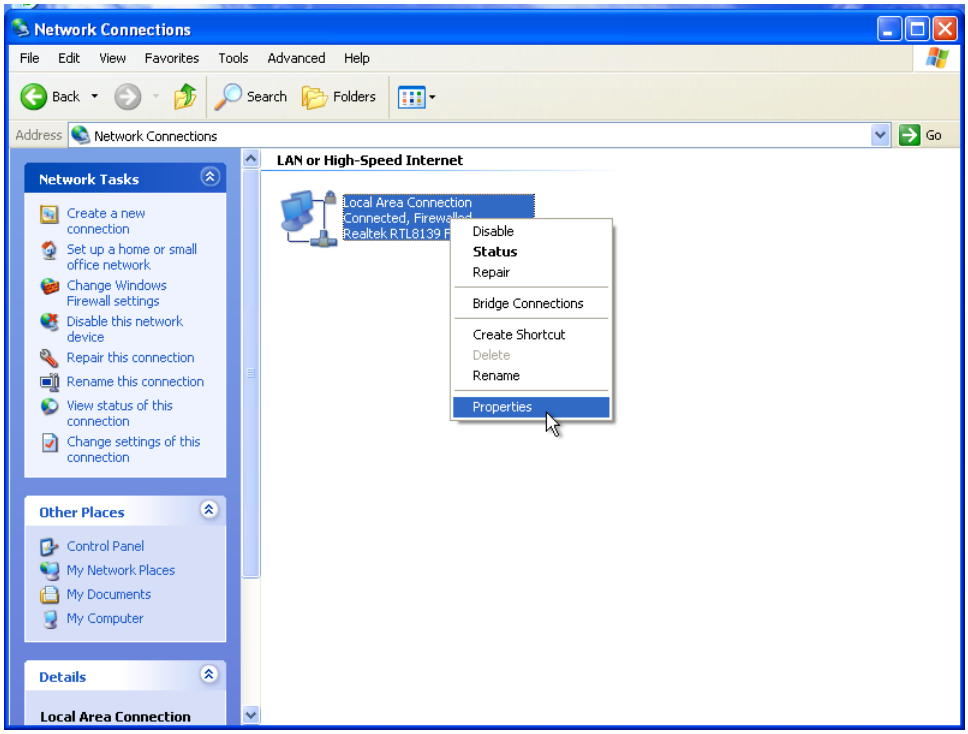
3. Access your windows computer to an open class project.
4. In the initial view of your computer, select the Start menu and then select the Control Panel menu.



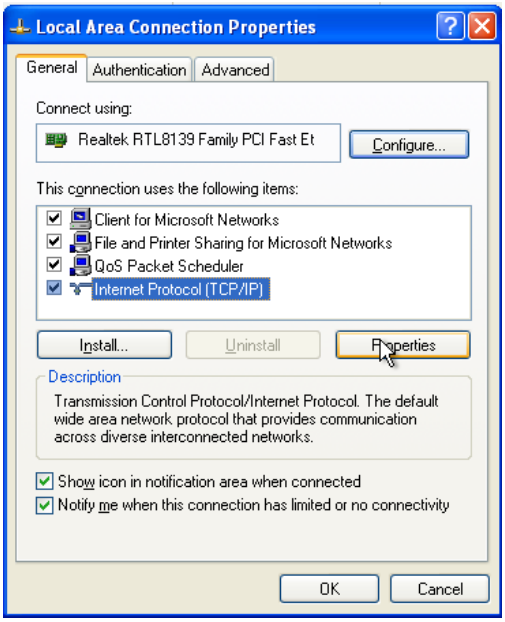
5. In the Control Panel window, select the Network Connections menu.



6. By default there will be one NIC / network interface setting on your computer, namely "Local Area Connection". Right-click on the settings logo and select the Properties option.

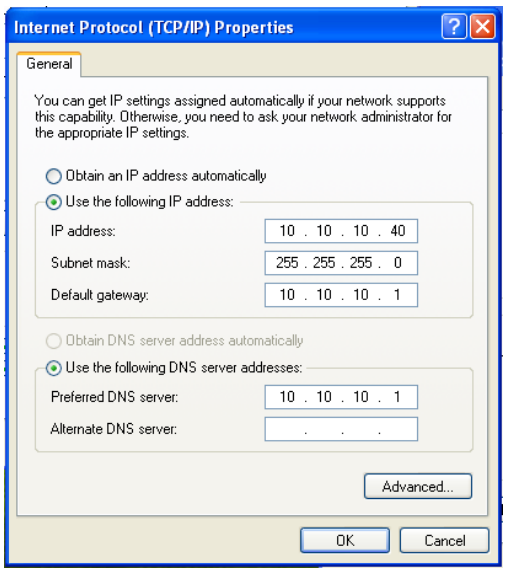


7. A "Local Area Connections" setting window will appear. Select the "Internet Protocol (TCP/IP)" option but do not let the check mark on the option disappear. Then click the properties button.

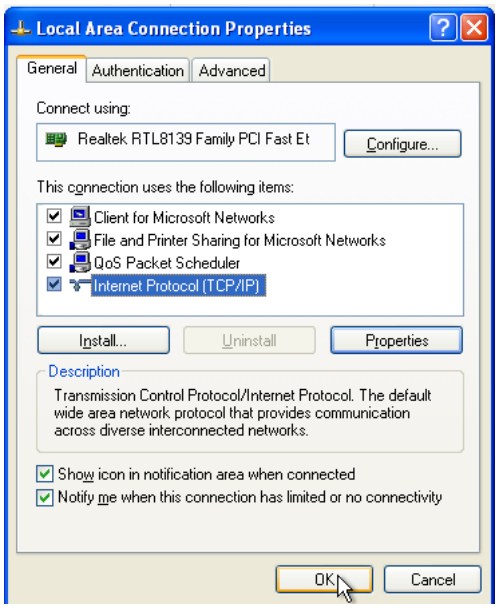


8. In the window "Internet Protocol (TCP/IP) Properties" select the "General" tab and select the option "Use the following IP address". Then enter the network settings according to the existing rules in step No. 2. Also select the option "Use

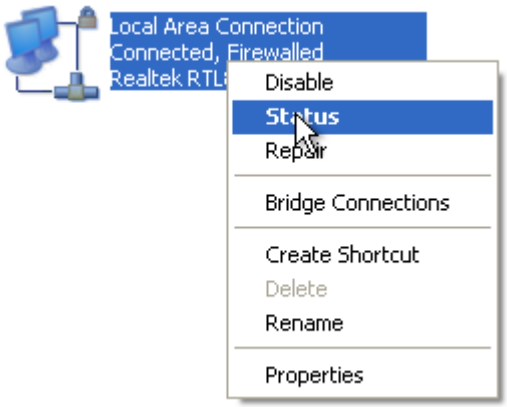
teh following DNS server address" and fill in the DNS server address in accordance with the rules in step No.2.



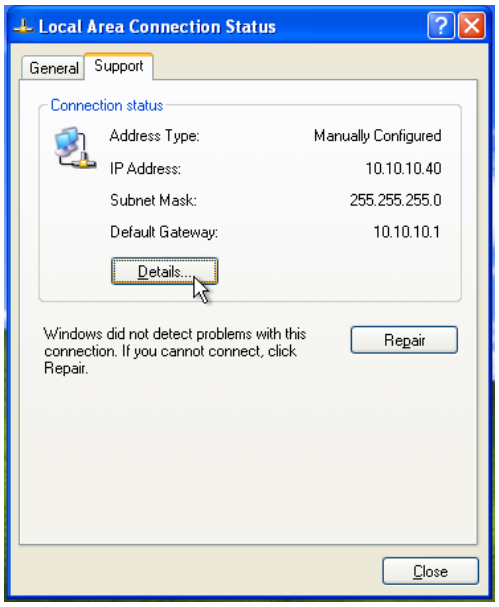
9. Then, press the OK button back in the "Local Area Connection Properties" window to save and exit the settings window.



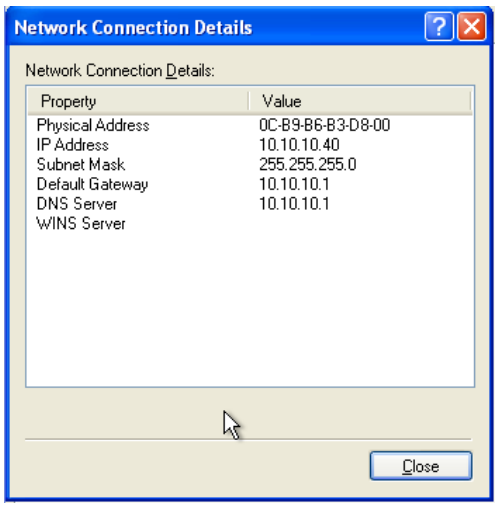
10. To see the IP, gateway and DNS addresses obtained automatically from the DHCP server, you can right-click on the "Local Area Connection" logo and then select the Status option.



11. In the "Local Area Connection Status" window, select the "Support" tab. Then the details of the IP address and gateway obtained will automatically appear there.



12. To get more complete information, about the dns server address for example, you can press the "Details" button. Then the DNS address and settings details will appear applied to your windows computer.



PRACTICUM TASKS

1. Do the practicum steps above and make a step-by-step documentation that you do in pdf document form. The file name format of your documentation is: Kelas_Absen_Nama.pdf (Example: MI2A_23_Sofyan NA.pdf)