1DV701

COMPUTER NETWORKS

AN INTRODUCTION

ASSIGMENT-4

(Network Topology and Routing)

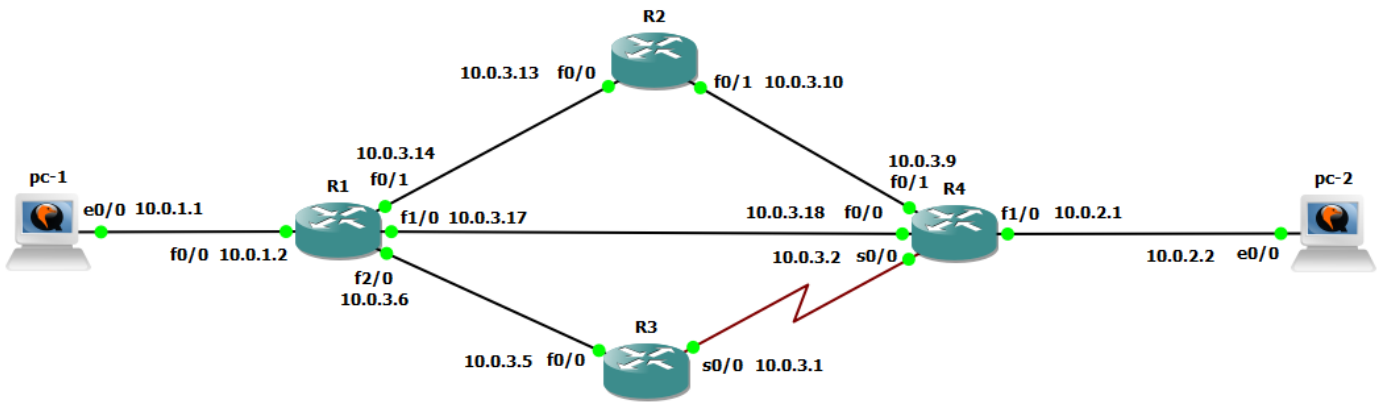
REPORT

FERHAT ATLINAR fa222py

PROBLEM 1

SCREENSHOT-0

NETWORK TOPOLOGY

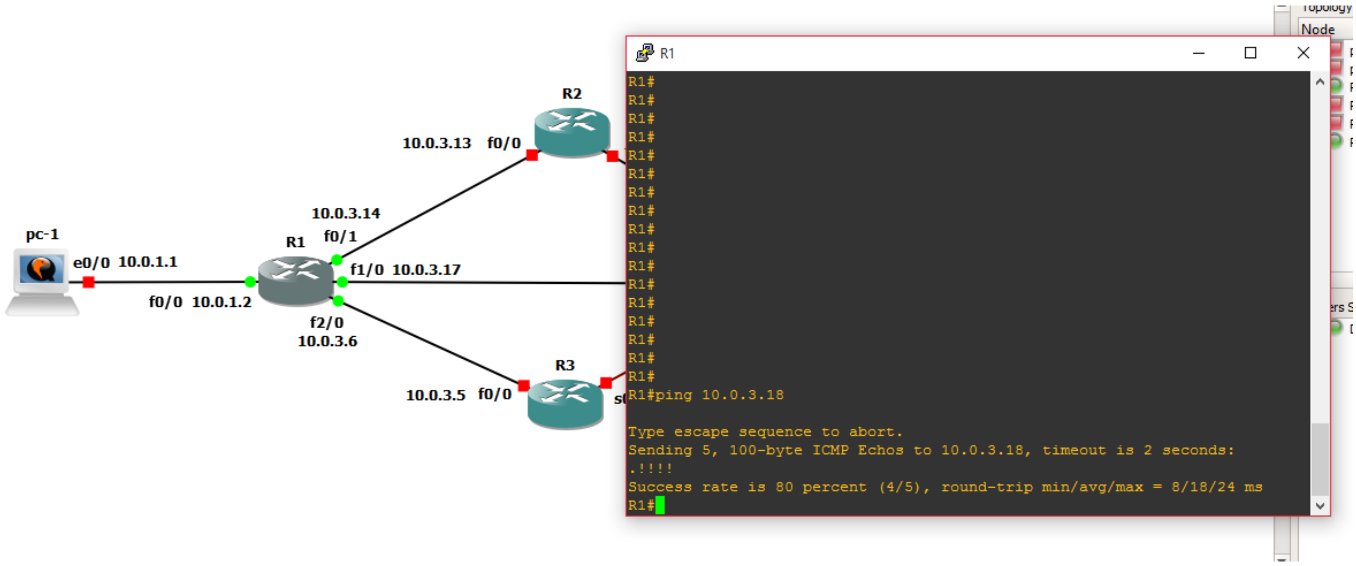


SCREENSHOT-1

PING FROM R1 TO C1

SCREENSHOT-2

PING FROM R1 TO R4



NM-1FE-TX

NM-1FE-TX is a network module with one fast Ethernet. It has 10/100 Base (TX) interface. It supports Virtual LANS which a group of devices are connected on a logical base rather than a physical one. Connections can easily be add, remove and switched.

WHY NM-1FE-TX ?

Between the available options (NM-1FE-TX, NM-4T, NM-16ESW)

-NM-4T supports only support sync mode but not the async mode

-NM-16ESW provides 16 ports which is more than we need.

Therefore NM-1FE-TX is the appropriate choice.

WIC-1T

WIC-1T is a one port serial WAN interface card. It grants serial connection to remote destinations.

WHY WIC-1T?

WIC-2T has two serial ports and it supports up to maximum of 8mpbs.

PRACTICAL DIFFERENCE BETWEEN /24 AND /30

The difference between this two subnet masks is the way they use IP addresses. /24 has 256 possible and 254 available addresses (one address for network and one for broadcast, remains 254) when /30 has 4 possible and 2 available addresses. In order to use IP addresses more efficient, we use subnet masks. For example if we have a lot of hosts, then we should be using /24 subnet instead of /30. And if we have few hosts, the other way round. The difference basically is efficient use of IP addresses.

PROBLEM 2

EXPLANATION OF IP ROUTE COMMAND

Command; ip route [ip] [netmask] [router_interface] [metric]

[ip] = it refers to IP Address of the network we want to reach.

[netmask] = it refers to netmask of the network we want to reach.

[router_interface] = it refers to router interface of the router that we use to reach the aimed network over.

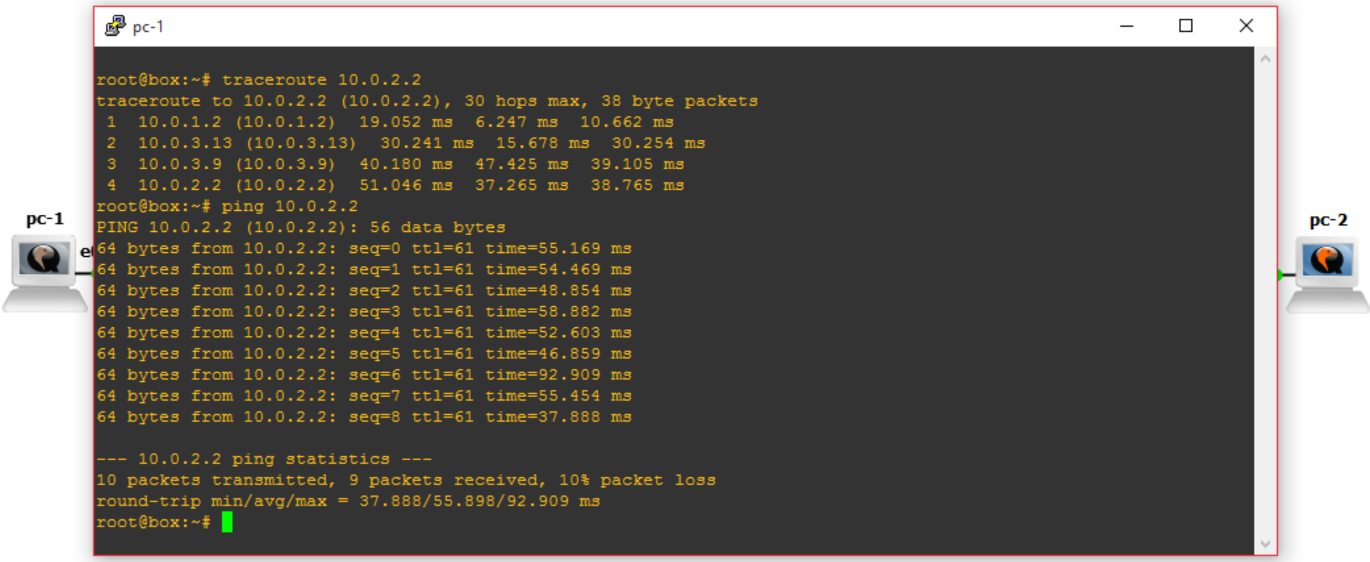
[metric] = it refers to priorty of the route. It is 1 by default. The lower it is, the higher it has priorty.

For example; ip route 10.0.3.8 255.255.255.252 f0/1 1

The above configuration is to reach network that has 10.0.3.8 IP address with 255.255.255.252 netmask (/30 subnet) over interface f0/1 with priority 1.

SCREENSHOT-3

PING FROM C1 TO C2

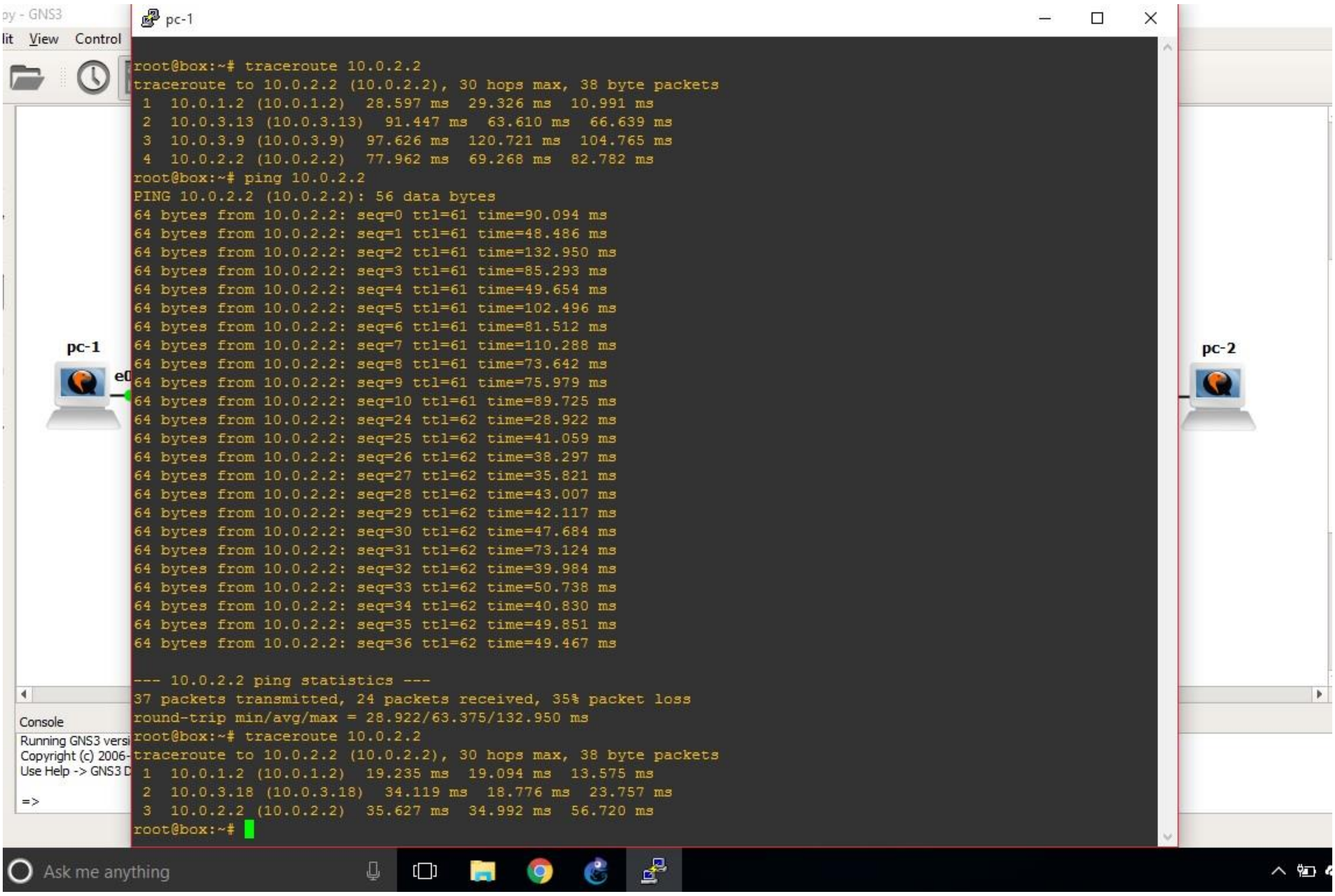


EXPLANATION OF ROUTE CHOICE

The path is C1-R1-R2-R4-C2 as it can be seen from the traceroute command as well. The reason for the chosen path is speed priority. Both part between R1-R2 and R2-R4 has 100 mbps while other paths has lower (10 mbps or 1544 kbps).

SCREENSHOT-4

CONTINOUS PING-FAILURE-CONTINUED PING



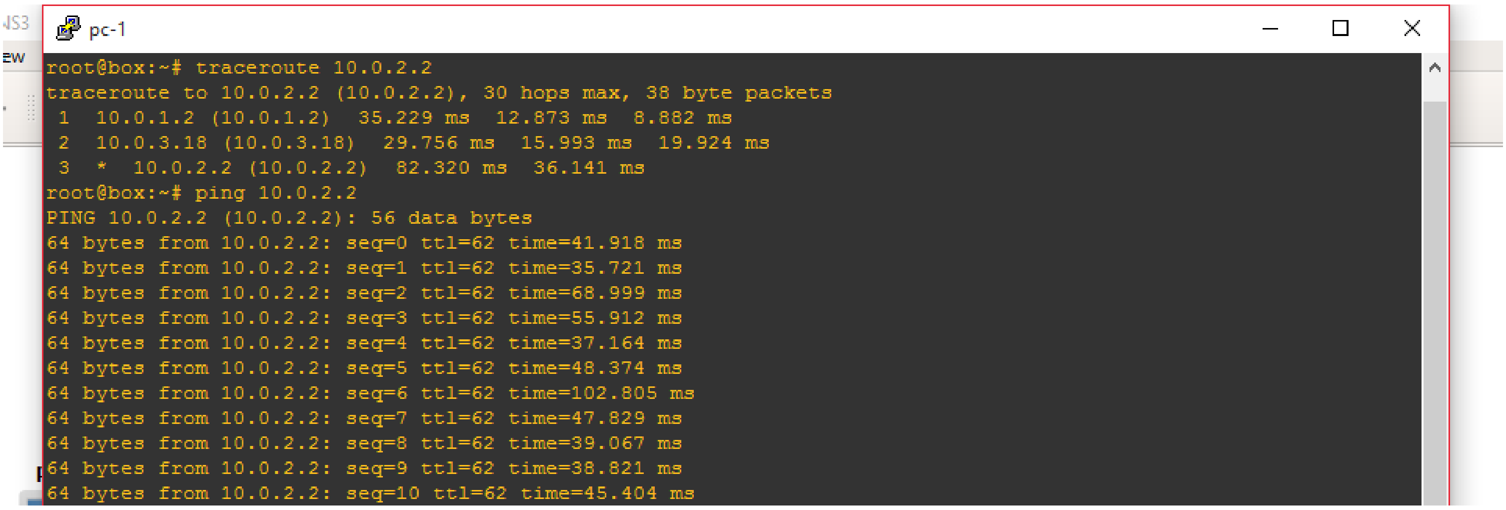
EXPLANATION OF FAILURE, LOST PACKAGES AND NEW ROUTE

From the above screenshot we can see that the default path is C1-R1-R2-R4-C2. When active interfaces are shut, ping fails for 14 packages and then continue when the new path is chosen. We can see that path has changed from the second traceroute in the screenshot.

PROBLEM 3

SCREENSHOT-5

PING FROM C1 TO C2



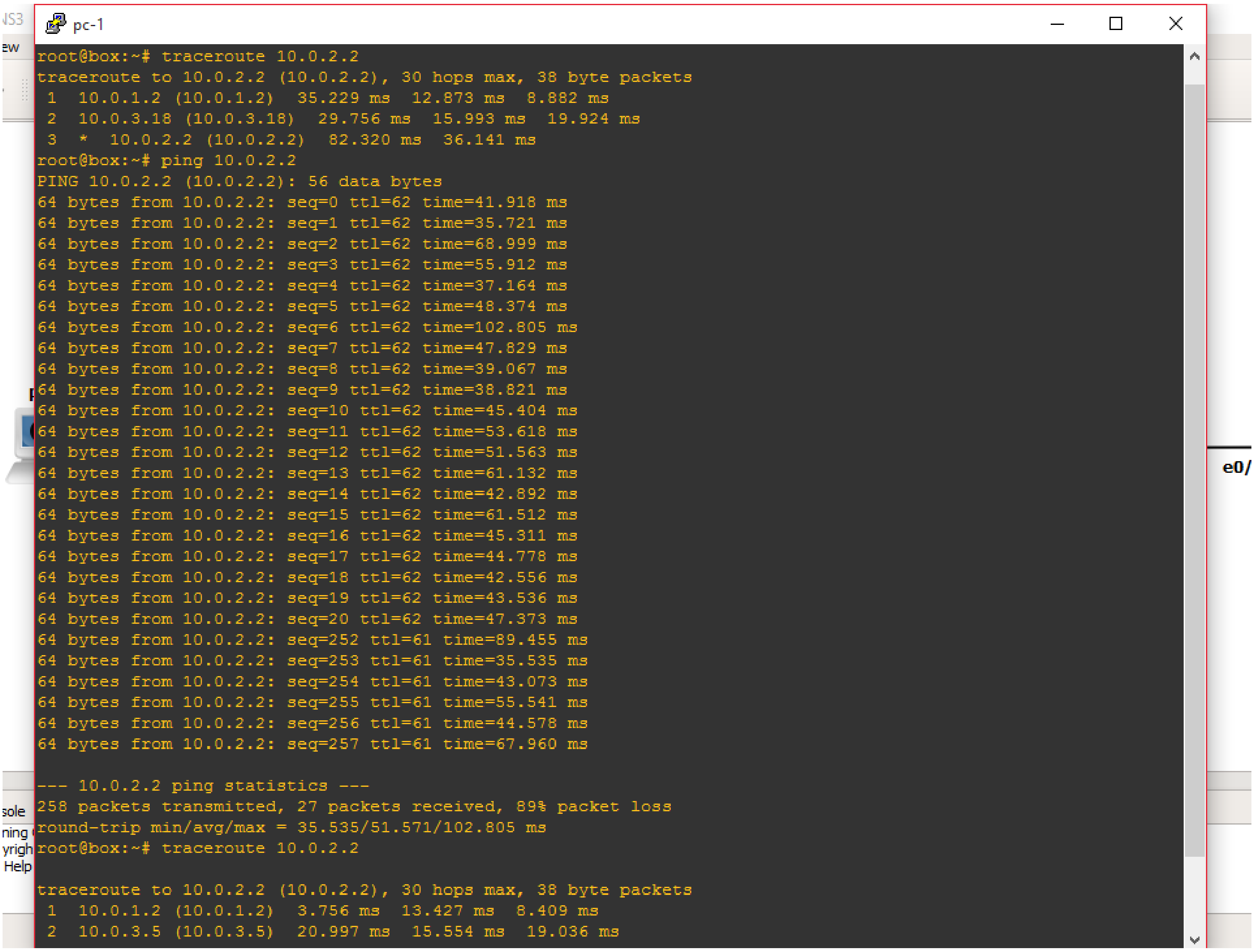
THE EXPLANATION OF THE DEFAULT ROUTE

RIP is a distance-vector routing. RIP counts hops, therefore, the best path is the path that includes least number of hops. In topology we use, the least amount of hops between C1-C2 is C1-R1-R4-C2 since it goes through two routers which makes hop count 2 for the path. This is the reason for the chosen path.

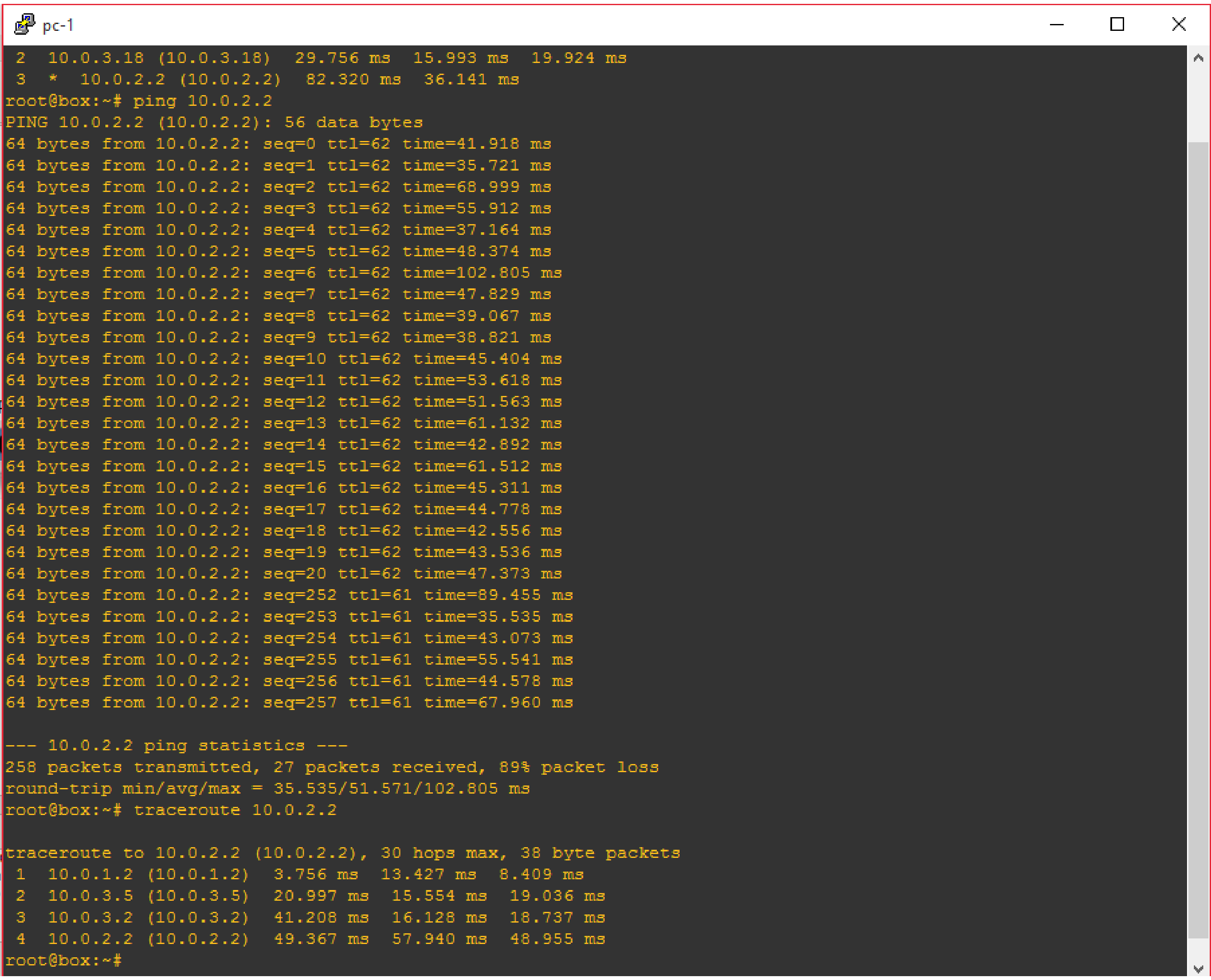
SCREENSHOT-6 & 7 (To show the whole process, I tried to make it one screenshot but to show second traceroute, I had to take two screenshots. Yet you can see it is same ping)

CONTINOUS PING-FAILURE-CONTINUED PING

SCREENSHOT-6



SCREENSHOT-7



```
pc-1
 2  10.0.3.18 (10.0.3.18)  29.756 ms  15.993 ms  19.924 ms
 3  *  10.0.2.2 (10.0.2.2)  82.320 ms  36.141 ms
root@box:~# ping 10.0.2.2
PING 10.0.2.2 (10.0.2.2): 56 data bytes
64 bytes from 10.0.2.2: seq=0 ttl=62 time=41.918 ms
64 bytes from 10.0.2.2: seq=1 ttl=62 time=35.721 ms
64 bytes from 10.0.2.2: seq=2 ttl=62 time=68.999 ms
64 bytes from 10.0.2.2: seq=3 ttl=62 time=55.912 ms
64 bytes from 10.0.2.2: seq=4 ttl=62 time=37.164 ms
64 bytes from 10.0.2.2: seq=5 ttl=62 time=48.374 ms
64 bytes from 10.0.2.2: seq=6 ttl=62 time=102.805 ms
64 bytes from 10.0.2.2: seq=7 ttl=62 time=47.829 ms
64 bytes from 10.0.2.2: seq=8 ttl=62 time=39.067 ms
64 bytes from 10.0.2.2: seq=9 ttl=62 time=38.821 ms
64 bytes from 10.0.2.2: seq=10 ttl=62 time=45.404 ms
64 bytes from 10.0.2.2: seq=11 ttl=62 time=53.618 ms
64 bytes from 10.0.2.2: seq=12 ttl=62 time=51.563 ms
64 bytes from 10.0.2.2: seq=13 ttl=62 time=61.132 ms
64 bytes from 10.0.2.2: seq=14 ttl=62 time=42.892 ms
64 bytes from 10.0.2.2: seq=15 ttl=62 time=61.512 ms
64 bytes from 10.0.2.2: seq=16 ttl=62 time=45.311 ms
64 bytes from 10.0.2.2: seq=17 ttl=62 time=44.778 ms
64 bytes from 10.0.2.2: seq=18 ttl=62 time=42.556 ms
64 bytes from 10.0.2.2: seq=19 ttl=62 time=43.536 ms
64 bytes from 10.0.2.2: seq=20 ttl=62 time=47.373 ms
64 bytes from 10.0.2.2: seq=252 ttl=61 time=89.455 ms
64 bytes from 10.0.2.2: seq=253 ttl=61 time=35.535 ms
64 bytes from 10.0.2.2: seq=254 ttl=61 time=43.073 ms
64 bytes from 10.0.2.2: seq=255 ttl=61 time=55.541 ms
64 bytes from 10.0.2.2: seq=256 ttl=61 time=44.578 ms
64 bytes from 10.0.2.2: seq=257 ttl=61 time=67.960 ms

--- 10.0.2.2 ping statistics ---
258 packets transmitted, 27 packets received, 89% packet loss
round-trip min/avg/max = 35.535/51.571/102.805 ms
root@box:~# traceroute 10.0.2.2

traceroute to 10.0.2.2 (10.0.2.2), 30 hops max, 38 byte packets
 1  10.0.1.2 (10.0.1.2)  3.756 ms  13.427 ms  8.409 ms
 2  10.0.3.5 (10.0.3.5)  20.997 ms  15.554 ms  19.036 ms
 3  10.0.3.2 (10.0.3.2)  41.208 ms  16.128 ms  18.737 ms
 4  10.0.2.2 (10.0.2.2)  49.367 ms  57.940 ms  48.955 ms
root@box:~#
```

EXPLANATION OF LOST PACKAGES AND NEW ROUTE

We can see that 231 packages are lost. That is because RIP has a slow convergence time.

Since RIP uses hop count as metric and the remaining two routes, after the default one is down, have equal number of routers on them, they have equal hop counts. Which means new path could have been either. In my ping, it was C1-R1-R3-R4-C2 as it can be seen above.

PROBLEM 4

SCREENSHOT-8

PING FROM C1 TO C2

pc-1

```
root@box:~# traceroute 10.0.2.2
traceroute to 10.0.2.2 (10.0.2.2), 30 hops max, 38 byte packets
 1  10.0.1.2 (10.0.1.2)  50.846 ms  31.668 ms  35.055 ms
 2  10.0.3.13 (10.0.3.13)  67.652 ms  62.662 ms  66.820 ms
 3  10.0.3.9 (10.0.3.9)  138.243 ms  65.336 ms  67.312 ms
 4  *  10.0.2.2 (10.0.2.2)  81.170 ms  46.804 ms
root@box:~# ping 10.0.2.2
PING 10.0.2.2 (10.0.2.2): 56 data bytes
64 bytes from 10.0.2.2: seq=0 ttl=61 time=42.294 ms
64 bytes from 10.0.2.2: seq=1 ttl=61 time=70.901 ms
64 bytes from 10.0.2.2: seq=2 ttl=61 time=77.336 ms
64 bytes from 10.0.2.2: seq=3 ttl=61 time=109.227 ms
64 bytes from 10.0.2.2: seq=4 ttl=61 time=76.574 ms
64 bytes from 10.0.2.2: seq=5 ttl=61 time=46.307 ms
64 bytes from 10.0.2.2: seq=6 ttl=61 time=73.457 ms
64 bytes from 10.0.2.2: seq=7 ttl=61 time=43.406 ms
64 bytes from 10.0.2.2: seq=8 ttl=61 time=63.566 ms
64 bytes from 10.0.2.2: seq=9 ttl=61 time=39.540 ms
64 bytes from 10.0.2.2: seq=10 ttl=61 time=38.751 ms
```

THE EXPLANATION OF THE DEFAULT ROUTE

OSPF (Open Shortest Path First) is a link state dynamic routing which uses Djikstra algorithm to calculate best path. Each router in an area constructing a tree which the router itself is the root and all the other networks are the branches of the tree. The tree contains only the networks that are on the same area. Since a router can have different areas connected to its different interfaces, it can have different trees that includes networks on same area with the interface.

OSPF uses a metric referred to as cost. The cost of the entire path is the sum of the outgoing interfaces along the path. Cisco uses a simple equation of 10^8/bandwidth. A 100 mbps Fast Ethernet has default 1 and 10 mbps has 10 as cost. With this information, we can see that the path with the lowest cost is C1-R1-R2-R4-C2 which is the default chosen path.

SCREENSHOT-9

CONTINOUS PING-FAILURE-CONTINUED PING

```
pc-1
root@box:~# traceroute 10.0.2.2
traceroute to 10.0.2.2 (10.0.2.2), 30 hops max, 38 byte packets
 1  10.0.1.2 (10.0.1.2)  17.791 ms  9.270 ms  9.732 ms
 2  10.0.3.13 (10.0.3.13)  29.823 ms  16.617 ms  19.091 ms
 3  10.0.3.9 (10.0.3.9)  50.081 ms  36.574 ms  29.357 ms
 4  *  10.0.2.2 (10.0.2.2)  147.596 ms  64.391 ms
root@box:~# ping 10.0.2.2
PING 10.0.2.2 (10.0.2.2): 56 data bytes
64 bytes from 10.0.2.2: seq=0 ttl=61 time=85.115 ms
64 bytes from 10.0.2.2: seq=1 ttl=61 time=51.742 ms
64 bytes from 10.0.2.2: seq=2 ttl=61 time=39.013 ms
64 bytes from 10.0.2.2: seq=3 ttl=61 time=75.167 ms
64 bytes from 10.0.2.2: seq=4 ttl=61 time=75.001 ms
64 bytes from 10.0.2.2: seq=5 ttl=61 time=67.921 ms
64 bytes from 10.0.2.2: seq=6 ttl=61 time=77.092 ms
64 bytes from 10.0.2.2: seq=7 ttl=61 time=56.878 ms
64 bytes from 10.0.2.2: seq=8 ttl=61 time=66.061 ms
64 bytes from 10.0.2.2: seq=9 ttl=61 time=60.780 ms
64 bytes from 10.0.2.2: seq=10 ttl=61 time=71.013 ms
64 bytes from 10.0.2.2: seq=11 ttl=61 time=91.097 ms
64 bytes from 10.0.2.2: seq=12 ttl=61 time=49.577 ms
64 bytes from 10.0.2.2: seq=13 ttl=61 time=108.118 ms
64 bytes from 10.0.2.2: seq=14 ttl=61 time=49.668 ms
64 bytes from 10.0.2.2: seq=15 ttl=61 time=77.028 ms
64 bytes from 10.0.2.2: seq=21 ttl=62 time=25.457 ms
64 bytes from 10.0.2.2: seq=22 ttl=62 time=31.887 ms
64 bytes from 10.0.2.2: seq=23 ttl=62 time=45.046 ms
64 bytes from 10.0.2.2: seq=24 ttl=62 time=48.163 ms
64 bytes from 10.0.2.2: seq=25 ttl=62 time=40.480 ms
64 bytes from 10.0.2.2: seq=26 ttl=62 time=79.409 ms
64 bytes from 10.0.2.2: seq=27 ttl=62 time=46.912 ms

--- 10.0.2.2 ping statistics ---
28 packets transmitted, 23 packets received, 17% packet loss
round-trip min/avg/max = 25.457/61.679/108.118 ms
root@box:~# traceroute 10.0.2.2
traceroute to 10.0.2.2 (10.0.2.2), 30 hops max, 38 byte packets
 1  10.0.1.2 (10.0.1.2)  4.439 ms  9.680 ms  12.233 ms
 2  10.0.3.18 (10.0.3.18)  29.500 ms  16.598 ms  18.741 ms
 3  10.0.2.2 (10.0.2.2)  29.495 ms  47.544 ms  28.940 ms
root@box:~#
```

EXPLANATION OF LOST PACKAGES AND NEW ROUTE

We can see that default chosen path is C1-R1-R2-R4-C2 as the best path. After shutting one active interface along the path, we see that OSPF converges fast, after 5 lost packages. Which is much faster than RIP. The new path is C1-R1-R4-C2. The reason behind chosen path after default one is down, is same reason with the choice of default one; cost. After the default path is down, there remain two path, one is C1-R1-R4-C2 and the other is C1-R1-R3-R4-C2. The first option has 10 as cost because of its bandwidth between R1-R4. The second option has cost 1 between R1-R3 but has a high cost between R3-R4 because of 1544 kbps bandwidth (Should be around 64.7 if I calculated correctly. Formula: 100 mbps /bandwidth). Therefore, the second chosen path goes as C1-R1-R4-C2.

STATIC ROUTING	RIPv2	OSPF
-It is configured manually.	-Uses Distance Vector	-Uses link state
-Default path is configured Manually	-Uses hop count for default path	-Uses cost (bandwidth) for default path-
-Works on Layer2	- Works on Layer3	-Works on Layer3
-In case of failure, lots of packages are lost	-In case of failure package loose is average	-In case of failure package loose is low

Static routing has the following advantages and disadvantages in order to clarify when to use and when not use

Advantages:

No overhead on the router CPU. So a cheaper router can be used.

No bandwidth usage

Since administrator can choose which networks to allow, it adds security.

Disadvantages

The administrator must really understand the internetwork and how each router is connected in order to configure routes correctly.

If a network is added, the administrator has to add a route to all routers manually.

Given the above information for the static routing, we can say it can be used for a small network, where we can configure, add, remove or change routes easily. This way, we can have a secure network and reduce the cost. Yet static routing is not suitable when we have a large network. Because in that case, configurations get complex and adding or removing a network is a whole messy job.

Dynamic routing is when protocols are used to find networks and update routing tables on routers. Comparing to static routing, dynamic routing is a better option when network gets large. Sure this way cost increases as well. The routing tables on routers will be updated continuously which means there will be overhead on router CPU which will increase the cost. We can easily say if the network gets large, dynamic routing should be used instead of static routing. But dynamic routing has different protocols in it as well and they have advantages and disadvantages between them.

RIPv2

In this protocol, routers exchange their routing tables with neighbors to complete their routing table. This is called routing by rumor because instead of finding it itself, router trust the information that is send by the neighbor.

RIPv2 is a distance vector routing protocol and uses hop count as metric. The limit is 15 hop counts which means 16 hop counts is unreachable. This indicates that RIPv2 can be used larger networks that we use static routing yet not so big networks. It also has a slow convergence which means there will be high amount of package loose in case of failure of the default path.

OSPF

It is link-state dynamic routing protocol. It uses Djikstra algorithm to construct a tree and uses cost as metric. For cisco, cost is bandwidth and formula to calculate the cost is 100 mbps/bandwidth. Unlike RIPv2, it has countless number of hops. Which means it easily can be used for large networks. And the convergence time is fast which means package loose is low. One another advantage that OSPF brings compring to RIPv2 is routing table update minimizing. Updates are event tricked for OSPF while RIPv2 updates every 30 seconds.

CONCLUSION

If the network is small which can be configured manually, static routing should be used in order to reduce the cost and have more security.

If the network is too big to handle by static routing, then we shall switch to dynamic routing. In this case, we can use RIPv2 if the network is not too big and if we can accept an amount of package loose in case of failure of the default path. OSPF should be choice if the network is big since it has no hop count limit and also can be choice if package loose is not something we can afford since it converges fast.