

OpenWRT Buildroot

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1 Task 1

- OpenWRT Virtual Box VM Installation guide is studied
- OpenWRT is installed to Virtual Box VM
- OpenWRT VM networking is configured: 2x Network Interfaces are configured in VM

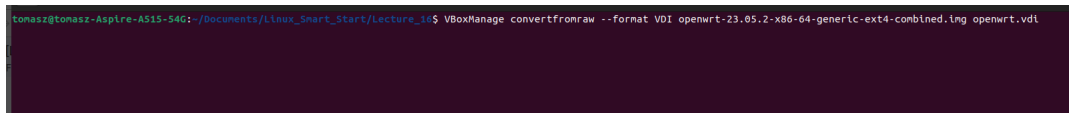


Figure 1: Create Virtual Disk Image

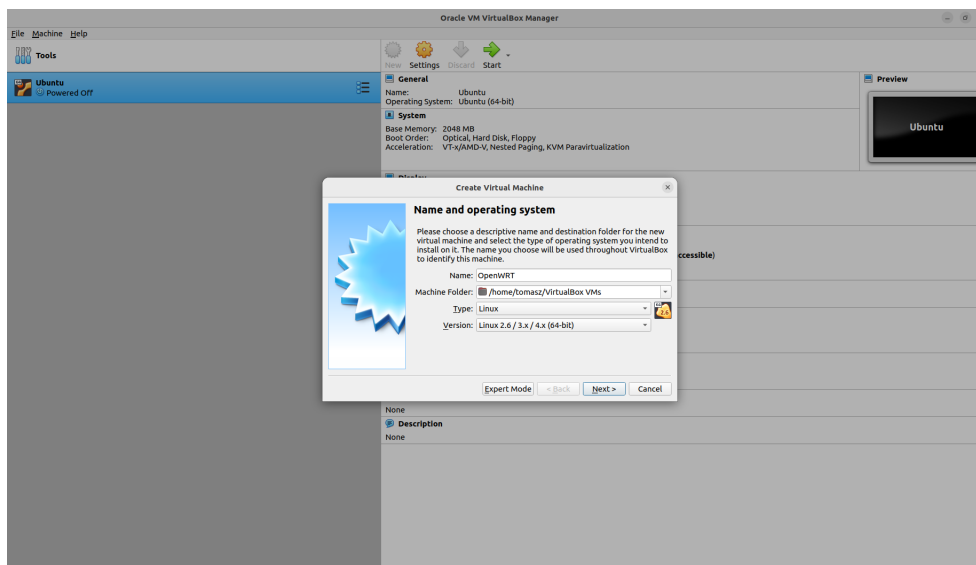


Figure 2: Choosing operating system in new VM

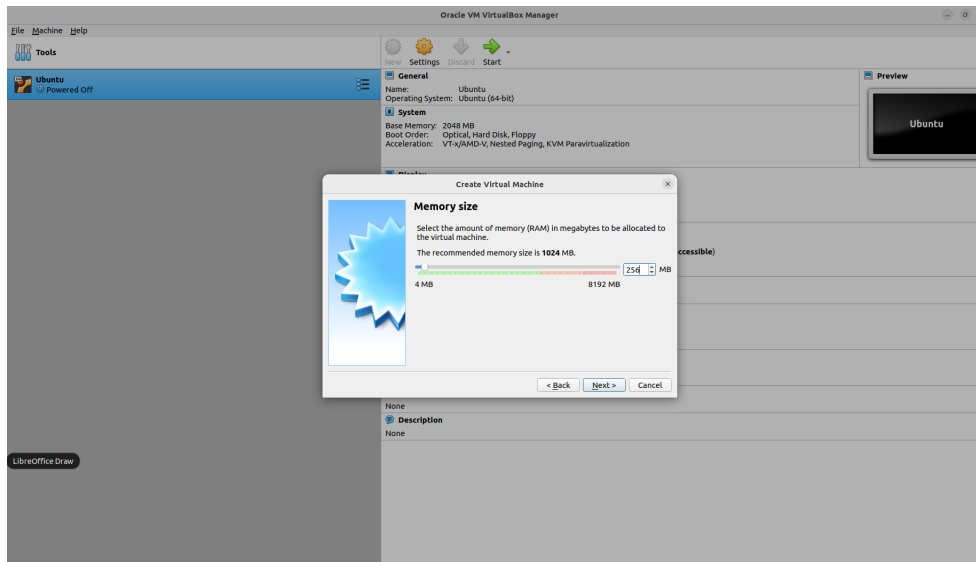


Figure 3: Choosing RAM memory. According to installation guide 128 Mb is enough. In the newly created machine 256 Mb RAM has been chosen

After creation of virtual machine, network adapters have been configured:

- Adapter 1 is bridged adapter,
- Adapter 2 is host-only network adapter. Host-only adapter was created during configuration of VM with ubuntu. DHCP server option has been enabled

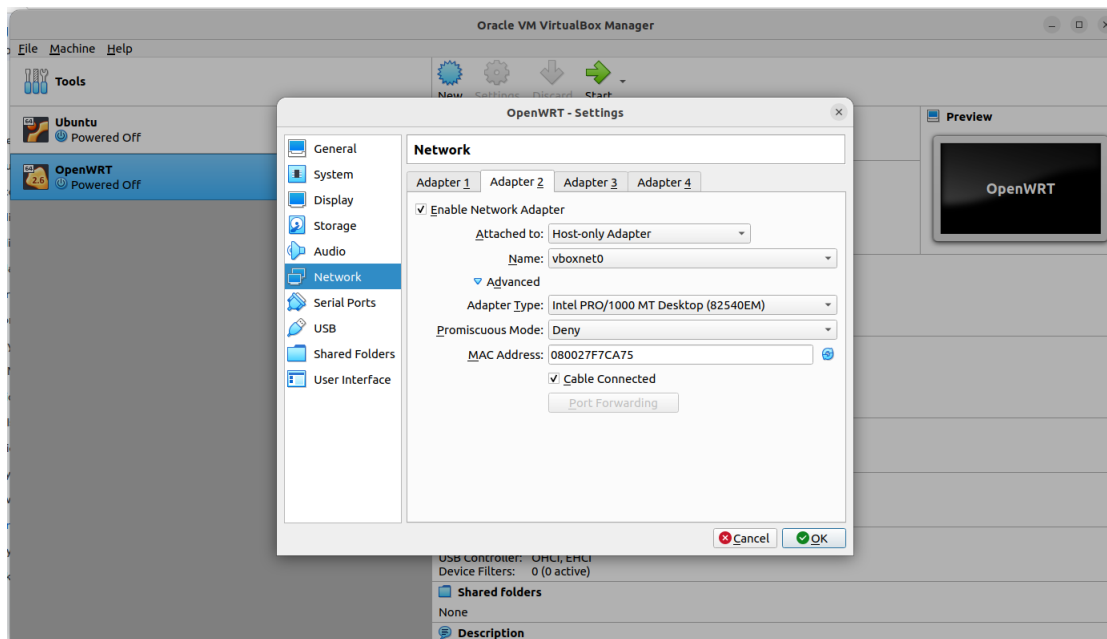


Figure 4: Network adapters configuraion on VM

2 Task 2

Configuration of network adapters on OpenWRT OS

2.1 Configuration of network adapters

In a file `/etc/config/network` following changes have been introduced:

```
config interface 'loopback'
    option device 'lo'
    option proto 'static'
    option ipaddr '127.0.0.1'
    option netmask '255.0.0.0'

config globals 'globals'
    option ula_prefix 'fd58:78f9:3e75::/48'

config device
    option name 'public-adapter'
    option type 'bridge'
    list ports 'eth0'

config interface 'lan'
    option device 'public-adapter'
    option proto 'dhcp'

config interface 'lan_host'
    option ifname 'eth1'
    option proto 'dhcp'

- /etc/config/network 1/25 4%
```

Figure 5: Network section configuration

Both network adapters will use DHCP (IP address is not binded statically). Public adapter is bound to interface `eth0`. Host only adapter is bound to interface `eth1`

After changes in `/etc/config/network` network adapter have been restarted with following commands:

```
/etc/init.d/network restart
```

2.2 Public Network Adapter (eth0)

To check correctness of configuration few test have been made.

2.2.1 uci show network.lan

```
root@OpenWrt:~# uci show network.lan
network.lan=interface
network.lan.device='public-adapter'
network.lan.proto='dhcp'
root@OpenWrt:~#
```

Figure 6: UCI show output for network.lan

2.2.2 ip a

```
root@OpenWrt:~# ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN 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 fq_codel master public
-adapter state UP qlen 1000
    link/ether 08:00:27:80:6c:b6 brd ff:ff:ff:ff:ff:ff
3: eth1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP qlen
1000
    link/ether 08:00:27:73:e6:39 brd ff:ff:ff:ff:ff:ff
    inet 192.168.56.106/24 brd 192.168.56.255 scope global eth1
        valid_lft forever preferred_lft forever
    inet6 fe80::a00:27ff:fe73:e639/64 scope link
        valid_lft forever preferred_lft forever
5: public-adapter: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue stat
e UP qlen 1000
    link/ether 08:00:27:80:6c:b6 brd ff:ff:ff:ff:ff:ff
    inet 192.168.0.190/24 brd 192.168.0.255 scope global public-adapter
        valid_lft forever preferred_lft forever
    inet6 fe80::a00:27ff:fe80:6cb6/64 scope link
        valid_lft forever preferred_lft forever
root@OpenWrt:~#
```

Figure 7: Output of ip -a

- Public adapter has following ip address: 192.168.56.190
- Network address 192.168.56.0/24
- IP address has been allocated dynamically

2.2.3 ifconfig -a

```
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
RX packets:2 errors:0 dropped:0 overruns:0 frame:0
TX packets:9 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:1180 (1.1 KiB) TX bytes:1510 (1.4 KiB)

lo        Link encap:Local Loopback
inet addr:127.0.0.1 Mask:255.0.0.0
inet6 addr: ::1/128 Scope:Host
UP LOOPBACK RUNNING MTU:65536 Metric:1
RX packets:290 errors:0 dropped:0 overruns:0 frame:0
TX packets:290 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:23832 (23.2 KiB) TX bytes:23832 (23.2 KiB)

public-adapter Link encap:Ethernet HWaddr 08:00:27:80:6C:B6
inet addr:192.168.0.190 Bcast:192.168.0.255 Mask:255.255.255.0
inet6 addr: fe80::a00:27ff:fe80:6cb6/64 Scope:Link
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
RX packets:189 errors:0 dropped:0 overruns:0 frame:0
TX packets:96 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:26391 (25.7 KiB) TX bytes:10592 (10.3 KiB)

root@OpenWrt:/#
```

Figure 8: Output of ifconfig -a

- Public adapter has following ip address: 192.168.56.190
- Network address 192.168.56.0/24
- IP address has been allocated dynamically

2.2.4 ping 8.8.8.8

```
root@OpenWrt:/# ping 8.8.8.8
PING 8.8.8.8 (8.8.8.8): 56 data bytes
64 bytes from 8.8.8.8: seq=0 ttl=119 time=16.372 ms
64 bytes from 8.8.8.8: seq=1 ttl=119 time=22.110 ms
64 bytes from 8.8.8.8: seq=2 ttl=119 time=28.298 ms
64 bytes from 8.8.8.8: seq=3 ttl=119 time=15.903 ms
64 bytes from 8.8.8.8: seq=4 ttl=119 time=16.003 ms
64 bytes from 8.8.8.8: seq=5 ttl=119 time=15.720 ms
^C
--- 8.8.8.8 ping statistics ---
6 packets transmitted, 6 packets received, 0% packet loss
round-trip min/avg/max = 15.720/19.067/28.298 ms
root@OpenWrt:/# _
```

Figure 9: Output of ping 8.8.8.8

To check correctness of network connection, few packet has been sent to ip address 8.8.8.8. Answers from 8.8.8.8 have been received. Network adapter eth0 is assumed to work correctly.

2.2.5 netstat -rn

```
root@OpenWrt:~# netstat -rn
Kernel IP routing table
Destination        Gateway           Genmask          Flags   MSS Window  irtt Iface
0.0.0.0            192.168.0.1      0.0.0.0          UG        0 0          0 public-
adapter
192.168.0.0        0.0.0.0          255.255.255.0    U        0 0          0 public-
adapter
192.168.56.0       0.0.0.0          255.255.255.0    U        0 0          0 eth1
root@OpenWrt:~# _
```

Figure 10: Output of netstat -rn

- For all network adapters Gateway, Netmask have been given

2.3 Host-only Network Adapter (eth1)

2.3.1 uci show network.host_lan

```
root@OpenWrt:~# uci show network.lan_host
network.lan_host=interface
network.lan_host.ifname='eth1'
network.lan_host.proto='dhcp'
root@OpenWrt:~#
```

Figure 11: UCI show output for network.lan_host

2.3.2 ip a

```
root@OpenWrt:~# ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN 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 fq_codel master public
    link/ether 08:00:27:80:6c:b6 brd ff:ff:ff:ff:ff:ff
3: eth1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP qlen
    1000
    link/ether 08:00:27:73:e6:39 brd ff:ff:ff:ff:ff:ff
    inet 192.168.56.106/24 brd 192.168.56.255 scope global eth1
        valid_lft forever preferred_lft forever
    inet6 fe80::a00:27ff:fe73:e639/64 scope link
        valid_lft forever preferred_lft forever
5: public-adapter: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue stat
    e UP qlen 1000
    link/ether 08:00:27:80:6c:b6 brd ff:ff:ff:ff:ff:ff
    inet 192.168.0.190/24 brd 192.168.0.255 scope global public-adapter
        valid_lft forever preferred_lft forever
    inet6 fe80::a00:27ff:fe80:6cb6/64 scope link
        valid_lft forever preferred_lft forever
root@OpenWrt:~#
```

Figure 12: Output of ip -a

- Public adapter has following ip address: 192.168.56.190
- Network address 192.168.56.0/24
- IP address has been allocated dynamically

2.3.3 ifconfig -a

```
root@OpenWrt:~# ifconfig -a | grep eth1 -A 8
eth1      Link encap:Ethernet  HWaddr 08:00:27:73:E6:39
          inet addr:192.168.56.106  Bcast:192.168.56.255  Mask:255.255.255.0
          inet6 addr: fe80::a00:27ff:fe73:e639/64  Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:12 errors:0 dropped:0 overruns:0 frame:0
          TX packets:19 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:2538 (2.4 KiB)  TX bytes:2620 (2.5 KiB)

root@OpenWrt:~#
```

Figure 13: Output of ifconfig -a

2.3.4 ping 192.168.56.1

```
root@OpenWrt:~# ping 192.168.56.1
PING 192.168.56.1 (192.168.56.1): 56 data bytes
64 bytes from 192.168.56.1: seq=0 ttl=64 time=1.368 ms
64 bytes from 192.168.56.1: seq=1 ttl=64 time=0.931 ms
64 bytes from 192.168.56.1: seq=2 ttl=64 time=0.933 ms
64 bytes from 192.168.56.1: seq=3 ttl=64 time=0.928 ms
64 bytes from 192.168.56.1: seq=4 ttl=64 time=0.871 ms
64 bytes from 192.168.56.1: seq=5 ttl=64 time=1.003 ms
^C
--- 192.168.56.1 ping statistics ---
6 packets transmitted, 6 packets received, 0% packet loss
round-trip min/avg/max = 0.871/1.005/1.368 ms
root@OpenWrt:~#
```

Figure 14: Output of ping 192.168.56.1

2.4 Configuration of firewall

2.4.1 Firewall configuration

```
config defaults
    option syn_flood      1
    option input          REJECT
    option output         ACCEPT
    option forward        REJECT
# Uncomment this line to disable ipv6 rules
# option disable_ipv6    1

config zone
    option name host
    option network lan_host
    option input 'ACCEPT'
    option output 'ACCEPT'
    option forward 'ACCEPT'

config zone
    option name lan
    list network 'lan'
    option input ACCEPT
    option output ACCEPT
    option forward ACCEPT

config zone
    option name wan
I /etc/config/firewall [Modified] 14/196 7%
```

Figure 15: Firewall configuration

After changing `/etc/config/firewall`, firewall has been restarted with following command:

```
/etc/init.d/firewall restart
```


2.4.2 uci show firewall.@zones[0]

```
root@tomasz_openwrt:/# uci show firewall.@zone[0]
firewall.cfg02dc81=zone
firewall.cfg02dc81.name='host'
firewall.cfg02dc81.network='lan_host'
firewall.cfg02dc81.input='ACCEPT'
firewall.cfg02dc81.output='ACCEPT'
firewall.cfg02dc81.forward='ACCEPT'
root@tomasz_openwrt:/#
```

Figure 16: Show firewall configuration

3 Task 3

3.1 Password change

```
root@OpenWrt:/# passwd
Changing password for root
New password:
Retype password:
passwd: password for root changed by root
root@OpenWrt:/#
```

Figure 17: Change password for root user

3.2 Log in to OpenWRT VM via SSH

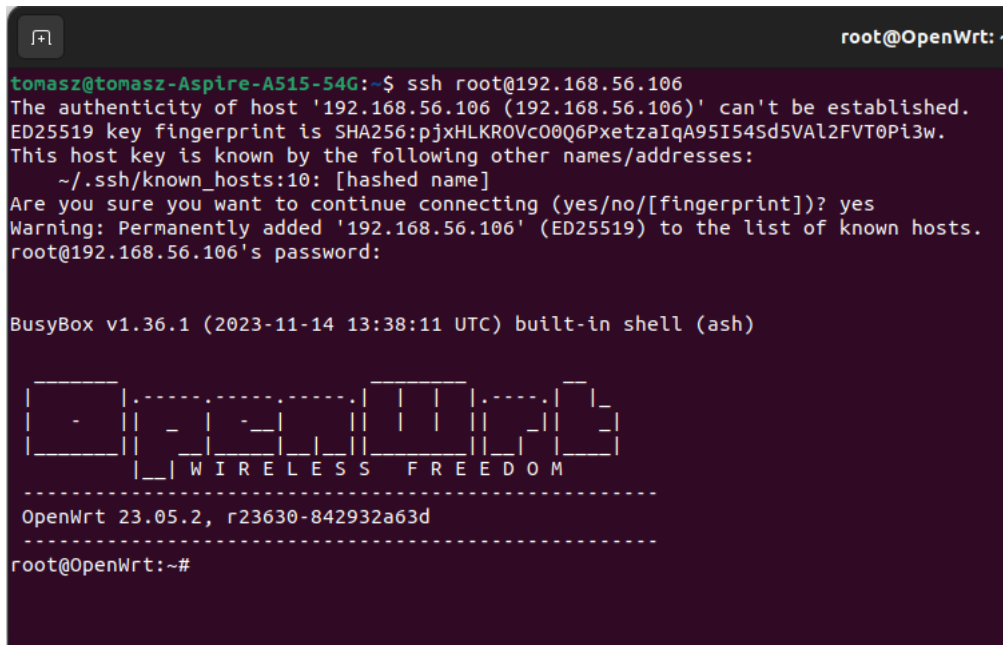


Figure 18: Log in to OpenWRT VM via SSH

SSH connection with OpenWRT VM has been succesfully established.

3.3 Hostname change

3.3.1 Set new hostname

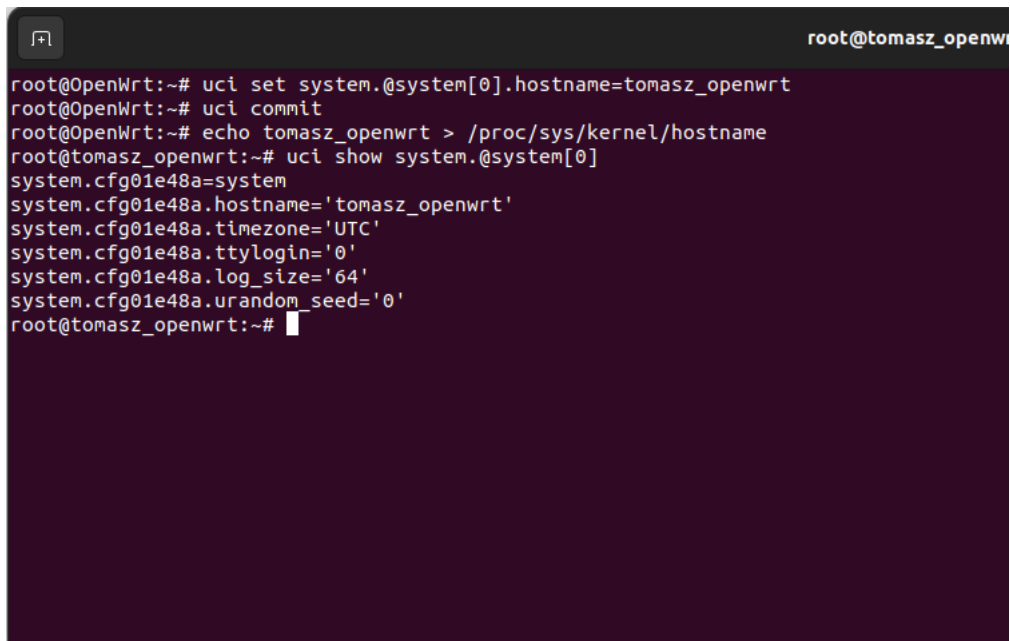
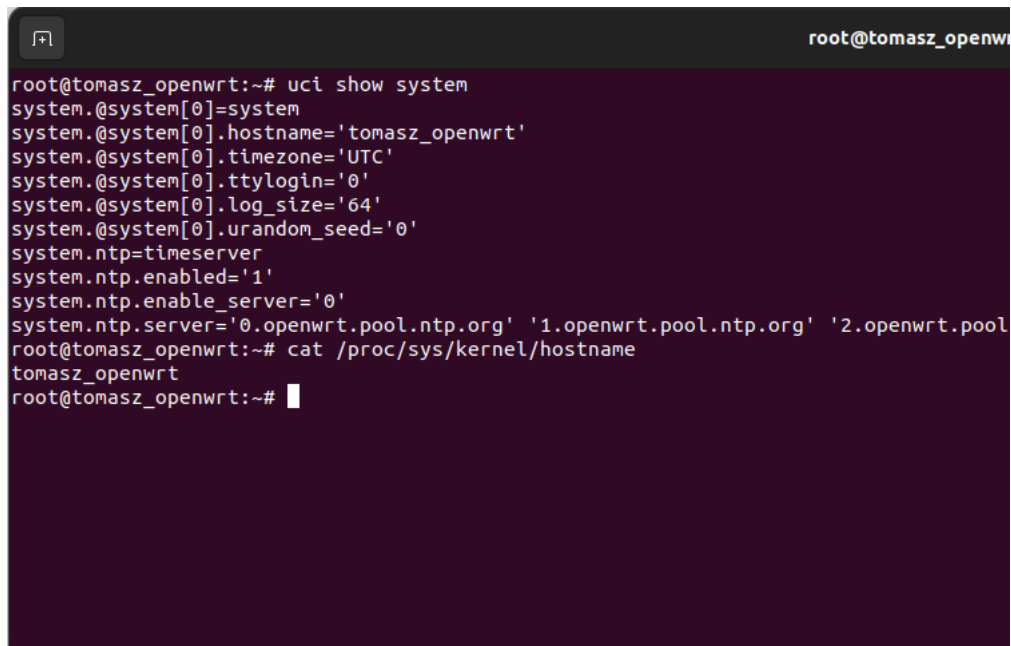


Figure 19: Set new hostname

3.3.2 Check new hostname

Hostname has been checked with 2 methods:

- `uci show system`
- `cat /proc/sys/kernel/hostname`

A terminal window with a dark background and light text. The title bar shows a window icon and the text 'root@tomasz_openwrt'. The terminal content shows the execution of two commands. The first command, 'uci show system', lists various system settings including hostname, timezone, ttylogin, log_size, urandom_seed, ntp server, and ntp enabled status. The second command, 'cat /proc/sys/kernel/hostname', outputs the current hostname 'tomasz_openwrt'.

```
root@tomasz_openwrt:~# uci show system
system.@system[0]=system
system.@system[0].hostname='tomasz_openwrt'
system.@system[0].timezone='UTC'
system.@system[0].ttylogin='0'
system.@system[0].log_size='64'
system.@system[0].urandom_seed='0'
system.ntp=timeserver
system.ntp.enabled='1'
system.ntp.enable_server='0'
system.ntp.server='0.openwrt.pool.ntp.org' '1.openwrt.pool.ntp.org' '2.openwrt.pool
root@tomasz_openwrt:~# cat /proc/sys/kernel/hostname
tomasz_openwrt
root@tomasz_openwrt:~#
```

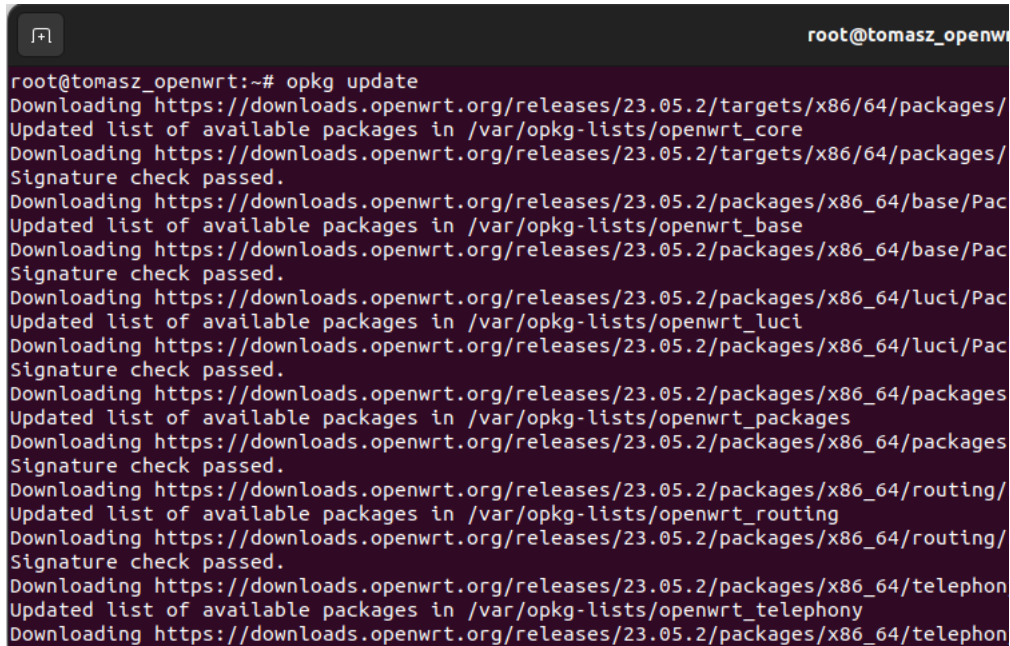
Figure 20: Check new hostname

For both methods we obtain information that new hostname is:

tomasz_openwrt

4 Task 4

4.1 Update list of OpenWRT packages



```
root@tomasz_openwrt:~# opkg update
Downloading https://downloads.openwrt.org/releases/23.05.2/targets/x86/64/packages/
Updated list of available packages in /var/opkg-lists/openwrt_core
Downloading https://downloads.openwrt.org/releases/23.05.2/targets/x86/64/packages/
Signature check passed.
Downloading https://downloads.openwrt.org/releases/23.05.2/packages/x86_64/base/Pac
Updated list of available packages in /var/opkg-lists/openwrt_base
Downloading https://downloads.openwrt.org/releases/23.05.2/packages/x86_64/base/Pac
Signature check passed.
Downloading https://downloads.openwrt.org/releases/23.05.2/packages/x86_64/luci/Pac
Updated list of available packages in /var/opkg-lists/openwrt_luci
Downloading https://downloads.openwrt.org/releases/23.05.2/packages/x86_64/luci/Pac
Signature check passed.
Downloading https://downloads.openwrt.org/releases/23.05.2/packages/x86_64/packages
Updated list of available packages in /var/opkg-lists/openwrt_packages
Downloading https://downloads.openwrt.org/releases/23.05.2/packages/x86_64/packages
Signature check passed.
Downloading https://downloads.openwrt.org/releases/23.05.2/packages/x86_64/routing/
Updated list of available packages in /var/opkg-lists/openwrt_routing
Downloading https://downloads.openwrt.org/releases/23.05.2/packages/x86_64/routing/
Signature check passed.
Downloading https://downloads.openwrt.org/releases/23.05.2/packages/x86_64/telephon
Updated list of available packages in /var/opkg-lists/openwrt_telephony
Downloading https://downloads.openwrt.org/releases/23.05.2/packages/x86_64/telephon
```

Figure 21: Update list of OpenWRT packages

4.2 Provide list of available and installed packages

Following commands have been used:

- `opkg list`, to list all available packages
- `opkg list-installed`, to list all installed packages

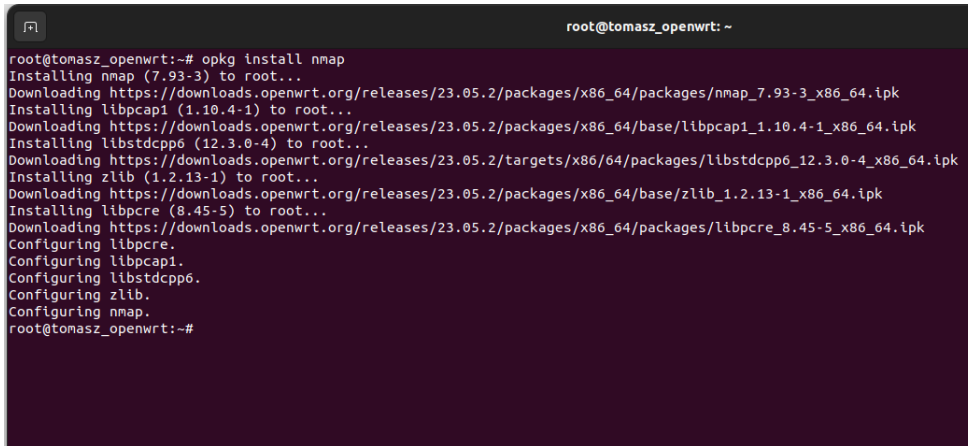
Output has been saved to following files:

- `available.txt` with list of all available packages
- `installed.txt` with list of all installed packages

Files have been provided on the disk.

5 Task 5

5.1 Nmap installing

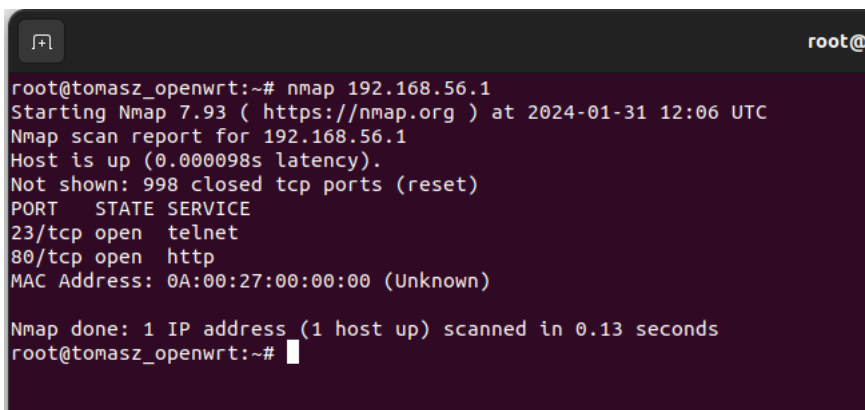
A terminal window with a dark purple background and white text. The prompt is 'root@tomasz_openwrt: ~'. The user enters 'opkg install nmap'. The terminal shows the installation process for nmap (7.93-3) and its dependencies: libpcap1 (1.10.4-1), libstdcpp6 (12.3.0-4), zlib (1.2.13-1), and libpcr (8.45-5). Each dependency is downloaded and installed before nmap is installed. Finally, nmap is configured and the prompt returns to 'root@tomasz_openwrt: ~#'.

```
root@tomasz_openwrt:~# opkg install nmap
Installing nmap (7.93-3) to root...
Downloading https://downloads.openwrt.org/releases/23.05.2/packages/x86_64/packages/nmap_7.93-3_x86_64.ipk
Installing libpcap1 (1.10.4-1) to root...
Downloading https://downloads.openwrt.org/releases/23.05.2/packages/x86_64/base/libpcap1_1.10.4-1_x86_64.ipk
Installing libstdcpp6 (12.3.0-4) to root...
Downloading https://downloads.openwrt.org/releases/23.05.2/targets/x86_64/packages/libstdcpp6_12.3.0-4_x86_64.ipk
Installing zlib (1.2.13-1) to root...
Downloading https://downloads.openwrt.org/releases/23.05.2/packages/x86_64/base/zlib_1.2.13-1_x86_64.ipk
Installing libpcr (8.45-5) to root...
Downloading https://downloads.openwrt.org/releases/23.05.2/packages/x86_64/packages/libpcr_8.45-5_x86_64.ipk
Configuring libpcr.
Configuring libpcap1.
Configuring libstdcpp6.
Configuring zlib.
Configuring nmap.
root@tomasz_openwrt:~#
```

Figure 22: Install nmap

5.2 Scan 192.168.56.1 with nmap

- 2 ports are opened:
 - 23/tcp, service telnet server
 - 80/tcp, service http server

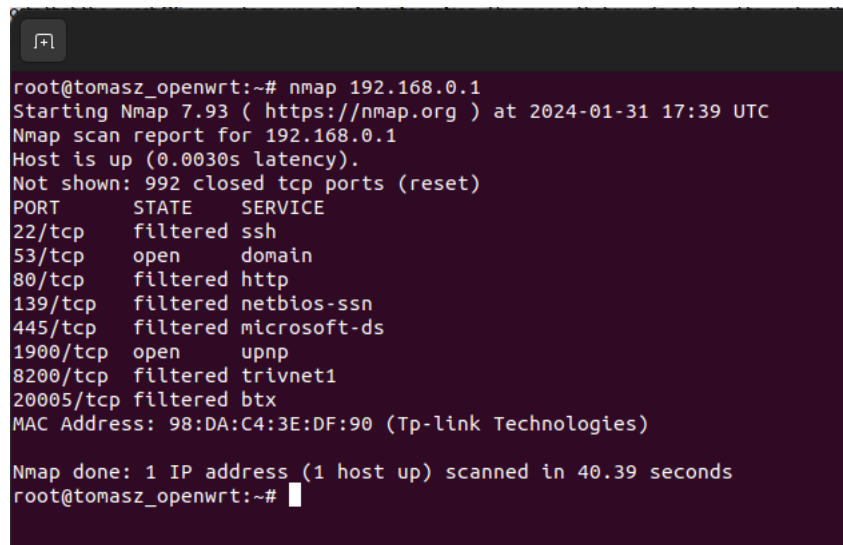
A terminal window with a dark purple background and white text. The prompt is 'root@tomasz_openwrt: ~'. The user enters 'nmap 192.168.56.1'. The terminal shows the nmap scan report for 192.168.56.1. It indicates the host is up with a latency of 0.000098s. It shows 998 closed tcp ports (reset). The open ports are 23/tcp (telnet) and 80/tcp (http). The MAC address is 0A:00:27:00:00:00 (Unknown). The scan is done in 0.13 seconds. The prompt returns to 'root@tomasz_openwrt:~#'.

```
root@tomasz_openwrt:~# nmap 192.168.56.1
Starting Nmap 7.93 ( https://nmap.org ) at 2024-01-31 12:06 UTC
Nmap scan report for 192.168.56.1
Host is up (0.000098s latency).
Not shown: 998 closed tcp ports (reset)
PORT      STATE SERVICE
23/tcp    open  telnet
80/tcp    open  http
MAC Address: 0A:00:27:00:00:00 (Unknown)

Nmap done: 1 IP address (1 host up) scanned in 0.13 seconds
root@tomasz_openwrt:~#
```

Figure 23: Network scanning

5.3 Scan 192.168.0.1 with nmap

A terminal window with a dark background and light-colored text. The text shows the execution of an nmap scan on the IP address 192.168.0.1. The output includes the nmap version (7.93), the scan time (2024-01-31 17:39 UTC), and a list of open and filtered ports with their corresponding services. The scan was completed in 40.39 seconds.

```
root@tomasz_openwrt:~# nmap 192.168.0.1
Starting Nmap 7.93 ( https://nmap.org ) at 2024-01-31 17:39 UTC
Nmap scan report for 192.168.0.1
Host is up (0.0030s latency).
Not shown: 992 closed tcp ports (reset)
PORT      STATE      SERVICE
22/tcp    filtered  ssh
53/tcp    open      domain
80/tcp    filtered  http
139/tcp   filtered  netbios-ssn
445/tcp   filtered  microsoft-ds
1900/tcp  open      upnp
8200/tcp  filtered  trivnet1
20005/tcp filtered  btx
MAC Address: 98:DA:C4:3E:DF:90 (Tp-link Technologies)

Nmap done: 1 IP address (1 host up) scanned in 40.39 seconds
root@tomasz_openwrt:~#
```

Figure 24: Network scanning