

Filled by Carla Jacobsen

Due: Thursday, February 10, 2022 @ 11:59 PM

## Lab 1: Networking with GNS3 and VirtualBox VMs

The goal of this lab is to create a network topology that allows machines connected to the same network to communicate with one another. This will test a working GNS3 setup using built-in Ethernet switch and Virtual PC Systems (VPCS). This also requires using VirtualBox Linux and Windows VMs to complete. In the process, you will access the terminal console or GUI of each machine (VPCS/VM) to set the IP address manually and return its network information.

You will create your own network simulation using built-in devices along with external Virtual Machines (VM) in a virtual lab setting to determine network communications among different hosts. This exercise will also allow some practice on using the labels to annotate your GNS3 topology for better readability of your own network environment.

Prerequisites:

- GNS3 Setup
- GNS3: VirtualBox VM Integration

To Do List:

- Provide answers to all of the yellow highlighted sections below to get full credit for this lab.
- Make a copy of this document and save it either locally or to your cloud storage such as Google/OneDrive drive, Dropbox, etc. Edit your copy of the file to insert your answers. You may replace any provided sample screenshots with your own materials.
- **Lab report submission format: 2 pts** `cpsc456-lab#-<insert-full-name-here>.{doc|pdf|docx|odt|rtf}`
  - e.g., using PDF, `cpsc456-lab1-hernan-manabat.pdf`

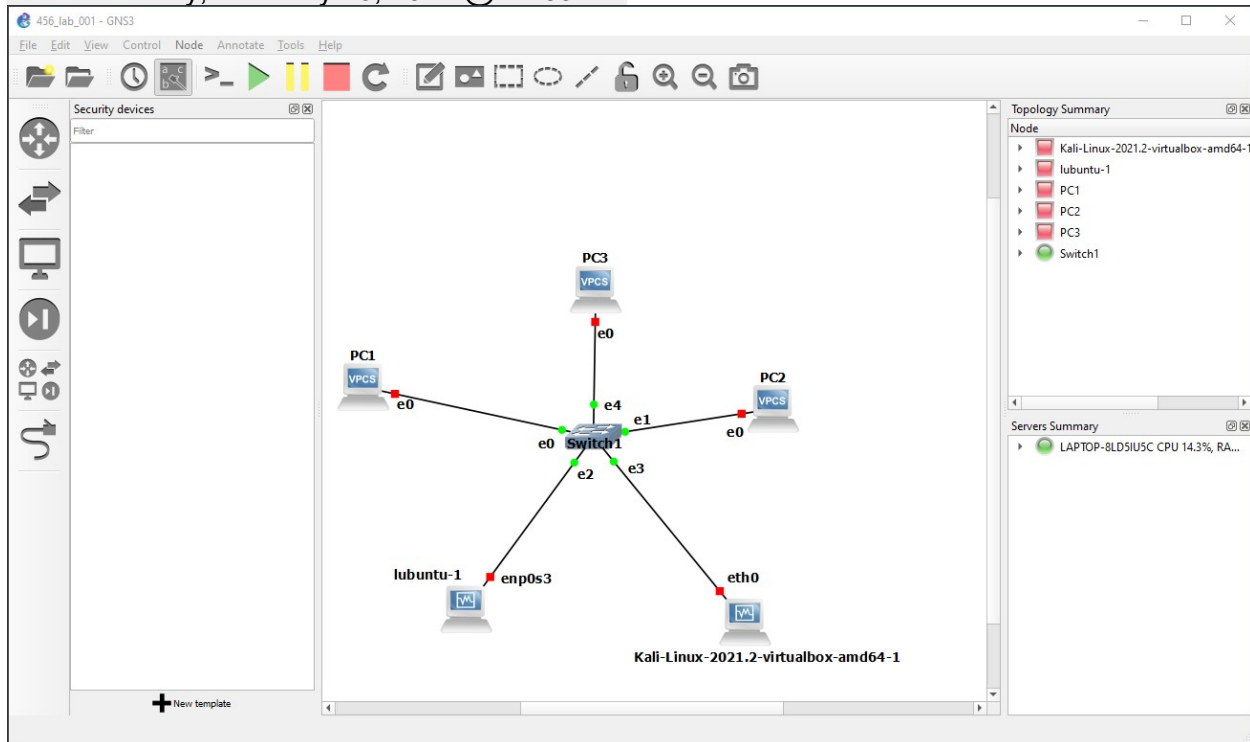
## Let us build that network topology!

1. Create a network topology similar to the one shown below with an Ethernet Switch, 3 VPCS hosts, Linux VM and Windows VM. You may use the Ubuntu and Kali VirtualBox VMs available in the Google Shared folder. Enable the "Show/Hide Interface Labels" to show each proper interface connection. **Take a screenshot of the entire GNS3 window including both the "Topology Summary" and the "Server Summary" (20 pts)**

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2. Turn on all devices by clicking on the green play button icon along the top bar on GNS3.  
*Note: Make sure to start your VMs using this method. Otherwise GNS3 will not be able to recognize that your VM is already on if you use the VirtualBox Manager*

Hostname - Static IPv4 Address & Subnet Mask

PC1 (VPCS) - 10.0.0.1 /24

PC2 (VPCS) - 10.0.0.2 /24

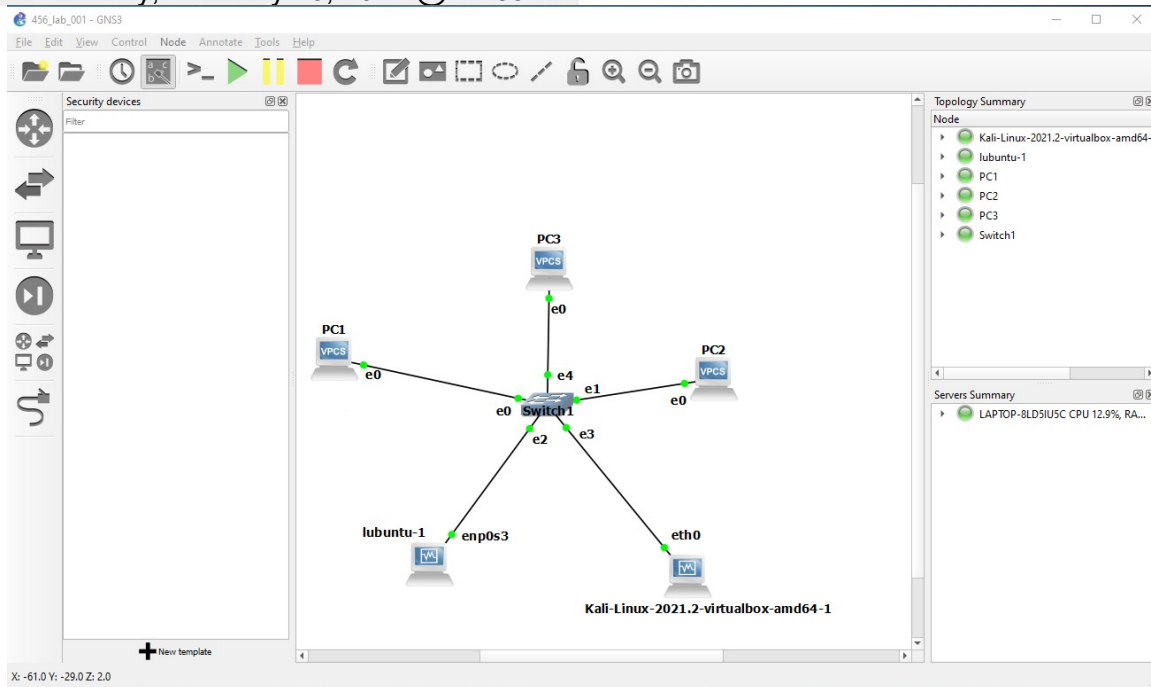
PC3 (VPCS) - 10.0.1.3 /24

lubuntu (Lubuntu VM) - 10.0.1.4 /24 (255.255.255.0)

kali (Kali VM) - 10.0.1.5 /16 (255.255.0.0)

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3. Update the network topology to include the assigned static IP addresses above. Provide a screenshot (10 pts). *Hint:* Use the 'Add a note' stencil to add labels.

PC1:

```
PC1> ip 10.0.0.1 /24
Checking for duplicate address...
PC1 : 10.0.0.1 255.255.255.0
```

PC2:

```
PC2> ip 10.0.0.2 /24
Checking for duplicate address...
PC1 : 10.0.0.2 255.255.255.0
```

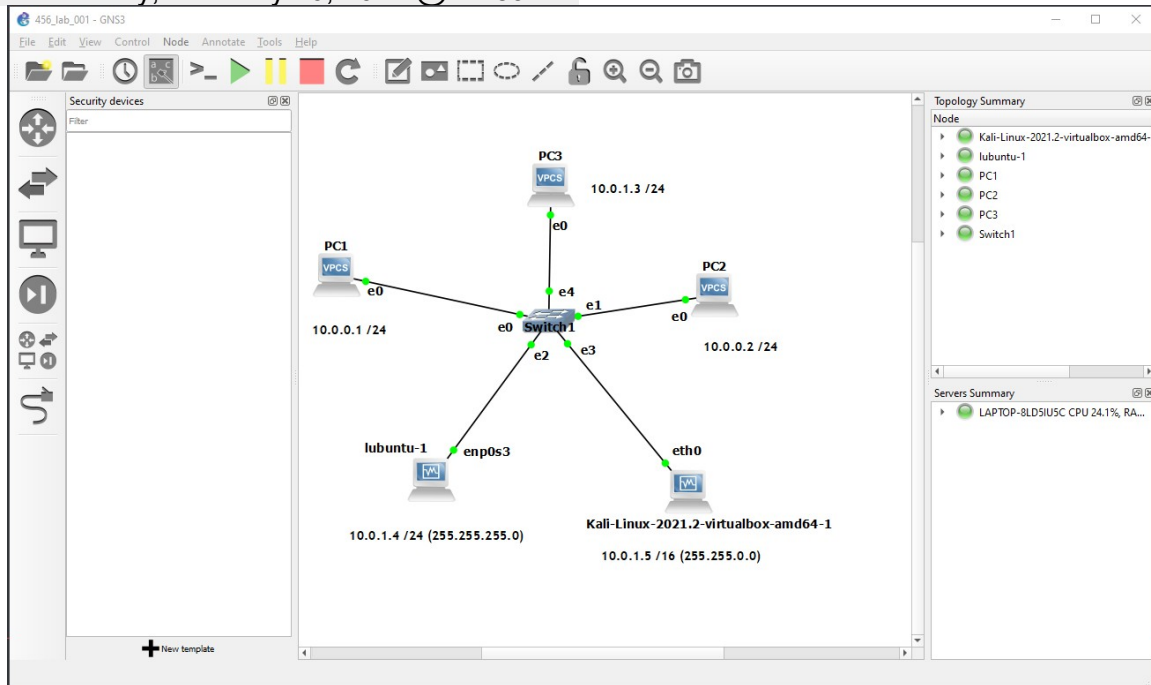
PC3:

```
PC3> ip 10.0.1.3 /24
Checking for duplicate address...
PC1 : 10.0.1.3 255.255.255.0
```

Topology:

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4. Configure each host with the corresponding static IPv4 address above. Provide screenshot(s) of the IPv4 address and MAC/Hardware address of each host network. Provide screenshot(s) as necessary (20 pts). *Note: Your VMs of choice may be different from mine. Adjust the VM hostname accordingly.*

a. VPCS Console:

- Use the “ip ?” command to assign static IP address/subnet mask.
- Use the “show ip” command to get IP/MAC information.
- Use the “clear ip” command to start over if you made a mistake.

Setting:

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PC1:

```
PC1> ip 10.0.0.1 /24
Checking for duplicate address...
PC1 : 10.0.0.1 255.255.255.0
```

PC2:

```
PC2> ip 10.0.0.2 /24
Checking for duplicate address...
PC1 : 10.0.0.2 255.255.255.0
```

PC3:

```
PC3> ip 10.0.1.3 /24
Checking for duplicate address...
PC1 : 10.0.1.3 255.255.255.0
```

show ip:

PC1:

```
PC1> show ip
NAME       : PC1[1]
IP/MASK    : 10.0.0.1/24
GATEWAY    : 0.0.0.0
DNS        :
MAC        : 00:50:79:66:68:00
LPORT      : 20014
RHOST:PORT : 127.0.0.1:20015
MTU        : 1500
```

PC2:

```
PC2> show ip
NAME       : PC2[1]
IP/MASK    : 10.0.0.2/24
GATEWAY    : 0.0.0.0
DNS        :
MAC        : 00:50:79:66:68:01
LPORT      : 20012
RHOST:PORT : 127.0.0.1:20013
MTU        : 1500
```

PC3:

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```
PC3> show ip
NAME       : PC3[1]
IP/MASK     : 10.0.1.3/24
GATEWAY     : 0.0.0.0
DNS         :
MAC         : 00:50:79:66:68:02
LPORT      : 20010
RHOST:PORT  : 127.0.0.1:20011
MTU         : 1500
```

b. Linux (Kali/Lubuntu) VM:

- i. You may use the GUI or terminal to assign its corresponding IPv4 address and subnet mask.

*Example:* If using the terminal to:

- manually assign an IPv4 address to the network interface eth0 (kali) and enp0s3 (lubuntu)

```
sudo ifconfig eth0 10.0.1.5 netmask 255.255.255.0
```

or

```
sudo ip addr add 10.0.1.5/24 dev eth0
```

- show IPv4/MAC information

```
ifconfig eth0
```

or ip a

Lubuntu:

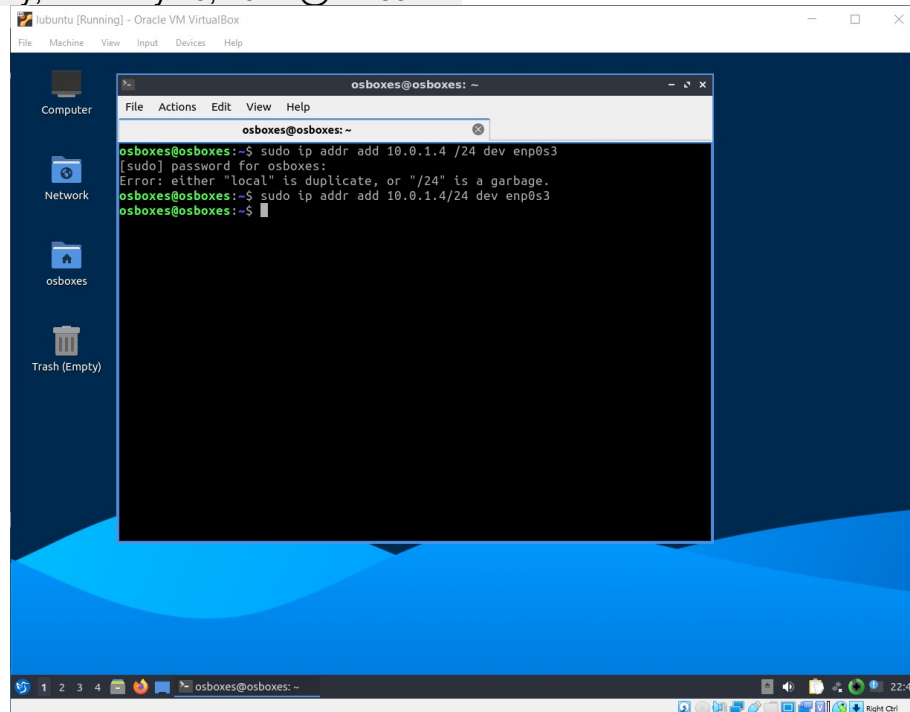
setting:10.0.1.4 /24

```
sudo ifconfig enp0s3 10.0.1.4 netmask 255.255.255.0
```

```
sudo ip addr add 10.0.1.4/24 dev enp0s3
```

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viewing:

```
osboxes@osboxes:~$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group def
    ault 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:f2:24:bf brd ff:ff:ff:ff:ff:ff
    inet 192.168.1.3/24 brd 192.168.1.255 scope global noprefixroute enp0s3
        valid_lft forever preferred_lft forever
    inet 10.0.1.4/24 scope global enp0s3
        valid_lft forever preferred_lft forever
    inet6 fe80::6bb3:f0db:f119:48d1/64 scope link noprefixroute
        valid_lft forever preferred_lft forever
```

```
osboxes@osboxes:~$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group def
    ault 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:f2:24:bf brd ff:ff:ff:ff:ff:ff
    inet 192.168.1.3/24 brd 192.168.1.255 scope global noprefixroute enp0s3
        valid_lft forever preferred_lft forever
    inet6 fe80::6bb3:f0db:f119:48d1/64 scope link noprefixroute
        valid_lft forever preferred_lft forever
```

Kali:

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setting:

```
sudo ifconfig eth0 10.0.1.5 netmask 255.255.0.0
sudo ip addr add 10.0.1.5/16 dev eth0
```

```
kali@kali: ~
File Actions Edit View Help
(kali@kali)-[~]
$ sudo ip addr add 10.0.1.5/16 dev eth0
[sudo] password for kali:
(kali@kali)-[~]
```

viewing:

```
(kali@kali)-[~]
$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group def
  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: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP
  group default qlen 1000
    link/ether 08:00:27:0e:34:8d brd ff:ff:ff:ff:ff:ff
    inet 10.0.1.5/16 scope global eth0
        valid_lft forever preferred_lft forever
```

```
(kali@kali)-[~]
$ ifconfig eth0
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.0.1.5 netmask 255.255.0.0 broadcast 0.0.0.0
    ether 08:00:27:0e:34:8d txqueuelen 1000 (Ethernet)
    RX packets 12 bytes 756 (756.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 1088 bytes 182656 (178.3 KiB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

```
(kali@kali)-[~]
$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group def
  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: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP
  group default qlen 1000
    link/ether 08:00:27:0e:34:8d brd ff:ff:ff:ff:ff:ff
```

- Based on your answers above, complete the Ethernet Switch's Content Addressable Memory (CAM) table below. If necessary, change the VM hostnames to reflect your own network topology. (20 pts)



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Note: Do not worry about the VLAN column for now. We will discuss VLAN in another lecture.

Hostname	MAC/HW Address	Switch Port	VLAN
PC1	00:50:79:66:68:00	e0	1
PC2	00:50:79:66:68:01	e1	1
PC3	00:50:79:66:68:02	e4	1
Lubuntu VM	08:00:27:f2:24:bf	e2	1
Kali VM	08:00:27:0e:34:8d	e3	1

6. From each terminal/console window, send `ping` messages to check if a host is able to communicate with other hosts. Answer the following questions below. Provide screenshot(s) as necessary to support your answers.
- Can PC1 reach PC2? (4 pts)
  - Besides itself, which other host(s) can PC2 reach? (5 pts)
  - Can PC2 reach PC3? (4 pts)
  - Besides itself, which host(s) can PC3 reach? (5 pts)
  - Explain why some hosts can reach some, but not the others? (10 pts)

A. Can PC1 reach PC2?

```
PC1> ping 10.0.0.2 /24
84 bytes from 10.0.0.2 icmp_seq=1 ttl=64 time=0.636 ms
84 bytes from 10.0.0.2 icmp_seq=2 ttl=64 time=0.948 ms
84 bytes from 10.0.0.2 icmp_seq=3 ttl=64 time=0.987 ms
84 bytes from 10.0.0.2 icmp_seq=4 ttl=64 time=1.012 ms
84 bytes from 10.0.0.2 icmp_seq=5 ttl=64 time=1.573 ms
```

Yes.

B. Besides itself, which other host(s) can PC2 reach?

Ping PC1:

```
PC2> ping 10.0.0.1 /24
84 bytes from 10.0.0.1 icmp_seq=1 ttl=64 time=0.950 ms
84 bytes from 10.0.0.1 icmp_seq=2 ttl=64 time=0.960 ms
84 bytes from 10.0.0.1 icmp_seq=3 ttl=64 time=0.949 ms
84 bytes from 10.0.0.1 icmp_seq=4 ttl=64 time=0.923 ms
84 bytes from 10.0.0.1 icmp_seq=5 ttl=64 time=0.931 ms
```

Success! PC2 can reach PC1!

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Ping PC3:

```
PC2> ping 10.0.1.3 /24  
No gateway found
```

Failure! PC2 cannot ping PC3!

Ping Lubuntu:

```
PC2> ping 10.0.1.4/24 (255.255.255.0)  
No gateway found
```

Failure! PC2 cannot ping Lubuntu!

Ping Kali:

```
PC2> ping 10.0.1.5  
No gateway found
```

Failure! PC2 cannot ping Kali!

PC2 can only ping PC1.

=====

C. Can PC2 reach PC3?

```
PC2> ping 10.0.1.3 /24  
No gateway found
```

No PC2 cannot reach PC3.

=====

D. Besides itself, which other host(s) can PC3 reach?

Ping PC1:

```
PC3> ping 10.0.0.1  
No gateway found
```

Failure! PC3 cannot reach PC1.

Ping PC2:

```
PC3> ping 10.0.0.2  
No gateway found
```

Failure! PC3 cannot reach PC2.

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Ping Lubuntu:

```
PC3> ping 10.0.1.4
84 bytes from 10.0.1.4 icmp_seq=1 ttl=64 time=0.843 ms
84 bytes from 10.0.1.4 icmp_seq=2 ttl=64 time=1.272 ms
84 bytes from 10.0.1.4 icmp_seq=3 ttl=64 time=1.138 ms
84 bytes from 10.0.1.4 icmp_seq=4 ttl=64 time=1.275 ms
84 bytes from 10.0.1.4 icmp_seq=5 ttl=64 time=1.204 ms
```

Success! PC3 is able to reach Lubuntu!

Ping Kali:

```
PC3> ping 10.0.1.5
84 bytes from 10.0.1.5 icmp_seq=1 ttl=64 time=0.900 ms
84 bytes from 10.0.1.5 icmp_seq=2 ttl=64 time=1.295 ms
84 bytes from 10.0.1.5 icmp_seq=3 ttl=64 time=1.497 ms
84 bytes from 10.0.1.5 icmp_seq=4 ttl=64 time=1.142 ms
84 bytes from 10.0.1.5 icmp_seq=5 ttl=64 time=1.118 ms
```

Success! PC3 is able to reach Kali!

PC3 is able to reach Lubuntu and Kali.

=====

E. Explain why some hosts can reach some but not the others?

Some hosts belong to different networks and cannot be reached without a router and gateway address.

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Bonus section: Bringing interface down and then up:

command: `sudo ip link set dev enp0s3 up`

`sudo ip link set dev enp0s3 down`

```
osboxes@osboxes:~$ sudo ip link set dev enp0s3 down
[sudo] password for osboxes:
osboxes@osboxes:~$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group def
ault 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> mtu 1500 qdisc fq_codel state DOWN group def
ault qlen 1000
    link/ether 08:00:27:f2:24:bf brd ff:ff:ff:ff:ff:ff
    inet 192.168.1.3/24 brd 192.168.1.255 scope global noprefixroute enp0s3
        valid_lft forever preferred_lft forever
    inet 10.0.1.4/24 scope global enp0s3
        valid_lft forever preferred_lft forever
```

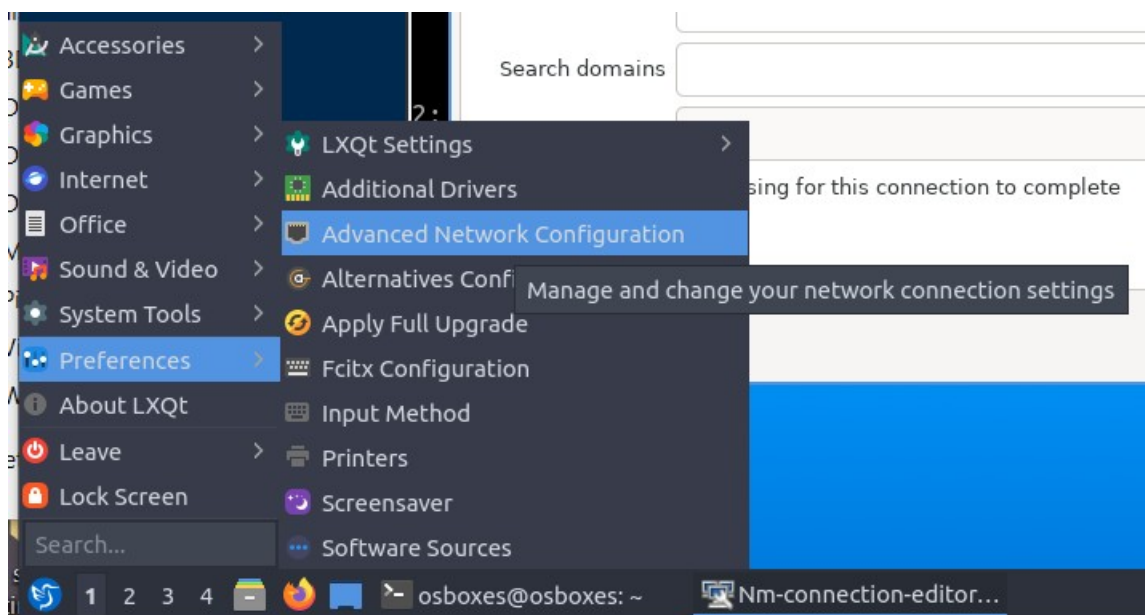
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```
osboxes@osboxes:~$ sudo ip link set dev enp0s3 up
osboxes@osboxes:~$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group def
  link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
  inet 127.0.0.1/8 scope host lo
    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:f2:24:bf brd ff:ff:ff:ff:ff:ff
  inet 192.168.1.3/24 brd 192.168.1.255 scope global noprefixroute enp0s3
    valid_lft forever preferred_lft forever
  inet6 fe80::6bb3:f0db:f119:48d1/64 scope link noprefixroute
    valid_lft forever preferred_lft forever
```

=====

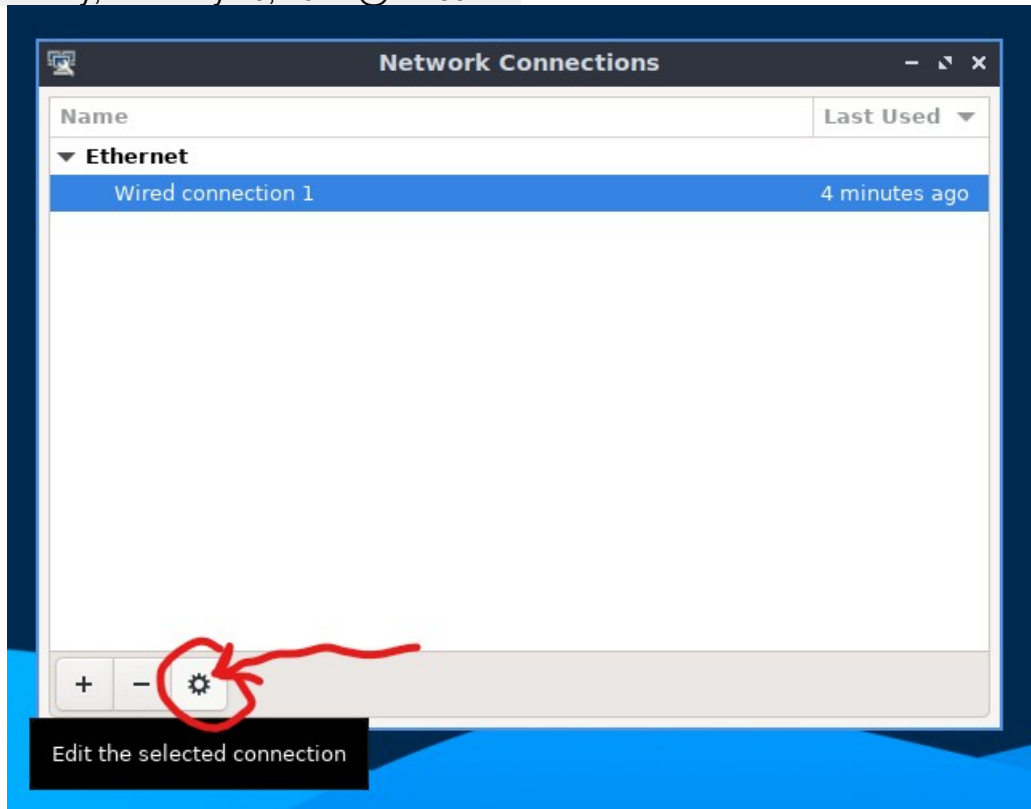
lubuntu gui ip address:



Preferences &gt; Advanced Network Configuration

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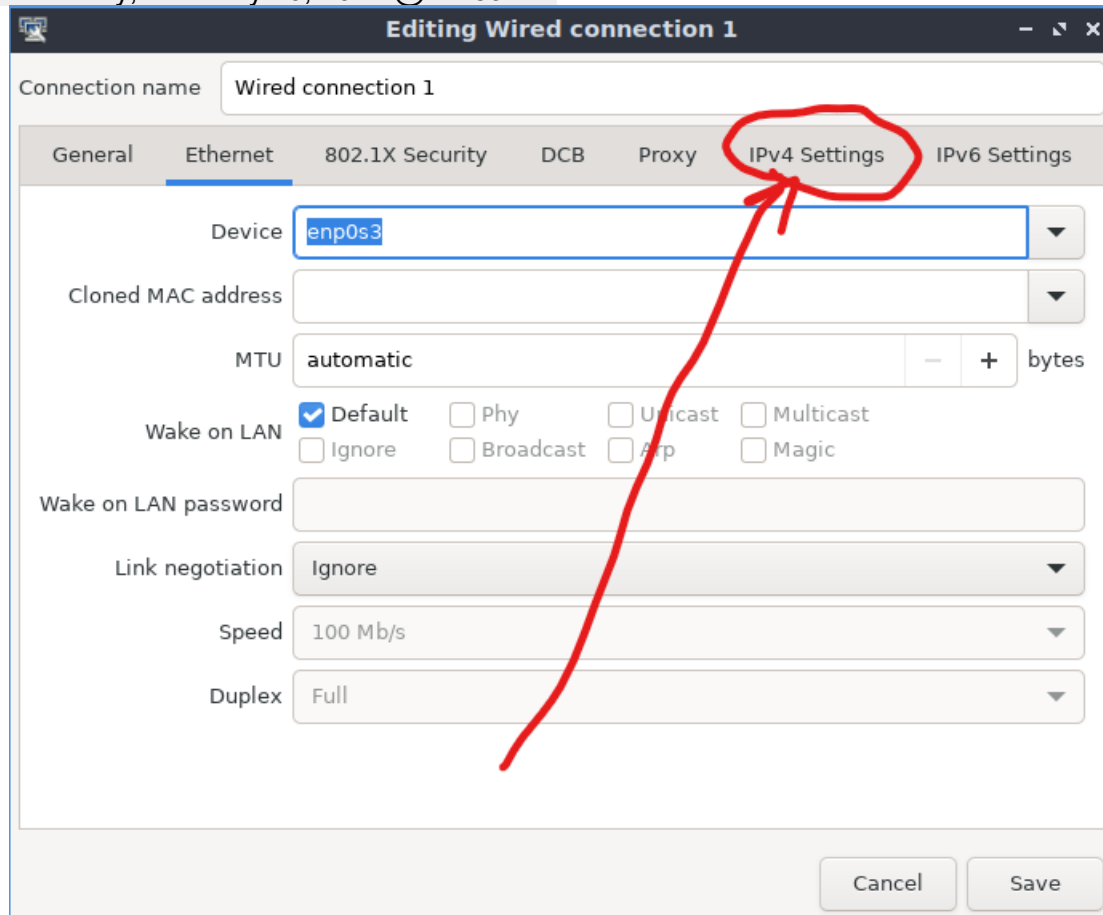
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Click the settings icon.

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Go to Ipv4 settings.

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Editing Wired connection 1

Connection name: Wired connection 1

General Ethernet 802.1X Security DCB Proxy **IPv4 Settings** IPv6 Settings

Method: Manual

**Addresses**

Address	Netmask	Gateway
192.168.1.3	24	

Add Delete

DNS servers

Search domains

DHCP client ID

☐ Require IPv4 addressing for this connection to complete

Routes...

Cancel Save

Change the IP address to 10.0.1.4/24 then click save



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Editing Wired connection 1

Connection name: Wired connection 1

General Ethernet 802.1X Security DCB Proxy IPv4 Settings IPv6 Settings

Method: Manual

Addresses

Address	Netmask	Gateway
10.0.1.4	24	

DNS servers

Search domains

DHCP client ID

☒ Require IPv4 addressing for this connection to complete

Routes...

Cancel Save

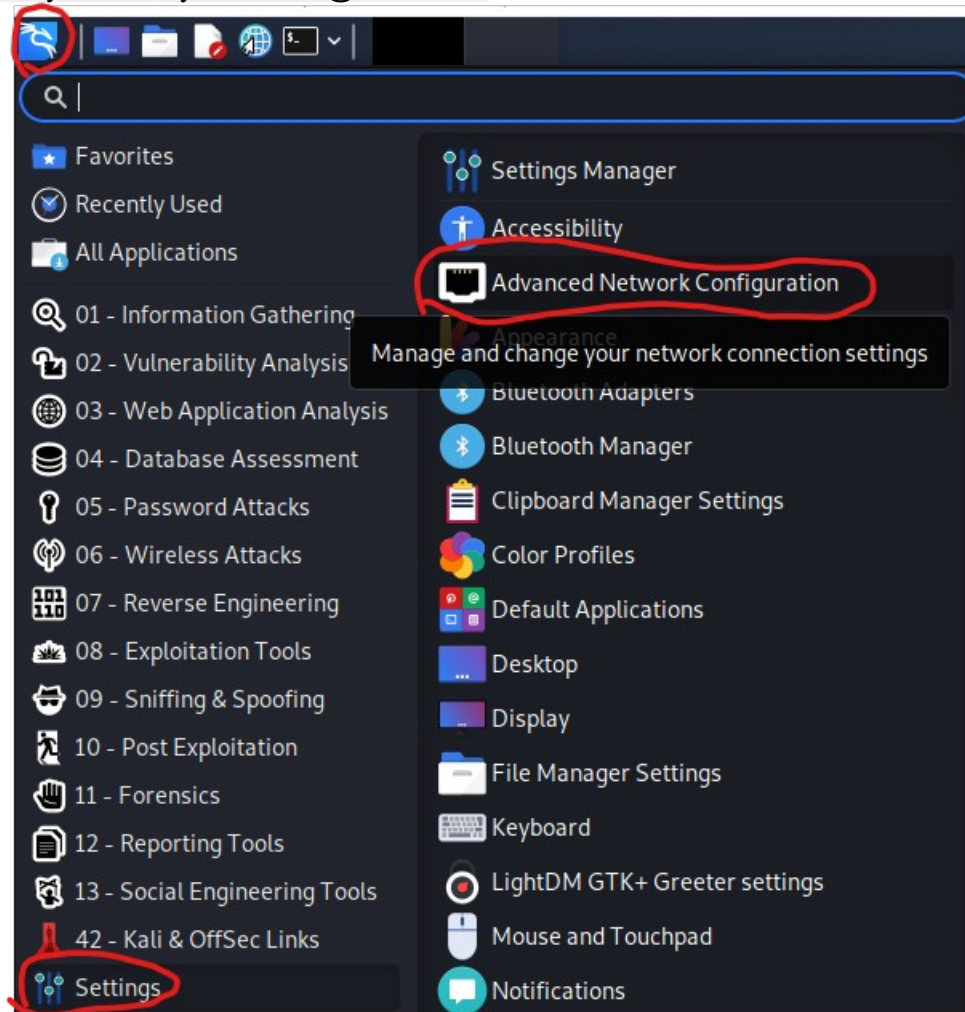
Reboot the VM to update the changes fully.

=====

IP address GUI Kali:

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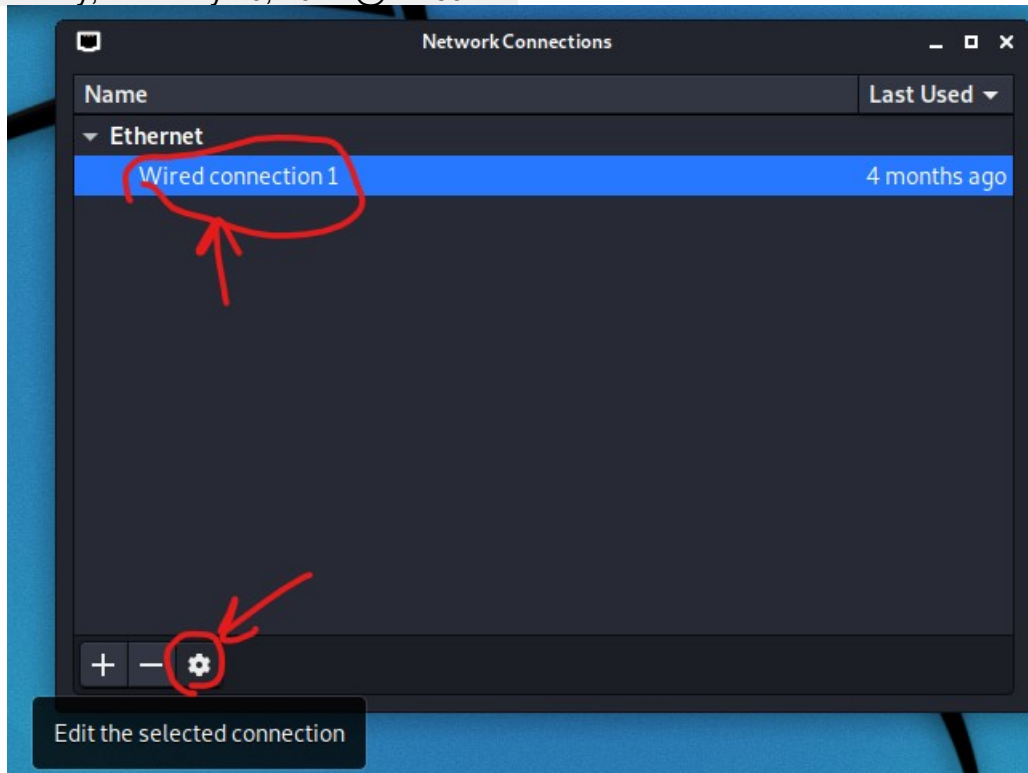
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Settings &gt; Advanced Network Configuration

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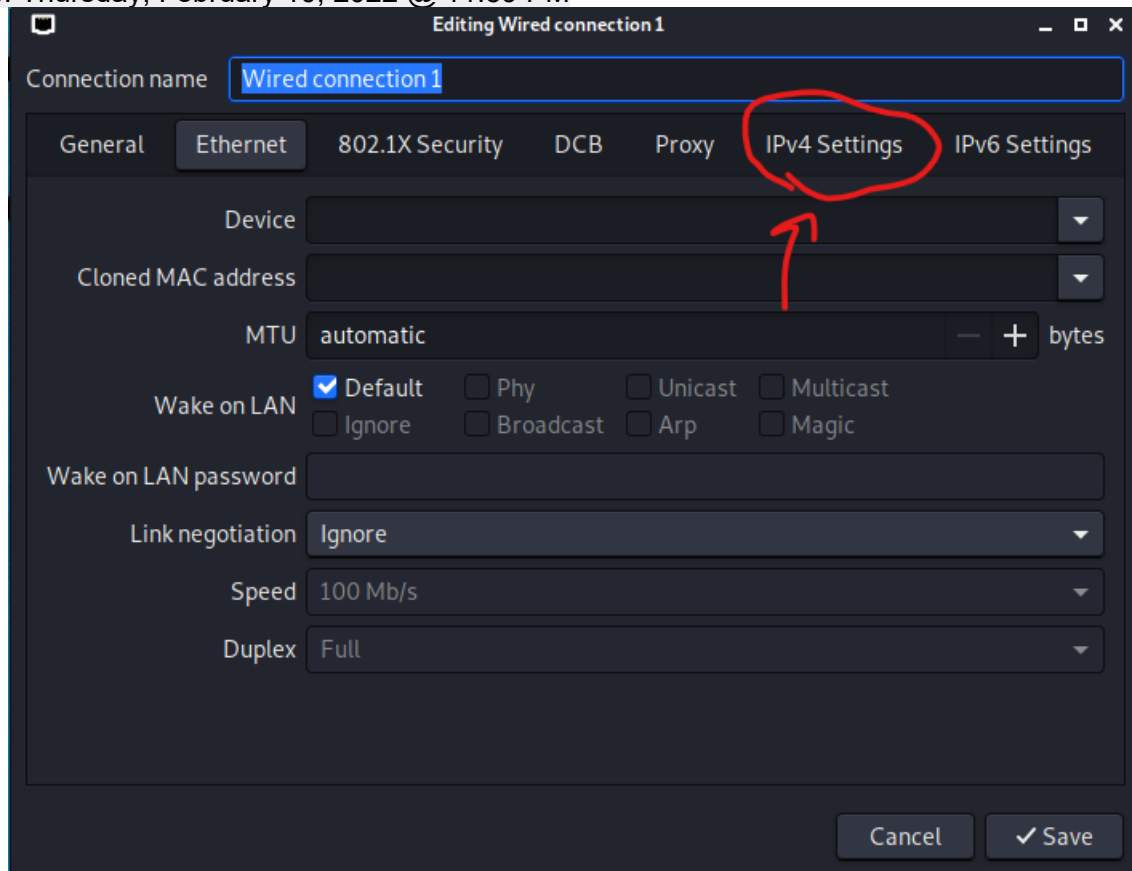
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Click the settings icon.

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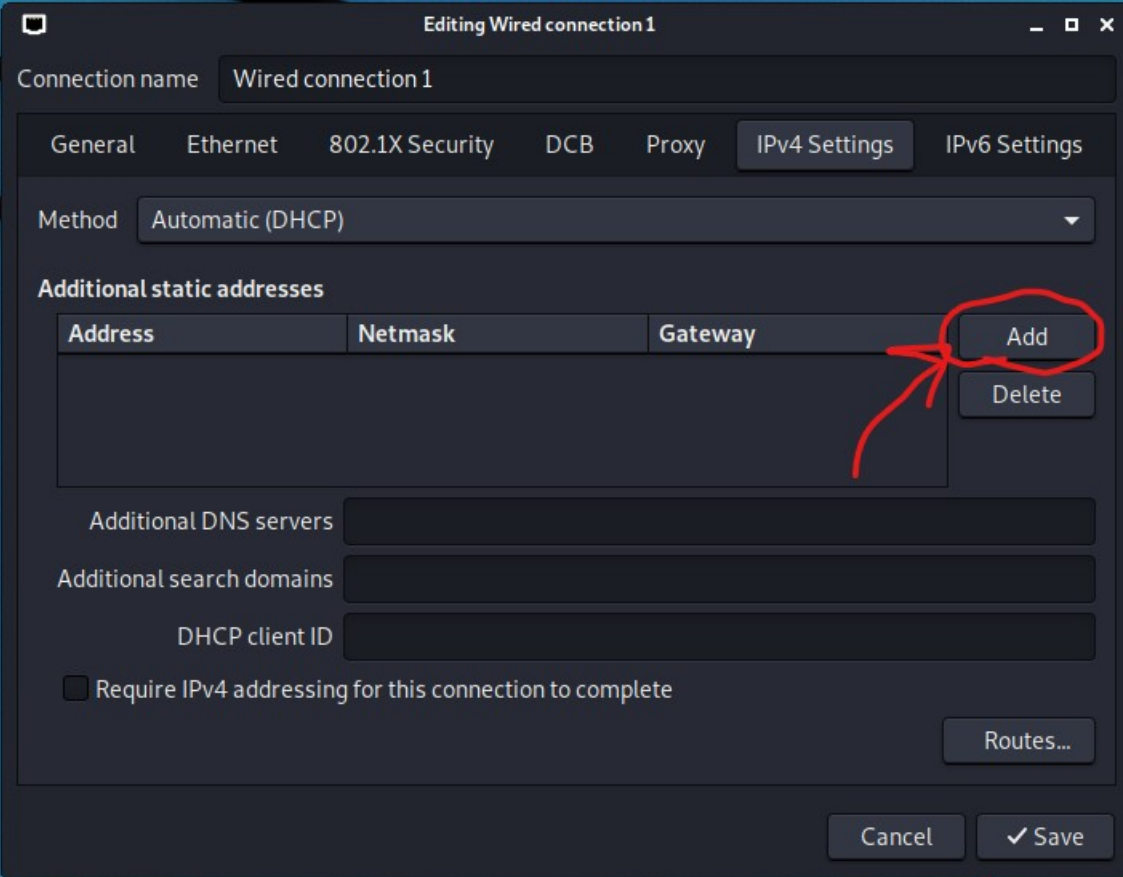
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Go to Ipv4 Settings.

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Editing Wired connection 1

Connection name: Wired connection 1

General Ethernet 802.1X Security DCB Proxy IPv4 Settings IPv6 Settings

Method: Automatic (DHCP)

Additional static addresses

Address	Netmask	Gateway
---------	---------	---------

Add Delete

Additional DNS servers

Additional search domains

DHCP client ID

☐ Require IPv4 addressing for this connection to complete

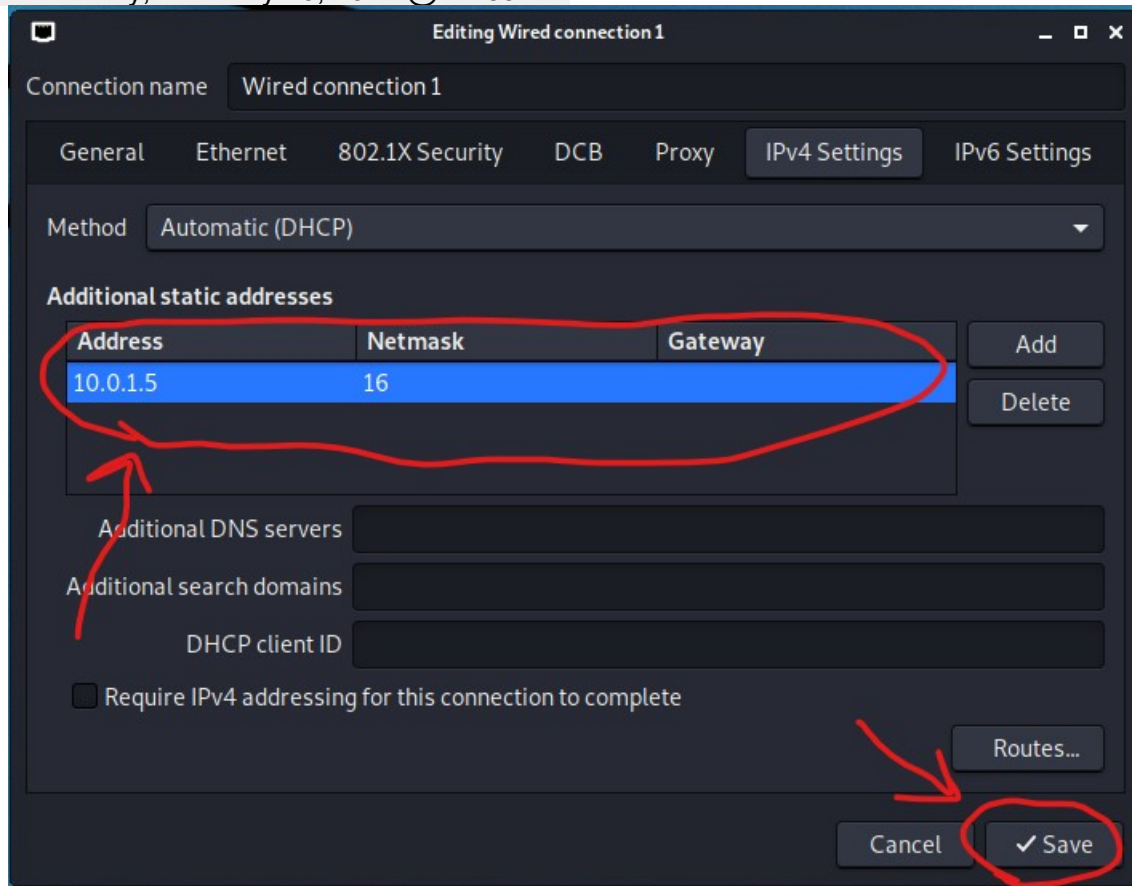
Routes...

Cancel Save

Click add.

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Add the ip address 10.0.1.5 / 16. Then click save.

Reboot the VM to update the saved changes

=====