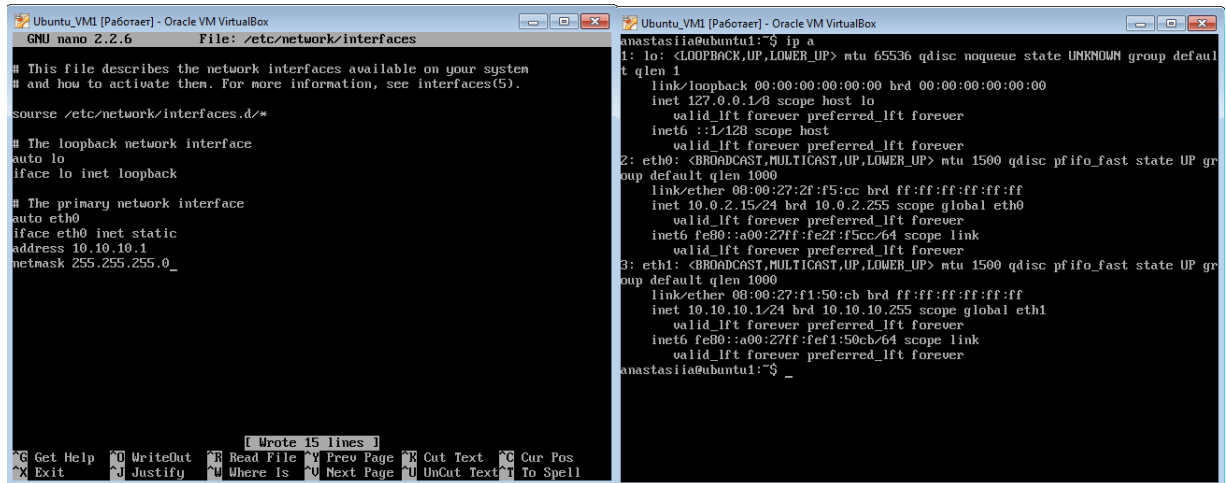


VM1 has NAT and internal interfaces



The left screenshot shows the `/etc/network/interfaces` file in nano editor. It contains configuration for a loopback interface `lo` and a primary network interface `eth0` with a static IP address of `10.10.10.1` and a netmask of `255.255.255.0`.

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

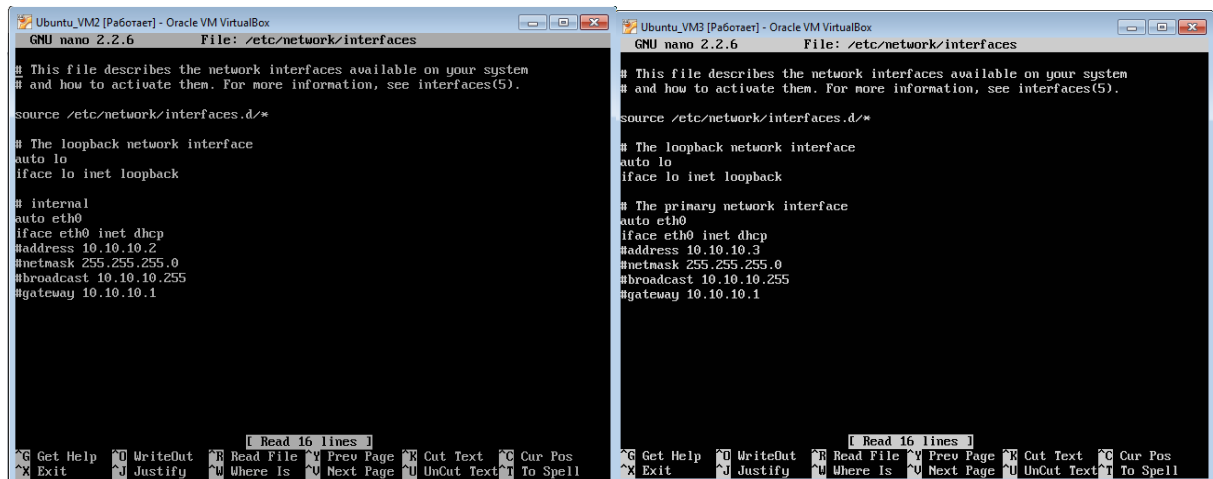
source /etc/network/interfaces.d/*

# The loopback network interface
auto lo
iface lo inet loopback

# The primary network interface
auto eth0
iface eth0 inet static
address 10.10.10.1
netmask 255.255.255.0
```

The right screenshot shows the output of the `ip a` command, displaying details for the `lo` and `eth0` interfaces, including their MAC addresses and IP configurations.

VM2 and VM3 have internal only interfaces



The left screenshot shows the `/etc/network/interfaces` file in nano editor for VM2. It configures a loopback interface `lo` and an internal network interface `eth0` with a static IP address of `10.10.10.2` and a netmask of `255.255.255.0`.

```
# 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

# internal
auto eth0
iface eth0 inet dhcp
address 10.10.10.2
netmask 255.255.255.0
broadcast 10.10.10.255
gateway 10.10.10.1
```

The right screenshot shows the `/etc/network/interfaces` file in nano editor for VM3. It configures a loopback interface `lo` and a primary network interface `eth0` with a static IP address of `10.10.10.3` and a netmask of `255.255.255.0`.

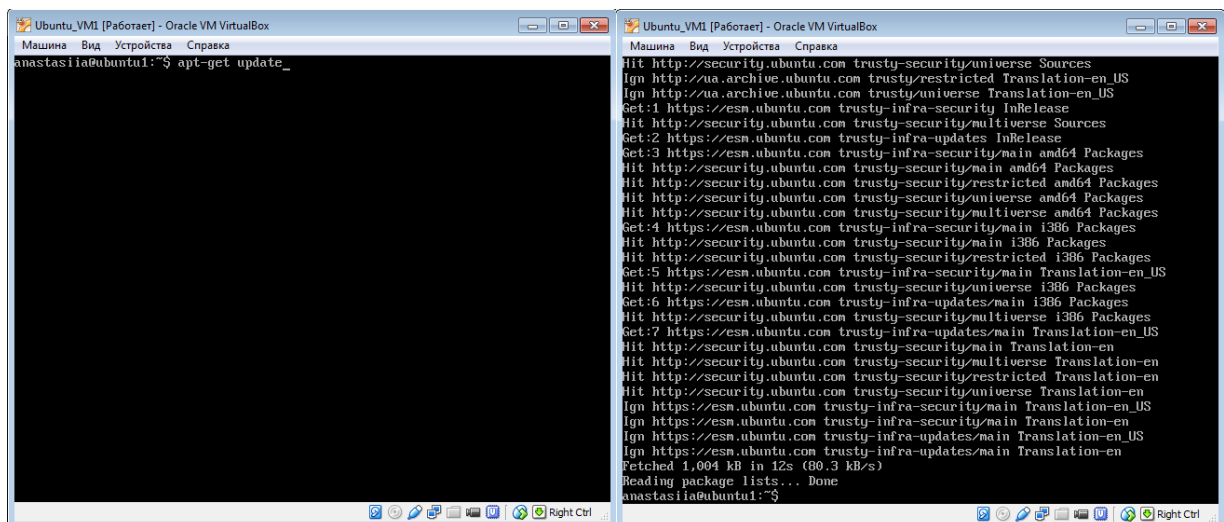
```
# This file describes the network interfaces available on your system
# and how to activate them. For more information, see interfaces(5).

source /etc/network/interfaces.d/*

# The loopback network interface
auto lo
iface lo inet loopback

# The primary network interface
auto eth0
iface eth0 inet dhcp
address 10.10.10.3
netmask 255.255.255.0
broadcast 10.10.10.255
gateway 10.10.10.1
```

Install and configure DHCP server on VM1



The left screenshot shows the terminal output of the `apt-get update` command, displaying the list of available packages and their versions.

```
анастасия@ubuntu1:~$ apt-get update_
```

The right screenshot shows the terminal output of the `dpkg-query -f='${Package} ${Version} ${Architecture}\n'` command, displaying the list of installed packages and their versions.

```
анастасия@ubuntu1:~$ dpkg-query -f='${Package} ${Version} ${Architecture}\n'
```

Make some changes in file `/etc/dnsmasq.conf`

```
GNU nano 2.2.6 File: /etc/dnsmasq.conf Modified
# and this sets the source (ie local) address used to talk to
# 10.1.2.3 to 192.168.1.1 port 55 (there must be a interface with that
# IP on the machine, obviously).
# server=10.1.2.3#192.168.1.1#55

# If you want dnsmasq to change uid and gid to something other
# than the default, edit the following lines.
#user=
#group=

# If you want dnsmasq to listen for DHCP and DNS requests only on
# specified interfaces (and the loopback) give the name of the
# interface (eg eth0) here.
# Repeat the line for more than one interface.
interface=eth1

# Or you can specify which interface _not_ to listen on
#except-interface=

# Or which to listen on by address (remember to include 127.0.0.1 if
# you use this.)
#listen-address=

# If you want dnsmasq to provide only DNS service on an interface,
# configure it as shown above, and then use the following line to
# disable DHCP and TFTP on it.
no-dhcp-interface=

^G Get Help ^O WriteOut ^R Read File ^Y Prev Page ^X Cut Text ^C Cur Pos
^X Exit ^J Justify ^W Where Is ^V Next Page ^U UnCut Text ^T To Spell

GNU nano 2.2.6 File: /etc/dnsmasq.conf Modified
# 3) Provides the domain part for "expand-hosts"
#domain=thekelleys.org.uk

# Set a different domain for a particular subnet
#domain=wireless.thekelleys.org.uk,192.168.2.0/24

# Same idea, but range rather than subnet
#domain=reserved.thekelleys.org.uk,192.168.3.100,192.168.3.200

# Uncomment this to enable the integrated DHCP server, you need
# to supply the range of addresses available for lease and optionally
# a lease time. If you have more than one network, you will need to
# repeat this for each network on which you want to supply DHCP
# service.
dhcp-range=10.10.10.10,10.10.10.20,12h

# This is an example of a DHCP range where the netmask is given. This
# is needed for networks we reach the dnsmasq DHCP server via a relay
# agent. If you don't know what a DHCP relay agent is, you probably
# don't need to worry about this.
#dhcp-range=192.168.0.50,192.168.0.150,255.255.255.0,12h

# This is an example of a DHCP range which sets a tag, so that
# some DHCP options may be set only for this network.
#dhcp-range=set:red,192.168.0.50,192.168.0.150

^G Get Help ^O WriteOut ^R Read File ^Y Prev Page ^X Cut Text ^C Cur Pos
^X Exit ^J Justify ^W Where Is ^V Next Page ^U UnCut Text ^T To Spell
```

Also check files /etc/resolv.conf and etc/dhcp/dhclient.conf

```
GNU nano 2.2.6 File: /etc/resolv.conf
# Dynamic resolv.conf(5) file for glibc resolver(3) generated by resolvconf(8)
# DO NOT EDIT THIS FILE BY HAND -- YOUR CHANGES WILL BE OVERWRITTEN
nameserver 127.0.0.1

[ Read 3 lines ]
^G Get Help ^O WriteOut ^R Read File ^Y Prev Page ^X Cut Text ^C Cur Pos
^X Exit ^J Justify ^W Where Is ^V Next Page ^U UnCut Text ^T To Spell

GNU nano 2.2.6 File: /etc/dhcp/dhclient.conf
# Configuration file for /sbin/dhclient, which is included in Debian's
# dhcp3-client package.

# This is a sample configuration file for dhclient. See dhclient.conf's
# man page for more information about the syntax of this file
# and a more comprehensive list of the parameters understood by
# dhclient.

# Normally, if the DHCP server provides reasonable information and does
# not leave anything out (like the domain name, for example), then
# few changes must be made to this file, if any.

option rfc3442-classless-static-routes code 121 = array of unsigned integer 8;

#send host-name "andare.fugue.com";
send host-name = gethostname();
#send dhcp-client-identifier 1:0:a0:24:ab:fb:9c;
#send dhcp-lease-time 3600;
#supersede domain-name "fugue.com home.vix.com";
prepend domain-name-servers 127.0.0.1;
request subnet-mask, broadcast-address, time-offset, routers,
domain-name, domain-name-servers, domain-search, host-name,
dhcp6.name-servers, dhcp6.domain-search,
netbios-name-servers, netbios-scope, interface-mtu,

^G Get Help ^O WriteOut ^R Read File ^Y Prev Page ^X Cut Text ^C Cur Pos
^X Exit ^J Justify ^W Where Is ^V Next Page ^U UnCut Text ^T To Spell
```

Check VM2 and VM3 for obtaining network addresses from DHCP server

```
anastasiia@ubuntu2:~$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default
    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 08:00:27:01:22:f8 brd ff:ff:ff:ff:ff:ff
    inet 10.10.10.14/24 brd 10.10.10.255 scope global eth0
        valid_lft forever preferred_lft forever
    inet6 fe80::a00:27ff:fe01:22f8/64 scope link
        valid_lft forever preferred_lft forever
anastasiia@ubuntu2:~$ _

Машинa Вид Устройства Справка
* Documentation: https://help.ubuntu.com/

System information as of Sun Nov 21 18:49:26 EET 2021

System load: 0.56          Memory usage: 1%      Processes:      85
Usage of /: 1.0% of 121.06GB Swap usage: 0%      Users logged in: 0

Graph this data and manage this system at:
https://landscape.canonical.com/

40 packages can be updated.
30 updates are security updates.

Your Hardware Enablement Stack (HWE) is supported until April 2019.
anastasiia@ubuntu3:~$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default
    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:c8:d7:a8 brd ff:ff:ff:ff:ff:ff
    inet 10.10.10.13/24 brd 10.10.10.255 scope global eth0
        valid_lft forever preferred_lft forever
    inet6 fe80::a00:27ff:fc08:d7a8/64 scope link
        valid_lft forever preferred_lft forever
anastasiia@ubuntu3:~$
```

Iptables:

```
Ubuntu_VM1 [Pa6opaer] - Oracle VM VirtualBox
Welcome to Ubuntu 14.04.6 LTS (GNU/Linux 4.4.0-148-generic x86_64)

* Documentation:  https://help.ubuntu.com/

System information as of Sun Nov 21 18:58:02 EET 2021

System load:  0.08      Processes:      87
Usage of /:   1.4% of 121.06GB   Users logged in:  0
Memory usage: 1%      IP address for eth0: 10.0.2.15
Swap usage:  0%      IP address for eth1: 10.10.10.1

Graph this data and manage this system at:
https://landscape.canonical.com/

New release '16.04.7 LTS' available.
Run 'do-release-upgrade' to upgrade to it.

Your Hardware Enablement Stack (HWE) is supported until April 2019.
anastasiia@ubuntu1:~$ sudo iptables -t nat -A POSTROUTING -o eth0 -j MASQUERADE
[sudo] password for anastasiia:
anastasiia@ubuntu1:~$ sudo iptables -A FORWARD -i eth1 -o eth0 -m state --state
RELATED,ESTABLISHED -j ACCEPT
anastasiia@ubuntu1:~$ sudo iptables -A FORWARD -i eth1 -o eth0 -j ACCEPT
anastasiia@ubuntu1:~$ sudo iptables -S
-P INPUT ACCEPT
-P FORWARD ACCEPT
-P OUTPUT ACCEPT
-A FORWARD -i eth1 -o eth0 -m state --state RELATED,ESTABLISHED -j ACCEPT
-A FORWARD -i eth1 -o eth0 -j ACCEPT
anastasiia@ubuntu1:~$
```

Dig provides the user with a command line interface to access the DNS system

```
Ubuntu_VM1 [Pa6opaer] - Oracle VM VirtualBox
anastasiia@ubuntu1:~$ dig g.co

;<>> DiG 9.9.5-3ubuntu0.19-Ubuntu <>> g.co
;; global options: +cmd
;; Got answer:
;;->HEADER<- opcode: QUERY, status: NOERROR, id: 18069
;; flags: qr rd ra ad: QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 0

;; QUESTION SECTION:
;g.co.                IN      A
;; ANSWER SECTION:
g.co.                 57      IN      A      172.217.19.110

;; Query time: 5 msec
;; SERVER: 127.0.0.1#53(127.0.0.1)
;; WHEN: Sun Nov 21 19:03:44 EET 2021
;; MSG SIZE rcvd: 38

anastasiia@ubuntu1:~$

Ubuntu_VM3 [Pa6opaer] - Oracle VM VirtualBox
anastasiia@ubuntu3:~$ dig g.co

;<>> DiG 9.9.5-3ubuntu0.19-Ubuntu <>> g.co
;; global options: +cmd
;; Got answer:
;;->HEADER<- opcode: QUERY, status: NOERROR, id: 43310
;; flags: qr rd ra ad: QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 0

;; QUESTION SECTION:
;g.co.                IN      A
;; ANSWER SECTION:
g.co.                 19      IN      A      172.217.19.110

;; Query time: 4 msec
;; SERVER: 10.10.10.1#53(10.10.10.1)
;; WHEN: Sun Nov 21 19:04:21 EET 2021
;; MSG SIZE rcvd: 38

anastasiia@ubuntu3:~$
```

Also check ping and traceroute for VM2 and VM3

```
Ubuntu_VM2 [Pa6opaer] - Oracle VM VirtualBox
anastasiia@ubuntu2:~$ ping 8.8.8.8
PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.
64 bytes from 8.8.8.8: icmp_seq=1 ttl=118 time=213 ms
64 bytes from 8.8.8.8: icmp_seq=2 ttl=118 time=110 ms
64 bytes from 8.8.8.8: icmp_seq=3 ttl=118 time=130 ms
^C
--- 8.8.8.8 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2000ms
rtt min/avg/max/mdev = 110.602/151.592/213.681/44.649 ms
anastasiia@ubuntu2:~$ sudo traceroute -n icmp 8.8.8.8
traceroute to 8.8.8.8 (8.8.8.8), 30 hops max, 60 byte packets
 1 10.10.10.1 (10.10.10.1) 0.038 ms 0.224 ms 0.315 ms
 2 10.0.2.2 (10.0.2.2) 0.611 ms 0.957 ms 0.848 ms
 3 * * *
 4 * * *
 5 * * *
 6 * * *
 7 * * *
 8 * * *
 9 * * *
10 * * *
11 * * *
12 * * *
13 * dns.google (8.8.8.8) 41.088 ms 0.694 ms
anastasiia@ubuntu2:~$

Ubuntu_VM3 [Pa6opaer] - Oracle VM VirtualBox
anastasiia@ubuntu3:~$ ping 8.8.8.8
PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.
64 bytes from 8.8.8.8: icmp_seq=1 ttl=118 time=23.0 ms
64 bytes from 8.8.8.8: icmp_seq=2 ttl=118 time=22.2 ms
64 bytes from 8.8.8.8: icmp_seq=3 ttl=118 time=219 ms
^C
--- 8.8.8.8 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 22.235/88.226/219.430/92.775 ms
anastasiia@ubuntu3:~$ sudo traceroute 8.8.8.8 -n icmp
traceroute to 8.8.8.8 (8.8.8.8), 30 hops max, 60 byte packets
 1 10.10.10.1 (10.10.10.1) 0.350 ms 0.224 ms 0.203 ms
 2 10.0.2.2 (10.0.2.2) 1.990 ms 1.063 ms 1.770 ms
 3 * * *
 4 * * *
 5 * * *
 6 * * *
 7 * * *
 8 * * *
 9 * * *
10 * * *
11 * * *
12 * * *
13 * * *
14 * * *
15 * * *
16 * * *
17 * * *
18 * dns.google (8.8.8.8) 15.559 ms
anastasiia@ubuntu3:~$
```