A Beginner's Guide to Configuring IPv4 and IPv6 Addresses in Linux

Ravi Saive | Last Updated: June 29, 2023 | Debian, Network, RedHat, Ubuntu | 8 Comments

As a systems administrator, you will occasionally be tasked with configuring or setting up the IP addresses of your servers to keep up with changing network requirements. As such, having fundamental skills in assigning IP addresses and configuring hostname resolution is crucial in ensuring that servers conform with the network topology.

In this topic, we will first look at what an IP address is and delve into the differences between Ipv4 and IPv6. Then finally, we will demonstrate how to configure IPV4 and IPv6 addresses on a Linux system as well as hostname resolution.

Table of Contents

What is an IP Address?

An IP address, which stands for **Internet Protocol**, is a unique numerical identifier or address that identifies a device in a **TCP/IP** network. This could be a local area network (**LAN**) or the internet.

The IP address allows communication between devices in a network such as servers, routers, switches, and any other network device connected to the network.

Difference Between IPv4 vs IPv6

An IP address can be broadly categorized into two: **IPv4** and **IPv6**.

IPv4 Address

An **IPv4** (IP version 4) address is a 32-bit number that is split into four octets, with each octet separated by a period or a decimal point. This is usually referred to as dotted-decimal format.

Each octet is made up of 8 bits which collectively represent a byte. An IPv4 address can further be divided into two sections. The first part represents the **network** section, while the remaining part defines the **host** section.

Network Section

The network section of an IP address identifies the class the IP address belongs. There are 3 distinct classes of IP addresses used in computer networks: **Class A**, **Class B**, and **Class C**.

What is IPv4 Class A

In **Class A** type of network, the first 8 bits (octet) define the network, while the remaining 24 bits are reserved for the hosts in the network.

- The Public IP addresses range from 1.0.0.0 to 127.0.0.0.
- The Private IP addresses range from 10.0.0.0 to 10.255.255.255.

Addresses **127.0.0.0** to **127.255.255.255** are reserved for loopback and other diagnostic purposes, and hence are not allocated to hosts in a network.

The default subnet mask of class A is **255.0.0.0** with the first 8 bits used to identify the network. The remaining 24 bits are designated for hosts. This class is used in networks that command a large number of hosts. It yields a maximum of **16,777,214** hosts and **126** networks.

What is IPv4 Class B

In **Class B**, the first two octets, or 16 bits are used to define the network ID.

- The Public IP addresses range from 128.0.0.0 to 191.255.0.0.
- The private IP range is from 172.16.0.0 to 172.31.255.255.

The default subnet mask is **255.255.0.0** where the first 16 bits define the network ID. This class of IP is typically used for medium-large networks and yields **65,534** hosts per network with a total of **16,382** networks.

What is IPv4 Class C

This class of IP is mostly used for small networks such as a home network or a small office or business.

In a **Class C** network, the first two network bits are set to 1 while the third is set to 0, i.e 0. The remaining 21 bits of the first three octets define the network ID, and the last defines the number of hosts.

As such, Class C IP address produces the highest number of networks amounting to **2,097,150**, and the least number of hosts per network which is **254** hosts.

- The public IP addresses range from 192.0.0.0 to 223.255.255.0.
- The private IP range is from 192.168.0.0 to 192.168.255.255.

The subnet mast is 255.255.255.0.

Host Portion

The remaining section of the IP address is the host portion, which is the section that determines the number of hosts in a network. This part uniquely identifies a host in a network. All hosts in the same network share the same network portion.

For example, the following host IP addresses belong to the same network.

```
192.168.50.15
192.168.50.100
192.168.50.90
```

IPv6 Address

An **IPv6** address is an alphanumeric address that is 128 bits long, arranged in eight groups, each of which contains 16 bits.

Like an IPv4 address, it is split into two parts: the **network** and **host** component. The network part makes up the first 64 bits and is used for routing purposes. The remaining 64 bits identified the address on the nodes.

Below is an example of a full IPv6 address.

```
fe80:ce00:0000:5029:45ff:0000:211E:469C
```

This can be further shortened as follows.

```
fe80:ce00:0:5029:45ff:0:211E:469C
```

IPv6 was developed as a solution to the imminent exhaustion of addresses in IPv4. As you know by now, IPv6 contains 128 bits which is four times more than the number of bits in IPv4 (32 bits). These extra bits provide more addressing space which will supplement the address provided by IPV4.

Although **IPv6** is set to take over from IPv4 addressing in the near future, many organizations and ISPs still use and largely rely on IPv4 addresses.

In fact, you'll hardly ever need to configure an IPv6 on your device to provide connectivity. The fact is, it will take a while before IPv6 replaces or phases out IPv4.

[You might also like: What's Wrong with IPv4 and Why We Are Moving to IPv6]

Dynamic (DHCP) and Static IP Configuration

IP allocation on client machines or any end-point devices connected to a network is done either using the **DHCP** protocol or manual configuration where IP addresses are statically allocated.

DHCP IP Address

DHCP (**Dynamic Host Configuration Protocol**) is a client-server protocol that dynamically allocates IP addresses to client systems on a network. The **DHCP** server, which in most cases is a router, contains a pool of addresses that it leases out to client devices on a network for a certain period of time. Thus, it simplifies and makes the configuration of IP addresses more efficient. Once the lease time lapses, the client acquires a new IP address.

Most systems, by default, are configured to obtain an IP automatically using the DHCP protocol. This eliminates the possibility of IP conflicts in a network where two devices share the same IP address.

The drawback of DHCP is that the IP addresses change once the lease expires. If a server is set to acquire an IP via DHCP, this will lead to connectivity issues once the IP address changes. And this is where static IP configuration comes in.

Static IP Address

In static IP configuration, IP addresses are manually configured on a client system, especially servers. Unlike dynamically allocated addresses, statically configured IP addresses remain the same and do not change.

However, the static configuration requires a lot of work from network admins. They have to manually log in and configure the static IP along with other details such as subnet mask, DNS servers, and gateway IP. In addition, they need to keep track of all the client systems with static IP addresses.

[You might also like: How to Creating Network Bonding and Bridging in Ubuntu]

In this tutorial, we will focus on how to statically configure IP addresses on various systems.

How to Configure IPv4 Networking in Linux

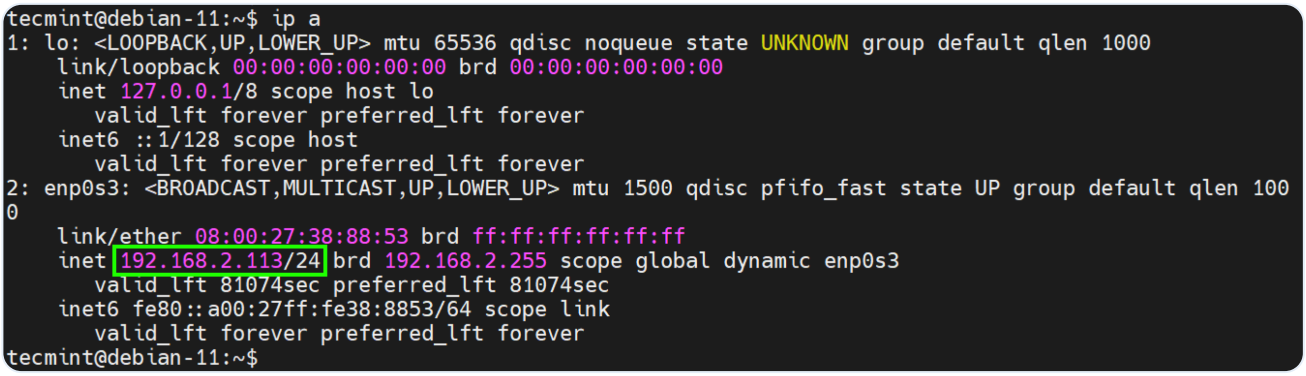
In this section, we will shift focus and see how to configure an IPv4 address on Linux. We will look at how you can do this on **Debian**, **Ubuntu**, and later on **RHEL** and Red Hat distributions.

Configure IPv4 Address on Debian

To get started, it’s always a good idea to check your current IP configuration of the Linux system.

```
$ ip a
```

This displays the IP addresses and status of your network interfaces. From the output, we have two interfaces.



```
tecmint@debian-11:~$ 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: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 100
0
    link/ether 08:00:27:38:88:53 brd ff:ff:ff:ff:ff:ff
    inet 192.168.2.113/24 brd 192.168.2.255 scope global dynamic enp0s3
       valid_lft 81074sec preferred_lft 81074sec
    inet6 fe80::a00:27ff:fe38:8853/64 scope link
       valid_lft forever preferred_lft forever
tecmint@debian-11:~$
```

Find IP Address in Linux

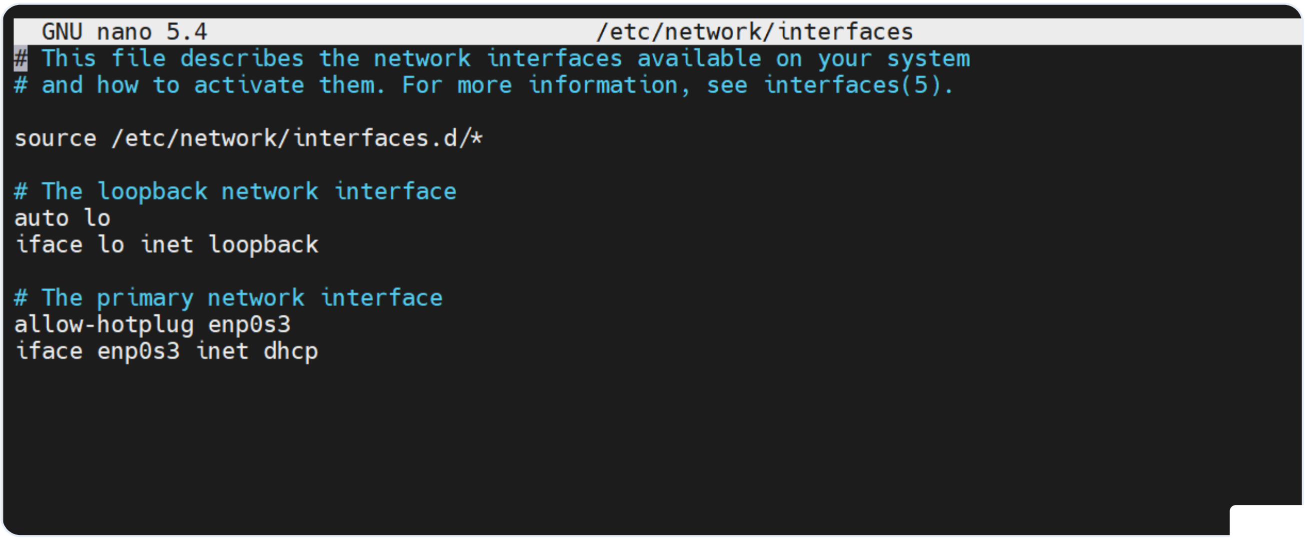
The first one is the lo interface which is a **loopback** address reserved for testing purposes only and is always designated the address **127.0.0.1**. The loopback address is not associated with any physical network interface.

The second interface is **enp0s3** (this might be different in your case). This is the active network interface that maps to the physical network card on the server.

Its **IPv4** address is denoted by the **inet** parameter, and in this case is **192.168.2.113**, which is assigned via the DHCP **protocol.**

In Debian, the network configuration is contained in the **/etc/network/interfaces** file. You can view it using the nano or vim editor.

```
$ sudo nano /etc/network/interfaces
```



```
  GNU nano 5.4                        /etc/network/interfaces
# This file describes the network interfaces available on your system
# and how to activate them. For more information, see interfaces(5).

source /etc/network/interfaces.d/*

# The loopback network interface
auto lo
iface lo inet loopback

# The primary network interface
allow-hotplug enp0s3
iface enp0s3 inet dhcp
```

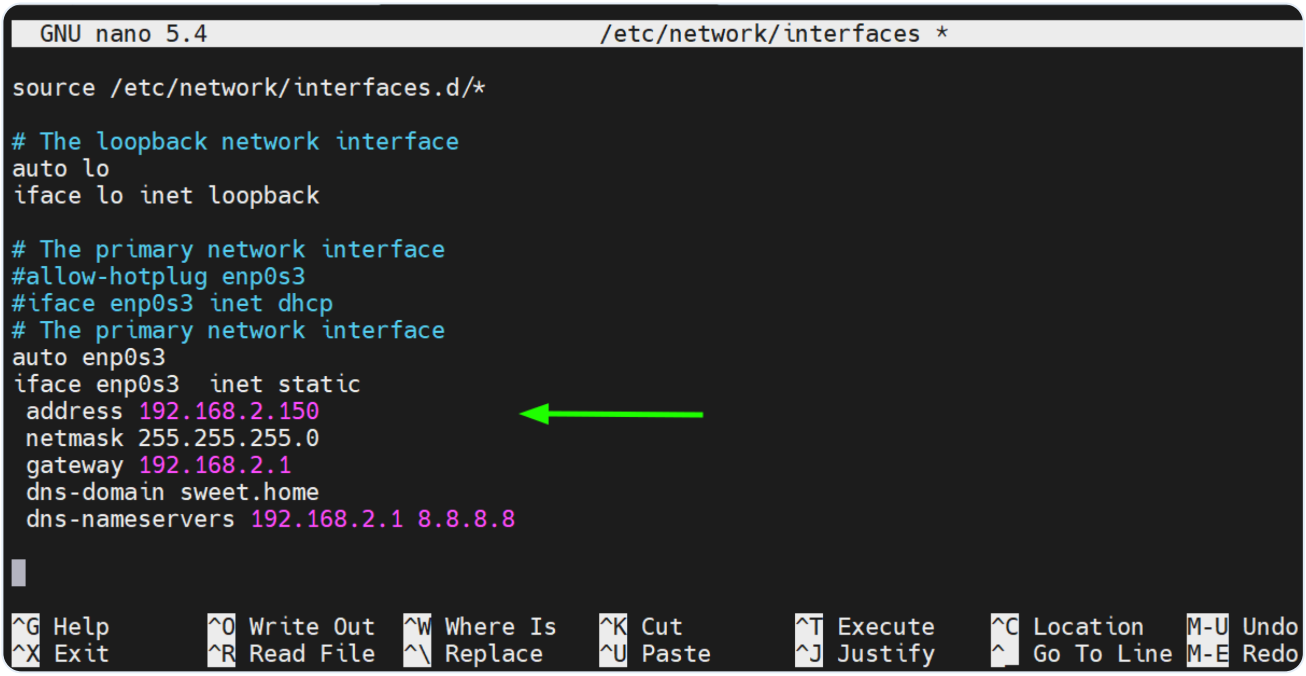
Debian Network Configuration

Privacy

To configure a static IPv4 address, remove or comment the **allow-hotplug** and **dhcp** lines, Then add the following configuration.

```
# The primary network interface
auto enp0s3
iface enp0s3  inet static
 address 192.168.2.150
 netmask 255.255.255.0
 gateway 192.168.2.1
 dns-nameservers 192.168.2.1 8.8.8.8
```

In this configuration, **192.168.2.150** will be our new **IPv4** address with a netmask or network subnet of 255.255.255.0. The default gateway, which also happens to be the router's IP, is **192.168.2.1** while the DNS nameservers are **192.168.2.1** and **8.8.8.8**.



```
  GNU nano 5.4                           /etc/network/interfaces *

source /etc/network/interfaces.d/*

# The loopback network interface
auto lo
iface lo inet loopback

# The primary network interface
#allow-hotplug enp0s3
#iface enp0s3 inet dhcp
# The primary network interface
auto enp0s3
iface enp0s3  inet static
 address 192.168.2.150
 netmask 255.255.255.0
 gateway 192.168.2.1
 dns-domain sweet.home
 dns-nameservers 192.168.2.1 8.8.8.8
```

Set Static IP Address in Debian

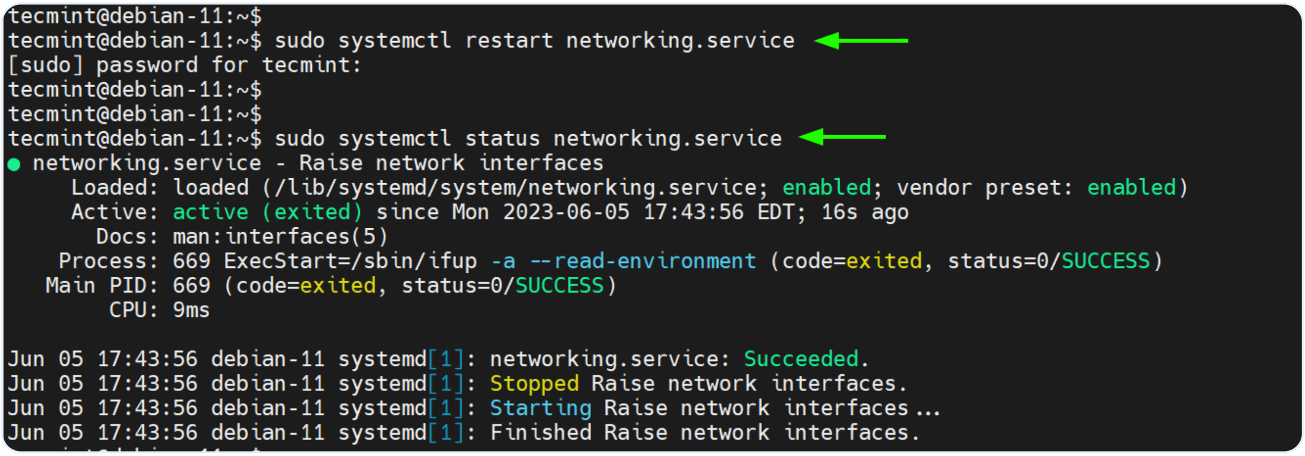
Save the changes and exit the file.

To apply the changes, restart the networking service.

```
$ sudo systemctl restart networking.service
```

Then confirm no errors were encountered

```
$ sudo systemctl status networking.service
```



```
tecmint@debian-11:~$
tecmint@debian-11:~$ sudo systemctl restart networking.service
[sudo] password for tecmint:
tecmint@debian-11:~$
tecmint@debian-11:~$
tecmint@debian-11:~$ sudo systemctl status networking.service
● networking.service - Raise network interfaces
     Loaded: loaded (/lib/systemd/system/networking.service; enabled; vendor preset: enabled)
     Active: active (exited) since Mon 2023-06-05 17:43:56 EDT; 16s ago
       Docs: man:interfaces(5)
    Process: 669 ExecStart=/sbin/ifup -a --read-environment (code=exited, status=0/SUCCESS)
   Main PID: 669 (code=exited, status=0/SUCCESS)
        CPU: 9ms

Jun 05 17:43:56 debian-11 systemd[1]: networking.service: Succeeded.
Jun 05 17:43:56 debian-11 systemd[1]: Stopped Raise network interfaces.
Jun 05 17:43:56 debian-11 systemd[1]: Starting Raise network interfaces...
Jun 05 17:43:56 debian-11 systemd[1]: Finished Raise network interfaces.
```

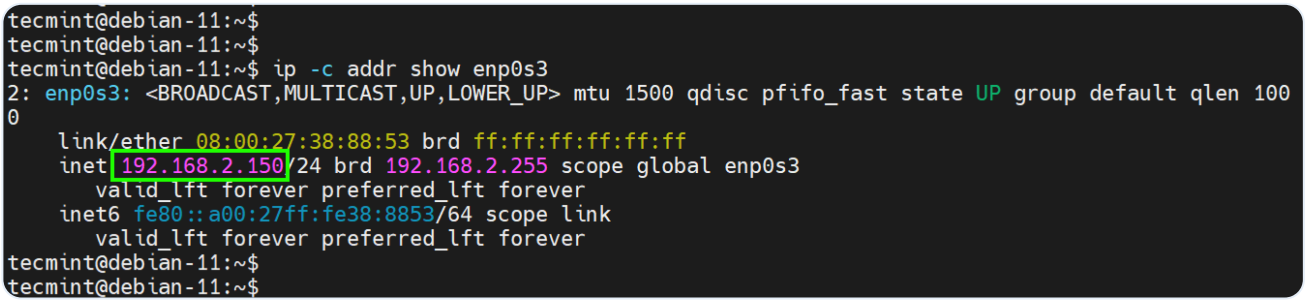
Start Network in Debian

> **Note**: If you are connected to the server via SSH, your connection will drop and you will be disconnected. To access the server once again, connect using the new IP address.

To confirm that the server has acquired the new IP, run the following command:

```
$ ip -c addr show enp0s3
```

The output below confirms that we have successfully configured the static IPv4 address.



```
tecmint@debian-11:~$
tecmint@debian-11:~$
tecmint@debian-11:~$ ip -c addr show enp0s3
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 100
0
    link/ether 08:00:27:38:88:53 brd ff:ff:ff:ff:ff:ff
    inet 192.168.2.150/24 brd 192.168.2.255 scope global enp0s3
       valid_lft forever preferred_lft forever
    inet6 fe80::a00:27ff:fe38:8853/64 scope link
       valid_lft forever preferred_lft forever
tecmint@debian-11:~$
tecmint@debian-11:~$
```

Find IP Address in Debian

Configure IPv4 Address on Ubuntu

Privacy

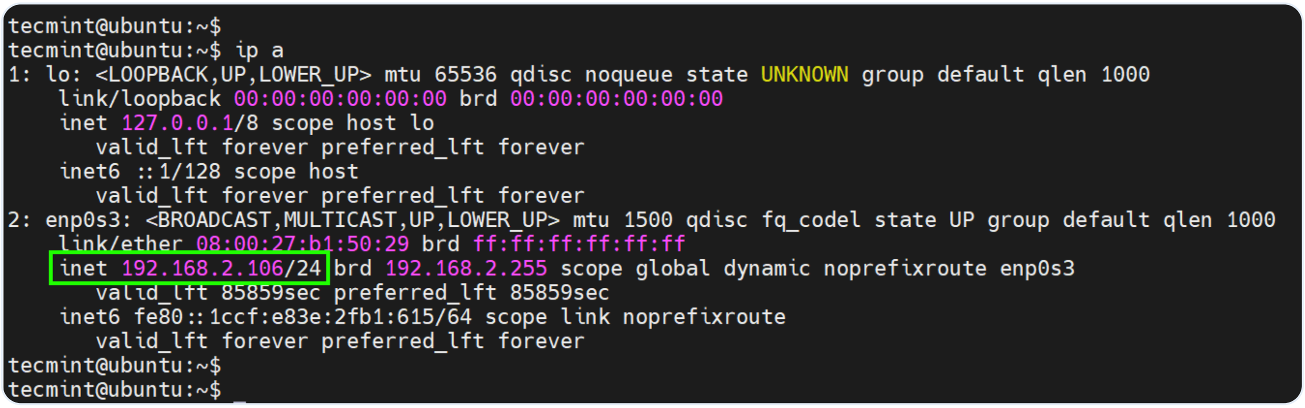
In **Ubuntu 18.04** and later versions, **Netplan** is the default network configuration tool, which enables easy configuration of network settings via **YAML** files. According to Canonical, **netplan** processes the **YAML** files and generates network configurations for **systemd-network** or **NetworkManager**.

The network configuration file for modern Ubuntu distributions is located in the **/etc/netplan** directory. For the desktop system, the configuration file in this directory is **01-network-manager-all.yaml**. For servers, the file is **/etc/netplan/01-netcfg.yaml**.

Once again, let's check our current IP address which is auto-assigned by DHCP.

```
$ ip a
```

Our current IP is **192.168.2.106**. We will set this to **192.168.2.180**.



```
tecmint@ubuntu:~$
tecmint@ubuntu:~$ 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: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 08:00:27:b1:50:29 brd ff:ff:ff:ff:ff:ff
    inet 192.168.2.106/24 brd 192.168.2.255 scope global dynamic noprefixroute enp0s3
       valid_lft 85859sec preferred_lft 85859sec
    inet6 fe80::1ccf:e83e:2fb1:615/64 scope link noprefixroute
       valid_lft forever preferred_lft forever
tecmint@ubuntu:~$
tecmint@ubuntu:~$
```

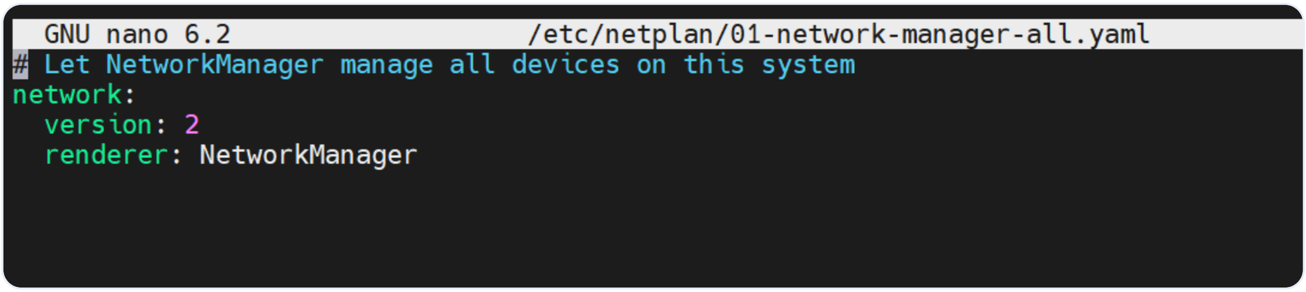
Check the IP Address in Ubuntu

To assign an IPv4 address, we will open the network configuration file.

```
$ sudo nano /etc/netplan/01-network-manager-all.yaml
```

By default, the following lines automatically set the system to use DHCP for IP assignment.

Privacy

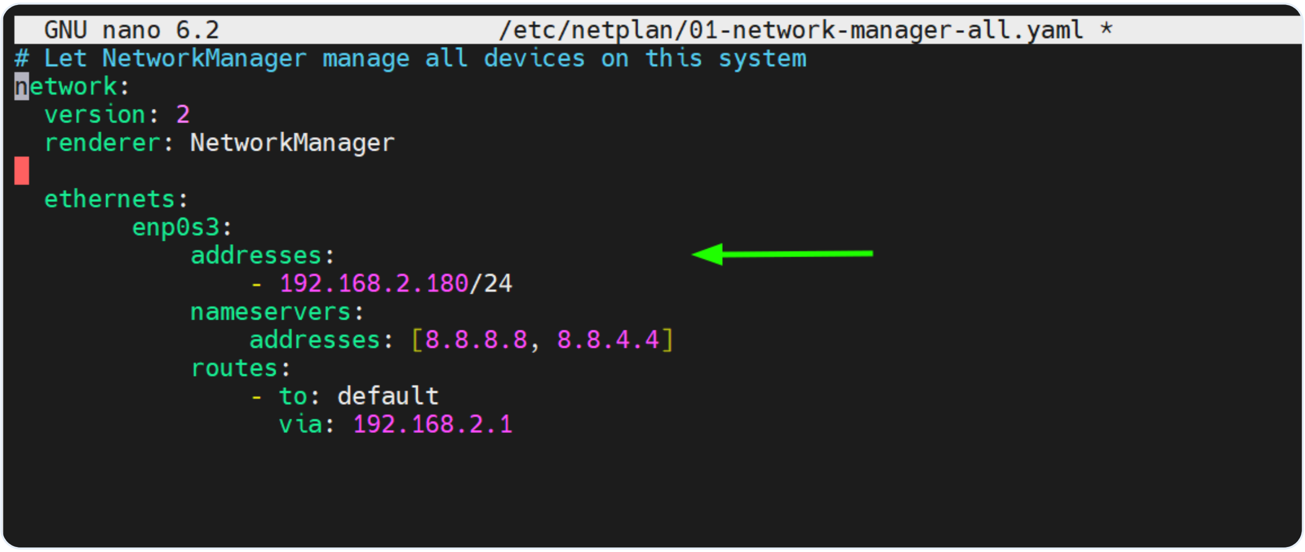


```
  GNU nano 6.2                    /etc/netplan/01-network-manager-all.yaml
# Let NetworkManager manage all devices on this system
network:
  version: 2
  renderer: NetworkManager
```

Ubuntu Network Configuration

Add the following lines to assign a static IP.

```
ethernets:
        enp0s3:
            addresses:
                - 192.168.2.180/24
            nameservers:
                addresses: [8.8.8.8, 8.8.4.4]
            routes:
                - to: default
                  via: 192.168.2.1
```



```
  GNU nano 6.2                    /etc/netplan/01-network-manager-all.yaml *
# Let NetworkManager manage all devices on this system
network:
  version: 2
  renderer: NetworkManager

  ethernets:
        enp0s3:
            addresses:
                - 192.168.2.180/24
            nameservers:
                addresses: [8.8.8.8, 8.8.4.4]
            routes:
                - to: default
                  via: 192.168.2.1
```

Set Static IP Address in Ubuntu

Let us break down the parameters used:

- **enp0s3** – is the name of the network interface.

Privacy

- **addresses** – This configures the IPv4 address on the interface. This is followed by the CIDR, in this case,/24 which implies a network subnet of 255.255.255.0.
- **nameservers** – This specifies the DNS servers to be used. In this case, we are using 8.8.8.8 and 8.8.4.4 which are Google's name servers.
- **routes** – This sets the gateway on your system.

Remember to replace the interface name and IP configuration to match your network environment.

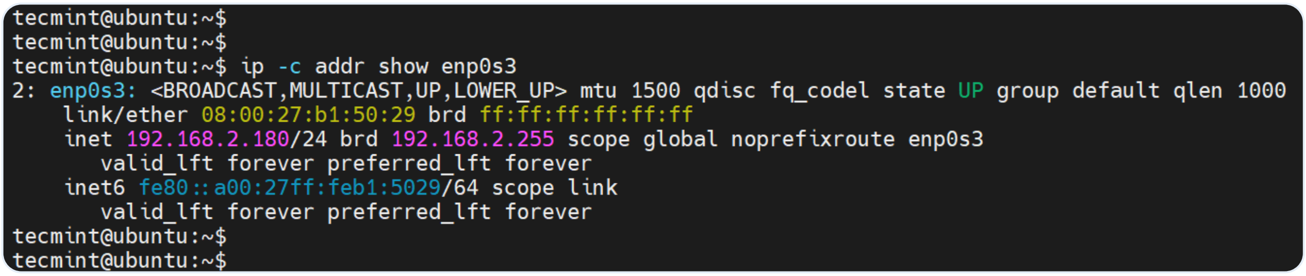
Save the changes and exit.

To apply the changes made, run the following command:

```
$ sudo netplan apply
```

Once again, verify if the changes have been reflected as shown.

```
$ ip -c addr show enp0s3
```



```
tecmint@ubuntu:~$
tecmint@ubuntu:~$
tecmint@ubuntu:~$ ip -c addr show enp0s3
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 08:00:27:b1:50:29 brd ff:ff:ff:ff:ff:ff
    inet 192.168.2.180/24 brd 192.168.2.255 scope global noprefixroute enp0s3
       valid_lft forever preferred_lft forever
    inet6 fe80::a00:27ff:feb1:5029/64 scope link
       valid_lft forever preferred_lft forever
tecmint@ubuntu:~$
tecmint@ubuntu:~$
```

Find IP Address in Ubuntu

Configure IPv4 Address on RHEL

In Red Hat distributions, the nmcli (NetworkManager Command Line Interface) command-line tool is one of the most preferred ways of configuring an IPv4 address. It does so using the NetworkManager service.

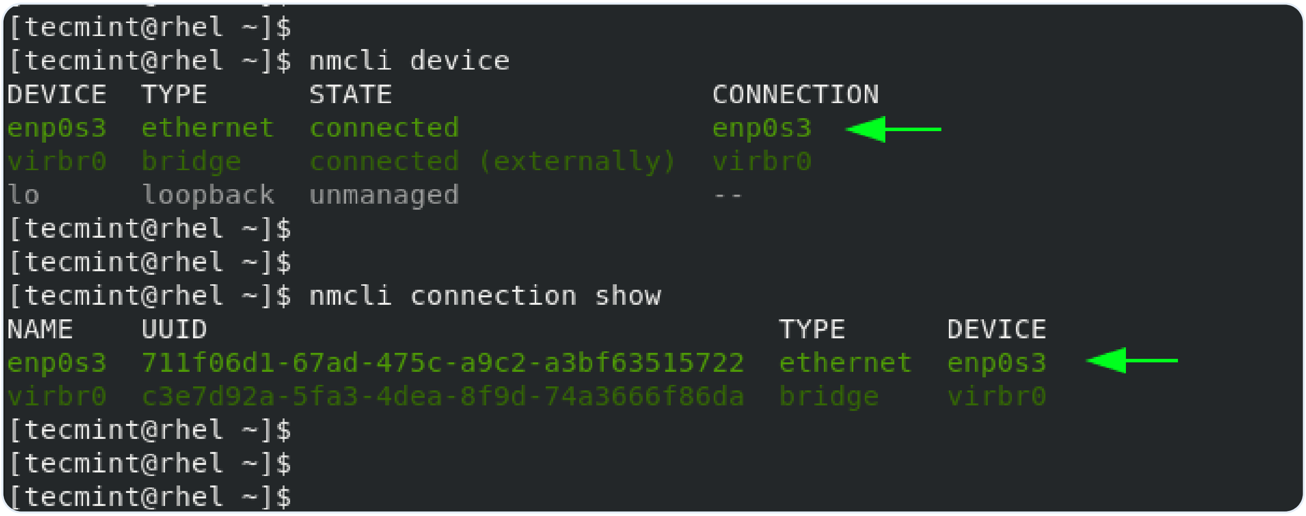
To view the network interface name attached to your system, execute the command:

Privacy

```
$ nmcli device
```

To display the active connection, run the command:

```
$ nmcli connection show
```



```
[tecmint@rhel ~]$
[tecmint@rhel ~]$ nmcli device
DEVICE  TYPE      STATE                   CONNECTION
enp0s3  ethernet  connected               enp0s3
virbr0  bridge    connected (externally)  virbr0
lo      loopback  unmanaged               --
[tecmint@rhel ~]$
[tecmint@rhel ~]$
[tecmint@rhel ~]$ nmcli connection show
NAME    UUID                                  TYPE      DEVICE
enp0s3  711f06d1-67ad-475c-a9c2-a3bf63515722  ethernet  enp0s3
virbr0  c3e7d92a-5fa3-4dea-8f9d-74a3666f86da  bridge    virbr0
[tecmint@rhel ~]$
[tecmint@rhel ~]$
[tecmint@rhel ~]$
```

Find Network Interface in RHEL

In **RHEL 9** and other Red Hat distributions based on RHEL, the network configuration file resides in the **/etc/sysconfig/network-scripts** directory. In our case, the configuration file is **ifcfg-enp0s3**.

We will assign a static IPv4 address on the interface '**enp0s3**' as shown:

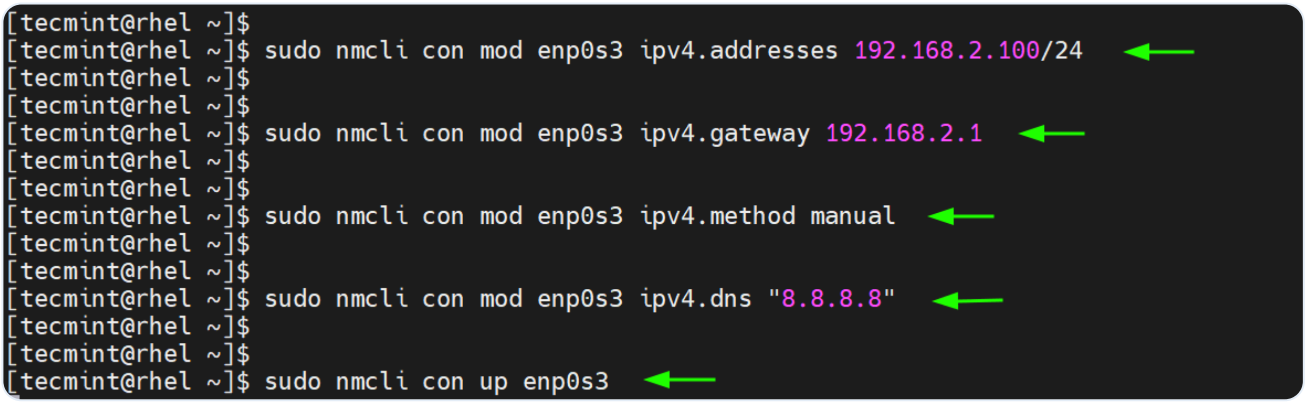
```
IP: 192.168.2.100
netmask: 255.255.255.0
gateway: 192.168.2.1
dns: 8.8.8.8
```

To do so, we will run the following commands:

```
$ sudo nmcli con mod enp0s3 ipv4.addresses 192.168.2.100/24
$ sudo nmcli con mod enp0s3 ipv4.gateway 192.168.2.1
```

Privacy

```
$ sudo nmcli con mod enp0s3 ipv4.method manual
$ sudo nmcli con mod enp0s3 ipv4.dns "8.8.8.8"
$ sudo nmcli con up enp0s3
```

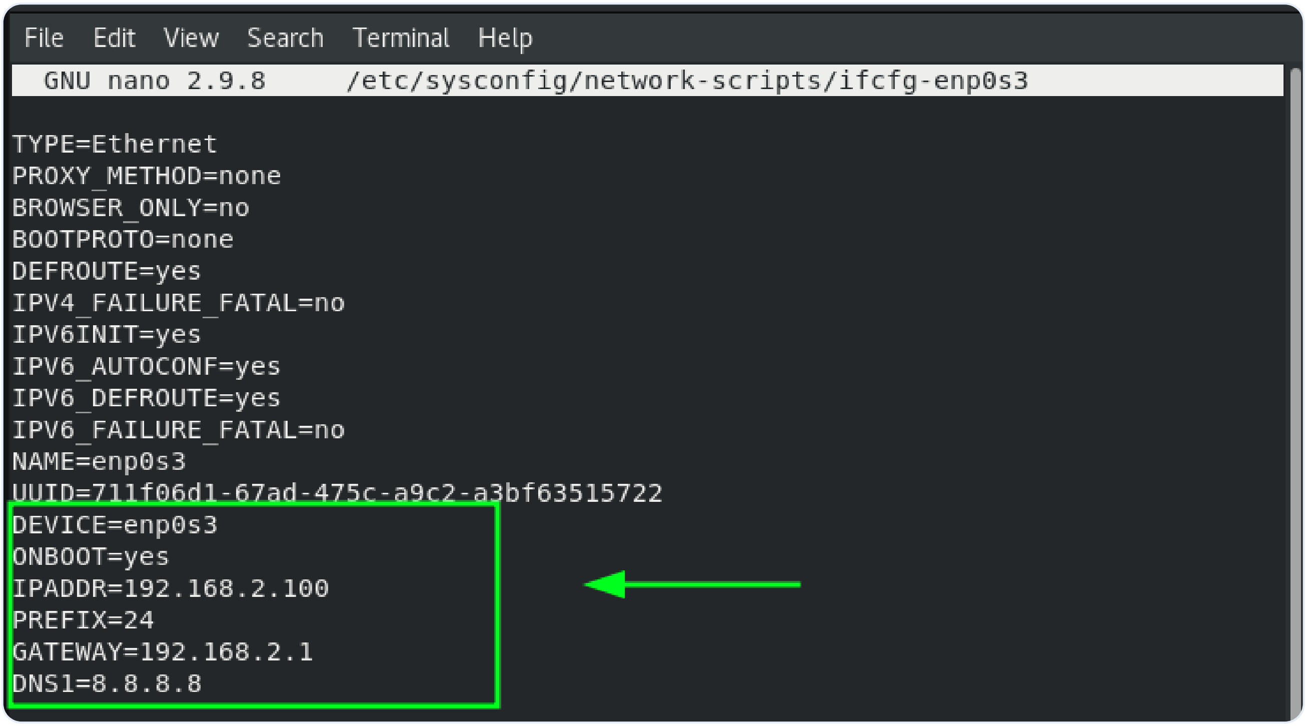


```
[tecmint@rhel ~]$
[tecmint@rhel ~]$ sudo nmcli con mod enp0s3 ipv4.addresses 192.168.2.100/24
[tecmint@rhel ~]$
[tecmint@rhel ~]$
[tecmint@rhel ~]$ sudo nmcli con mod enp0s3 ipv4.gateway 192.168.2.1
[tecmint@rhel ~]$
[tecmint@rhel ~]$
[tecmint@rhel ~]$ sudo nmcli con mod enp0s3 ipv4.method manual
[tecmint@rhel ~]$
[tecmint@rhel ~]$
[tecmint@rhel ~]$ sudo nmcli con mod enp0s3 ipv4.dns "8.8.8.8"
[tecmint@rhel ~]$
[tecmint@rhel ~]$
[tecmint@rhel ~]$ sudo nmcli con up enp0s3
```

Set Static IP Address in RHEL

The commands save the changes inside the associated network configuration file. You can view the file using your preferred text editor

```
$ sudo nano etc/sysconfig/network-scripts ifcfg-enp0s3
```



```
  GNU nano 2.9.8     /etc/sysconfig/network-scripts/ifcfg-enp0s3

TYPE=Ethernet
PROXY_METHOD=none
BROWSER_ONLY=no
BOOTPROTO=none
DEFROUTE=yes
IPV4_FAILURE_FATAL=no
IPV6INIT=yes
IPV6_AUTOCONF=yes
IPV6_DEFROUTE=yes
IPV6_FAILURE_FATAL=no
NAME=enp0s3
UUID=711f06d1-67ad-475c-a9c2-a3bf63515722
DEVICE=enp0s3
ONBOOT=yes
IPADDR=192.168.2.100
PREFIX=24
GATEWAY=192.168.2.1
DNS1=8.8.8.8
```

RHEL Network Configuration

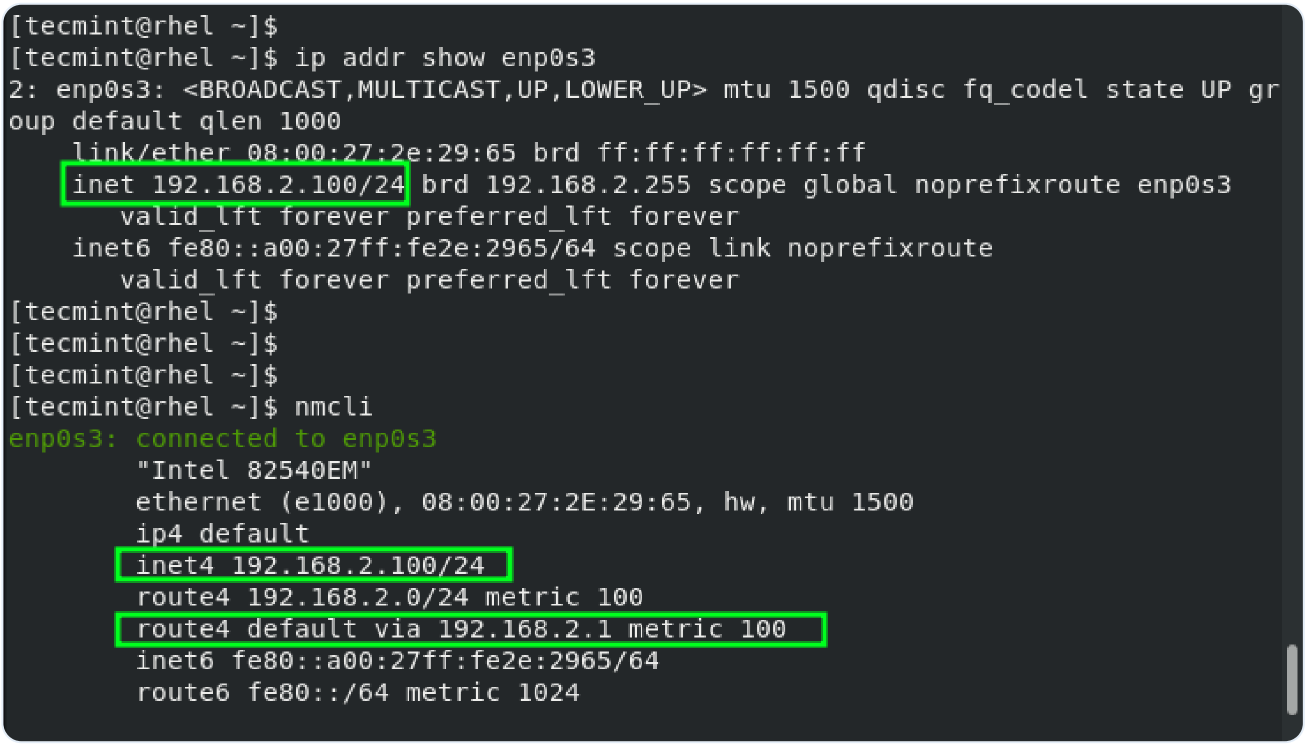
Privacy

To confirm the new IP address, run the following command

```
$ ip addr show enp0s3
```

You can also run the **nmcli** command without any command-line options and the active interface will be displayed at the top.

```
$ nmcli
```



```
[tecmint@rhel ~]$
[tecmint@rhel ~]$ ip addr show enp0s3
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP gr
oup default qlen 1000
    link/ether 08:00:27:2e:29:65 brd ff:ff:ff:ff:ff:ff
    inet 192.168.2.100/24 brd 192.168.2.255 scope global noprefixroute enp0s3
       valid_lft forever preferred_lft forever
    inet6 fe80::a00:27ff:fe2e:2965/64 scope link noprefixroute
       valid_lft forever preferred_lft forever
[tecmint@rhel ~]$
[tecmint@rhel ~]$
[tecmint@rhel ~]$
[tecmint@rhel ~]$ nmcli
enp0s3: connected to enp0s3
        "Intel 82540EM"
        ethernet (e1000), 08:00:27:2E:29:65, hw, mtu 1500
        ip4 default
        inet4 192.168.2.100/24
        route4 192.168.2.0/24 metric 100
        route4 default via 192.168.2.1 metric 100
        inet6 fe80::a00:27ff:fe2e:2965/64
        route6 fe80::/64 metric 1024
```

Find IP Address in RHEL

How to Configure Hostname in Linux

A well-configured system should be able to resolve its hostname or domain name to the IP address configured. Usually, the hostname and IP address mapping is done in the **/etc/hosts** file.

To configure hostname resolution, add a host's entry to the **/etc/hosts** file. This entry includes the host's IP address and the hostname as shown.

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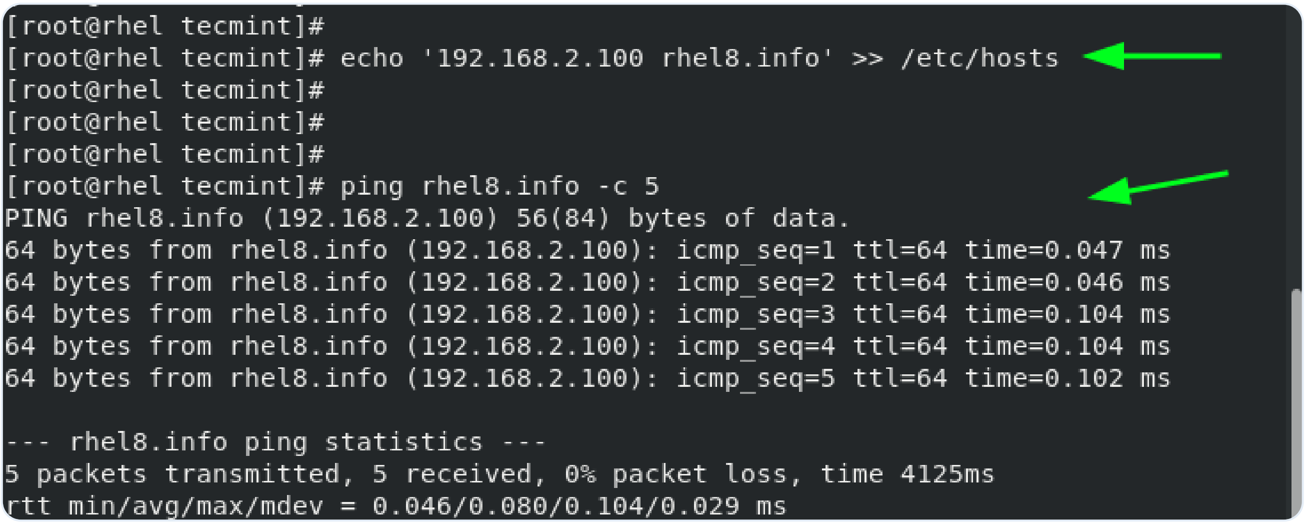
```
$ echo '192.168.2.150  debian-11' >> /etc/hosts
```

Be sure to update the **/etc/hosts** file on every Linux system that you intend to connect to the system on the same local network.

Once done, you can successfully ping the hostname of the Linux machine.

```
$ ping debian-11 -c 5
```



```
[root@rhel tecmint]#
[root@rhel tecmint]# echo '192.168.2.100 rhel8.info' >> /etc/hosts
[root@rhel tecmint]#
[root@rhel tecmint]#
[root@rhel tecmint]#
[root@rhel tecmint]# ping rhel8.info -c 5
PING rhel8.info (192.168.2.100) 56(84) bytes of data.
64 bytes from rhel8.info (192.168.2.100): icmp_seq=1 ttl=64 time=0.047 ms
64 bytes from rhel8.info (192.168.2.100): icmp_seq=2 ttl=64 time=0.046 ms
64 bytes from rhel8.info (192.168.2.100): icmp_seq=3 ttl=64 time=0.104 ms
64 bytes from rhel8.info (192.168.2.100): icmp_seq=4 ttl=64 time=0.104 ms
64 bytes from rhel8.info (192.168.2.100): icmp_seq=5 ttl=64 time=0.102 ms

--- rhel8.info ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4125ms
rtt min/avg/max/mdev = 0.046/0.080/0.104/0.029 ms
```

Ping Hostname in Linux

Conclusion

In this tutorial, we have covered IPv4 and IPv6 IP addresses and explored how you can configure IPv4 networking and hostname resolution on Linux.

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