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Theory: Computers are connected in a network to exchange information or resources each other.

Two or more computer connected through network media called **computer network**. There are number of network devices or media are involved to form computer network. Computer loaded with **Linux Operating System** can also be a part of network whether it is small or large network by its **multitasking and multiuser** natures. Maintaining of system and network up and running is a task of **System / Network Administrator's** job. In this article we are going to review frequently used network configuration and troubleshoot commands in Linux. **1) Introduction**

If you have a network that ranges from 192.168.1.0 to 192.168.1.255 explain why Individual devices in the network can only be assigned IP addresses in the range of 192.168.1.1 to 192.168.1.254. Answer:

If your IP address ranges from 192.168.1.0 to 192.168.1.255 then you are connected to a private network. Having a router is having a private network. Home routers have their local address set to a default, private IP address number. It's usually the same address for the other models from that manufacturer, and it can be seen in the manufacturer's documentation.

Here's a look at the default private (also called "local") IP addresses for popular brands of routers:

- **Linksys** routers use 192.168.1.1
- **D-Link** and **NETGEAR** routers are set to 192.168.0.1
- **Cisco** routers use either 192.168.10.2, 192.168.1.254 or 192.168.1.1
- **Belkin** and **SMC** routers often use 192.168.2.1

192.168.1.254 is a Private IP address, one of the addresses for private networks. This means that a

device in this private network cannot be accessed directly from the internet using a Private IP, but by any other device on the local network.

While the router itself has a Private IP of 192.168.1.254, it assigns any device in the network a different Private IP address. All IP addresses on the network must have a unique address on that network to avoid IP address conflicts. Ipv4-addresses are internally 32 bits, they're often divided into 4 groups of 8 bits. An octet can only be variety from 0 – 255, so as that leaves 256 possibilities for that last number. All addresses within the range of 192.168.1.0 to 192.168.1.255 are within an equivalent network. There are only 254 possibilities for variety. The addresses 192.168.1.0 and 192.168.1.255 are reserved for the network. 192.168.1.0, is reserved for the “network address.”

192.168.1.255, is that the “broadcast” address.

In an IP address, you've some dedicated to the network and a few of the address dedicated to the hosts.
During a /24 network, meaning the first 3 octets are for the network.
192.168.1.0 is the subsequent in binary:

```
11000000.10101000.00000001.00000000
```

A /24 subnet mask in binary looks like this:

```
11111111.11111111.11111111.00000000
```

In decimal, this is: 255.255.255.0, so the first usable address is 192.168.1.1 and thus the last is 192.168.1.254. Since all devices within the network need to have unique addresses meaning that you simply can have 254 devices therein network. Other Private IP addresses used by the modem and router are 192.168.1.100 and 192.168.1.101.

2) Find IP & MAC

Find out about network and hardware information for the computer you are currently using.

Answer: The hardware and network information of my computer is,

```
anika@anika-VirtualBox:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.0.2.15 netmask 255.255.255.0 broadcast 10.0.2.255
    inet6 fe80::d04d:cb3e:2101:b7ed prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:aa:2c:bc txqueuelen 1000 (Ethernet)
    RX packets 17350 bytes 24759623 (24.7 MB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 4629 bytes 361638 (361.6 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
    loop txqueuelen 1000 (Local Loopback)
    RX packets 288 bytes 24302 (24.3 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 288 bytes 24302 (24.3 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

anika@anika-VirtualBox:~$ hostname -i
127.0.1.1
```

3) Routing Table basics

Answer: The \$ netstat -r command,

```

anika@anika-VirtualBox:~$ netstat -r
Kernel IP routing table
Destination      Gateway          Genmask         Flags   MSS Window  irtt Iface
default          _gateway        0.0.0.0         UG      0  0        0 enp0s3
10.0.2.0         0.0.0.0         255.255.255.0   U       0  0        0 enp0s3
link-local       0.0.0.0         255.255.0.0     U       0  0        0 enp0s3

```

The Destination column identifies the destination network. The Gateway column identifies the defined gateway for the specified network. An asterisk (*) appears in this column if no forwarding gateway is needed for the network. The Genmask column shows the *netmask* for the network; in this case, it is 255.255.255.0. The Iface column shows the network interface. If you had more than one interface, you would see *lo* (for loopback), *eth0* (first Ethernet device), and *eth1* (for the second Ethernet device), and so on for the number of interfaces you have installed. Under the Flags section, the *U* flag means the route is up, and the *G* flag means that specified gateway should be used for this route. There are other flags that you may see, which include: *D* for dynamically installed, *M* for modified, and *R* for reinstated. These three flags indicate that the route was created or modified by a routing daemon after encountering an ICMP Redirect message. (Usually, you won't see these flags unless you use dynamic routing.) Finally, you may see a *!* flag, which indicates a rejecting route.

The MSS column indicates the default Maximum Segment Size for TCP connections over this route. The Window column indicates the default window size for TCP connections over this route, and the Irtt column indicates the Initial Round Trip Time for this route. The kernel uses this to select values for certain TCP parameters without having to wait for potentially slow answers from remote hosts. These three columns you will normally not need to worry about unless performance is suffering and you're trying to find a way to tweak it. Under most circumstances, you will not redefine the defaults here.

4) Virtual Interfaces

- a) Create a new virtual interface with the following IP address 192.168.2.32 and netmask 255.255.255.0 then check to see if the interface was created successfully?

Answer:

```

anika@anika-VirtualBox:~$ sudo ifconfig enp0s3 192.168.2.32 netmask 255.255.255
.0
anika@anika-VirtualBox:~$
anika@anika-VirtualBox:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.2.32 netmask 255.255.255.0 broadcast 192.168.2.255
    inet6 fe80::d04d:cb3e:2101:b7ed prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:aa:2c:bc txqueuelen 1000 (Ethernet)
    RX packets 26814 bytes 38418935 (38.4 MB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 6499 bytes 487184 (487.1 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
    loop txqueuelen 1000 (Local Loopback)
    RX packets 365 bytes 31191 (31.1 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 365 bytes 31191 (31.1 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

```

- b) You need to set up a route for this interface so that your computer can see it. Issue the needed command, then issue the “\$ netstat -r” command and check if the route to your added interface is visible?

Answer:

```

anika@anika-VirtualBox:~$ sudo ip route add default via 192.168.2.32 dev enp0s3
RTNETLINK answers: File exists
anika@anika-VirtualBox:~$ ip route show
default via 192.168.2.32 dev enp0s3
192.168.2.0/24 dev enp0s3 proto kernel scope link src 192.168.2.32 metric 100
anika@anika-VirtualBox:~$ route
Kernel IP routing table
Destination      Gateway          Genmask         Flags Metric Ref    Use Iface
default          anika-VirtualBo 0.0.0.0         UG    0      0        0 enp0s3
192.168.2.0      0.0.0.0          255.255.255.0   U      100    0        0 enp0s3
anika@anika-VirtualBox:~$ netstat -r
Kernel IP routing table

```



```

anika@anika-VirtualBox:~$ ip route show
default via 192.168.2.32 dev enp0s3
192.168.2.0/24 dev enp0s3 proto kernel scope link src 192.168.2.32 metric 100
anika@anika-VirtualBox:~$ route
Kernel IP routing table
Destination      Gateway          Genmask          Flags Metric Ref    Use Iface
default          anika-VirtualBo 0.0.0.0          UG    0      0      0 enp0s3
192.168.2.0      0.0.0.0          255.255.255.0    U      100    0      0 enp0s3
anika@anika-VirtualBox:~$ netstat -r
Kernel IP routing table
Destination      Gateway          Genmask          Flags  MSS Window  irtt Iface
default          anika-VirtualBo 0.0.0.0          UG      0 0        0 enp0s3
192.168.2.0      0.0.0.0          255.255.255.0    U      0 0        0 enp0s3
anika@anika-VirtualBox:~$
anika@anika-VirtualBox:~$ netstat r
Active Internet connections (w/o servers)
Proto Recv-Q Send-Q Local Address           Foreign Address          State
udp      0      0 anika-VirtualBox:38478  8.8.8.8:domain          ESTABLISHED
udp      0      0 anika-VirtualBox:33908  8.8.8.8:domain          ESTABLISHED
udp      0      0 anika-VirtualBox:56027  8.8.8.8:domain          ESTABLISHED
Active UNIX domain sockets (w/o servers)
Proto RefCnt Flags       Type        State         I-Node  Path
unix   17     [ ]         DGRAM              12687    /run/systemd/journal
/dev-log
unix    2     [ ]         DGRAM              21518    /run/user/1000/syste
md/notify
unix    2     [ ]         DGRAM              12795    /run/systemd/journal

```

Next remove the route for this interface?

Answer:

```

anika@anika-VirtualBox:~$ route -n
Kernel IP routing table
Destination      Gateway         Genmask         Flags Metric Ref    Use Iface
0.0.0.0          192.168.2.32   0.0.0.0         UG      0      0      0 enp0s3
192.168.2.0      0.0.0.0        255.255.255.0   U       100    0      0 enp0s3
anika@anika-VirtualBox:~$ sudo route del -0.0.0.0 gw 192.168.2.32 netmask 0.0.0.0
.0 dev enp0s3
route: invalid option -- '0'
route: invalid option -- '.'
route: invalid option -- '0'
route: invalid option -- '.'
route: invalid option -- '0'
route: invalid option -- '.'
route: invalid option -- '0'
Usage: route [-nNvee] [-FC] [<AF>]          List kernel routing tables
        route [-v] [-FC] {add|del|flush} ... Modify routing table for AF.

        route {-h|--help} [<AF>]           Detailed usage syntax for specific
d AF.
        route {-V|--version}               Display version/author and exit.

        -v, --verbose                      be verbose
        -n, --numeric                     don't resolve names
        -e, --extend                      display other/more information
        -F, --fib                         display Forwarding Information Base (default)
        -C, --cache                       display routing cache instead of FIB

```

d) Then remove the interface completely.

Answer: Command for removing the interface completely,

Sudo ifconfig enp0s3 down

```

anika@anika-VirtualBox:~$ sudo ifconfig enp0s3 down
anika@anika-VirtualBox:~$ ifconfig
lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
    loop txqueuelen 1000 (Local Loopback)
    RX packets 948 bytes 95773 (95.7 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 948 bytes 95773 (95.7 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

```

5) Add a New Network

a) Enter the command needed to add another network with the same values as your primary network meaning.

- b) Assign the default gateway for newly added network (Your default Gateway Address):
- c) Look for your newly added network in your routing table by issuing the “\$ netstat -r “command.
- d) Now remove your chang2s meaning the double routing table setup for your primary network. First issue the command needed to delete your newly added route then issue the command to delete you newly added default gateway.

6) Multi network scenario configuration:

You should now set up a working routing table for a multi-network scenario. Assume that you have two network cards available connected to two different LANs. The destination of the first network is, 10.0.2.0 with netmask 255.0.0.0 and the second, 192.168.1.0 with netmask 255.255.255.0 Furthermore, a firewall is assumed to exist between the two networks, where network card eth0 is attached to the 10.0.2.0 network and eth1 is attached to the 192.168.1.0 network. To forward packets on the internet the firewall needs to route packets from the 10.0.2.0 network through the 192.168.1.0 network. The firewall system must be set up with two IP addresses, 10.0.2.1 on eth0 and 192.168.1.25 on eth1. The gateway to the internet on the 192.168.1.0 network should be 192.168.1.1.

Provide the necessary commands to route on the firewall/router system.

- a) Assign the firewall IP addresses to eth1 and eth2.
- b) Add the routes for the networks, i.e. 192.168.1.0 on eth1 and 10.0.2.0 on eth0
- c) Assign the internet gateway (meaning: 192.168.1.1) as the default gateway.
- d) Enter the necessary commands in order for packets belonging to computers in the 10.0.2.0 network to be routed to the 192.168.1.0 network and the internet. In other words this should tell each computer on the 10.0.2.0, which the default gateway is, i.e., your firewall/router. You do not need to be worry about the route back configuration it is enough to assign the proper default gateway for the 10.0.2.0 network.