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**Linux networking commands**

**Report**

**CENTRIA UNIVERSITY OF APPLIED SCIENCES**

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## ABSTRACT

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<p>The purpose of this report is understanding about data communication.</p> <p>In order to achieve this goal, it is using several Linux commands and reading the output information one by one. <b>Ifconfig</b> and <b>ip</b> command were used for confirming status of current network interface. <b>Ping</b>, <b>tracert</b> and <b>mtr</b> command were used for testing network connectivity and route between the laptop used for this report and google.com.</p> <p>As a result, the laptop had 192.168.64.2 as IP address and this address was class C. Therefore, net-mask was printed as 255.255.255.0. It means that network was not divided to any subnet. Tracert command showed that there are 9 routers between the laptop and google.com. As using ping command to test the connectivity, all packets were transmitted and received properly. However, when mtr command was used for testing, some packets were lost during communicating.</p>		
<b>Key words</b> command, data communication, Linux, network interface		

## **CONCEPT DEFINITIONS**

### **Linux**

Linux is a kind of Operating System (OS) as well as Windows and Mac OS. OS is connecting between software (ex: application) and hardware (ex: system that save data). Unlike Windows and Mac OS, Linux is for free to use.

### **Virtual machine**

Virtual machine is a technology that can reproduce another computer in a computer by using virtualization technology.

### **Network Interface**

Network interface is a point of cross-connection between computer and network.

### **ICMP (Internet Control Message Protocol)**

ICMP is a protocol that is used for confirming communication status between nodes which is connecting network by TCP/IP.

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# **1 INTRODUCTION**

## **1.1 Purpose of this report**

Knowledge of data communication is one of the significant skills for people who will work in IT industry.

The main purpose of this report is understanding about data communication through using several network commands in Linux and reading the output information.

## **1.2 Prerequisite**

Followings are prerequisite of this report:

- Using machine: MacBook Air (M1, 2020)/ Apple M1 chip
- Linux distribution: Kali Linux
- Virtual machine: UTM
- How to connect internet: using phone's personal hotspot

## 2 IFCONFIG COMMAND

### 2.1 Purpose

This command is used for

- printing the current settings of network interface
- assigning address to network interface

### 2.2 Output

```
(misato@kali)-[~]
$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.64.2 netmask 255.255.255.0 broadcast 192.168.64.255
    inet6 fe80::e86d:2dff:fec8:ecff prefixlen 64 scopeid 0x20<link>
    inet6 fd8c:944d:41d9:ef23:ff79:eda8:3de2:22e1 prefixlen 64 scopeid 0x0<global>
    inet6 fd8c:944d:41d9:ef23:e86d:2dff:fec8:ecff prefixlen 64 scopeid 0x0<global>
    ether ea:6d:2d:c8:ec:ff txqueuelen 1000 (Ethernet)
    RX packets 26 bytes 3402 (3.3 KiB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 56 bytes 7818 (7.6 KiB)
    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 0 bytes 0 (0.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 0 bytes 0 (0.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

eth0 / lo	Name of interface lo = local loopback
flags	Show any flags related to the interface
UP	Ready to send and receive
BROADCAST	Whether the interface can use the broadcast or not (Only IPv4)
RUNNING	Whether the system is transmitting packets through interface or not
MULTICAST	Whether the interface can use multicast transmitting or not
mtu	Maximum Transfer Unit (byte)
inet	Current IP address (IPv4)
netmask	Specify how much of the address to reserve for dividing networks into sub-net
broadcast	IP address for broadcast
inet6	current IP address (IPv6)

prefixlen	Prefix length Specify from the front to how many bits represent the network
scopeid 0 * 20 < link > link global	Address is valid for WHICH range Valid only inside the local network Valid everywhere
ether	MAC address
txqueuelen	Number of buffers that can be queued in one queue
RX	About receiver
packets	Number of received packets
bytes	Amount of received packets
error	Number of errored packets
dropped	Number of dropped (discarded) packets
overruns	Number of overrun (delayed) packets
frame	Number of packets that exceeded the designated frame
TX	About Transmitter
carrier	Number of carriers
collisions	Number of times detected collisions

## 3 IP COMMAND

### 3.1 Purpose

Ip command is same as ifconfig, therefore this command is used for

- printing the current settings of network interface
- assigning address to network interface

Ip command is recommended to use instead of ifconfig.

### 3.2 Output

```
(misato@kali)-[~]
$ ip addr show
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: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether ea:6d:2d:c8:ec:ff brd ff:ff:ff:ff:ff:ff
    inet 192.168.64.2/24 brd 192.168.64.255 scope global dynamic noprefixroute eth0
        valid_lft 86362sec preferred_lft 86362sec
    inet6 fd8c:944d:41d9:ef23:7bc:ebfc:56fe:ee0b/64 scope global temporary dynamic
        valid_lft 604763sec preferred_lft 86058sec
    inet6 fd8c:944d:41d9:ef23:e86d:2dff:fec8:ecff/64 scope global dynamic mngtmpaddr noprefixroute
        valid_lft 2591980sec preferred_lft 604780sec
    inet6 fe80::e86d:2dff:fec8:ecff/64 scope link noprefixroute
        valid_lft forever preferred_lft forever
```

lo, eth0	Name of interface lo = local loopback
LOOPBACK	Loopback state
UP	Network interface is available
LOWER_UP	Cable is connecting to device
mtu	Maximum Transfer Unit (byte)
qdisc	Queueing Discipline
state	State of network interface
group	Group interface
qlen	Length of queue
brd	IP address for broadcast
inet	IPv4 address
scope host/ global	host: valid only inside this host global: valid everywhere
lft	Lifetime (expiration day)
inet6	IPv6 address



BROADCAST	Whether the interface can use the broadcast or not
MULTICAST	Whether the interface can use multicast transmitting or not
link/ether	MAC address

## 4 PING COMMAND

### 4.1 Purpose

Ping command is

- used for testing connection between 2 systems
- using ICMP (Internet Control Message Protocol) and communicating to nodes on network for testing

### 4.2 Output

```
(misato@kali)-[~]
$ ping google.com
PING google.com (216.58.210.174) 56(84) bytes of data.
64 bytes from mad06s10-in-f14.1e100.net (216.58.210.174): icmp_seq=1 ttl=58 time=36.2 ms
64 bytes from mad06s10-in-f14.1e100.net (216.58.210.174): icmp_seq=2 ttl=58 time=34.0 ms
64 bytes from mad06s10-in-f14.1e100.net (216.58.210.174): icmp_seq=3 ttl=58 time=49.7 ms
64 bytes from mad06s10-in-f14.1e100.net (216.58.210.174): icmp_seq=4 ttl=58 time=107 ms
64 bytes from mad06s10-in-f14.1e100.net (216.58.210.174): icmp_seq=5 ttl=58 time=73.3 ms
64 bytes from mad06s10-in-f14.1e100.net (216.58.210.174): icmp_seq=6 ttl=58 time=48.9 ms
64 bytes from mad06s10-in-f14.1e100.net (216.58.210.174): icmp_seq=7 ttl=58 time=48.6 ms
64 bytes from mad06s10-in-f14.1e100.net (216.58.210.174): icmp_seq=8 ttl=58 time=48.3 ms
64 bytes from mad06s10-in-f14.1e100.net (216.58.210.174): icmp_seq=9 ttl=58 time=52.8 ms
64 bytes from mad06s10-in-f14.1e100.net (216.58.210.174): icmp_seq=10 ttl=58 time=47.8 ms
^C
— google.com ping statistics —
10 packets transmitted, 10 received, 0% packet loss, time 9038ms
rtt min/avg/max/mdev = 34.024/54.687/107.216/20.145 ms
```

N bytes from ----	Amount of data that was used for testing connectivity (bytes)
icmp_seq=N	How many times ICMP was transmitted (connectivity was tested)
ttl	Time To Live <ul style="list-style-type: none"><li>• Number is lost one by one every packet going through network equipment</li><li>• Packet data is discarded when the number become 0</li></ul>
time	Time that was spent for your computer sending packet data and receiving reaction from designated network
N packets transmitted	Number of packets that was transmitted from your computer
N received	Number of packets that was received from designated network
N% packet loss	Amount of losing packets
rtt	Round Trip Time (it's same meaning as "time")
min/ave/max/mdev	minimum/ average/ maximum/ deviation

## 5 TRACEROUTE COMMAND

### 5.1 Purpose

Traceroute command

- can show path from your computer to designated network
- is used for finding causes of communication trouble

### 5.2 Output

```
(misato@kali)-[~]
$ traceroute google.com
traceroute to google.com (216.58.210.174), 30 hops max, 60 byte packets
 1  192.168.64.1 (192.168.64.1)  1.212 ms  0.837 ms  0.820 ms
 2  172.20.10.1 (172.20.10.1)  7.433 ms  7.425 ms  7.417 ms
 3  * * 213-243-152-111.bb.dnainternet.fi (213.243.152.111)  47.779 ms
 4  * * *
 5  * * *
 6  142.250.169.179 (142.250.169.179)  42.615 ms  37.771 ms  37.687 ms
 7  142.250.169.178 (142.250.169.178)  37.670 ms  35.359 ms  32.937 ms
 8  * * *
 9  mad06s10-in-f174.1e100.net (216.58.210.174)  37.467 ms  37.452 ms  39.004 ms
```

traceroute to ...	IP address of destination
N hops max	Maximum number of
1,2,3...	Number of routers The closer to computer, the smaller number is.
192.168.64.1 * * *	IP address of routers No reaction or the router enable the Firewall
1.212ms 0.837ms 0.820ms...	Response time of routers (It was done 3 times)

## 6 MTR COMMAND

### 6.1 Purpose

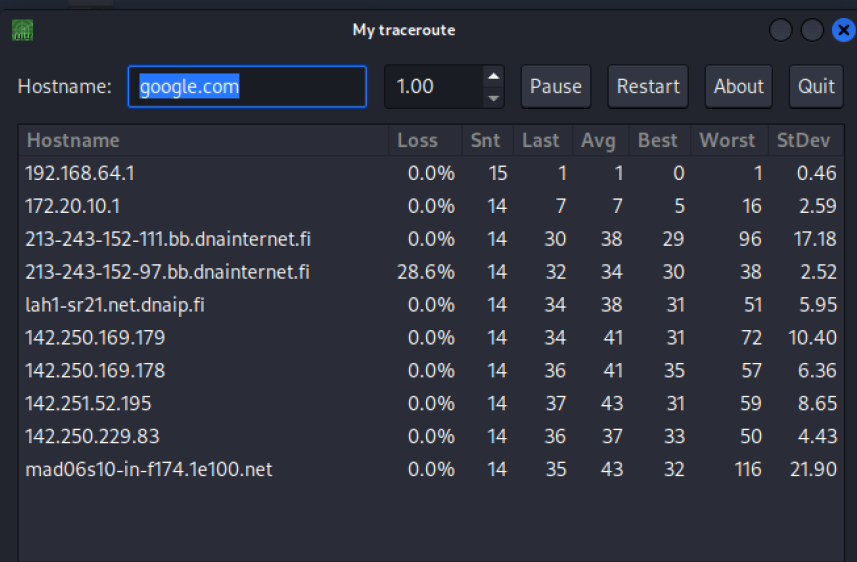
Mtr command

- can search for the route and response from your network to the designated network.
- is combination of ping command and traceroute command.

### 6.2 Output

```
(misato@kali)-[~]
$ mtr google.com
Gtk-Message: 06:36:56.628: Failed to load module "gail"

** (.:1642): WARNING **: 06:36:56.641: (../atk-adaptor/bridge.c:1018):atk_bridge_adaptor_init: runtime check failed: (root)
[]
```



The screenshot shows a terminal window with the command `mtr google.com` executed. Below the terminal, a window titled "My traceroute" is open. It features a "Hostname" input field containing "google.com", a "1.00" value with up/down arrows, and buttons for "Pause", "Restart", "About", and "Quit". Below these controls is a table with the following data:

Hostname	Loss	Snt	Last	Avg	Best	Worst	StDev
192.168.64.1	0.0%	15	1	1	0	1	0.46
172.20.10.1	0.0%	14	7	7	5	16	2.59
213-243-152-111.bb.dnainternet.fi	0.0%	14	30	38	29	96	17.18
213-243-152-97.bb.dnainternet.fi	28.6%	14	32	34	30	38	2.52
lah1-sr21.net.dnainp.fi	0.0%	14	34	38	31	51	5.95
142.250.169.179	0.0%	14	34	41	31	72	10.40
142.250.169.178	0.0%	14	36	41	35	57	6.36
142.251.52.195	0.0%	14	37	43	31	59	8.65
142.250.229.83	0.0%	14	36	37	33	50	4.43
mad06s10-in-f174.1e100.net	0.0%	14	35	43	32	116	21.90

Hostname	IP address of routers
Loss	Rate of loss
Snt	Number of packets that was sent
Last	Latest round-trip time
Avg	Average of round-trip time
Best	Best round-trip time
Worst	Worst round-trip time
StDev	Standard deviation

## 7 CONCLUSION

First, Virtual Box that was recommended for this assignment didn't work on a MacBook laptop. Therefore, UTM was used in this report.

**Ifconfig** and **ip** command shows IP address 192.168.64.2 and this address is class C. The first 24 bits are designated as network. Therefore, netmask was indicated as 255.255.255.0. This netmask means that network was not divided to subnet because this network was used for household and didn't need any subnet.

The connectivity between this MacBook laptop and google.com was tested by **ping** command. 10 packets were transmitted from MacBook and all of them were received from google.com. The minimum Round Trip Time was 34.024 ms, maximum one was 107.216 ms, average of this was 54.687 and the deviation of this was 20.145 ms.

**Traceroute** command searched for the route from this MacBook laptop to google.com. There were 9 routers between them and some of IP address were masked.

By using **mtr** command, the connectivity and route were tested again. At this time, 4<sup>th</sup> router (213-243-152-97. bb.dnainternet.fi) lost some packets.

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