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Report

Assignment 4 - GNS3

1DV701

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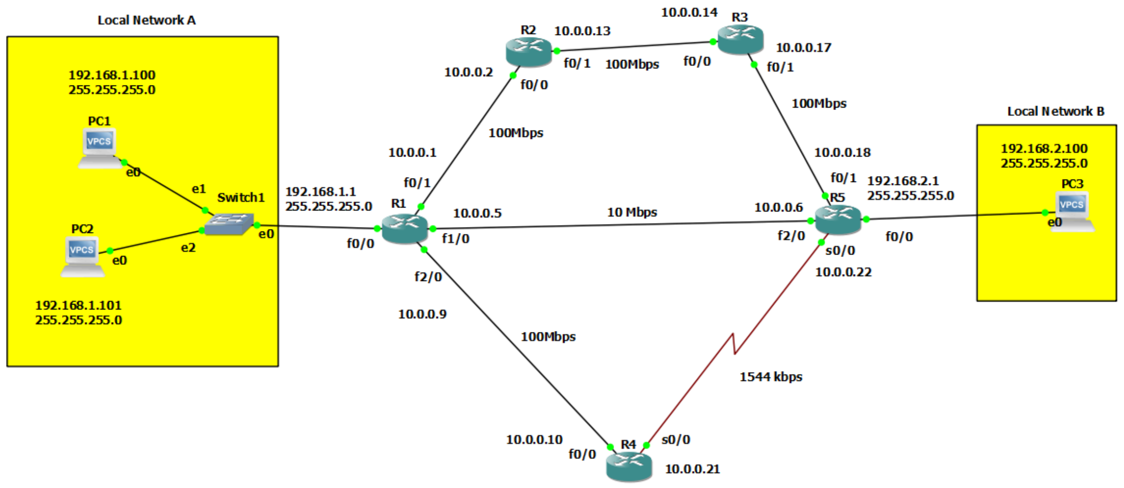
1 Problem 1

a) Screenshot of the topology



b) Screenshot of the pings

Ping from PC1 to PC2: succeed to reach

```
Checking for duplicate address...
PC1 : 192.168.1.100 255.255.255.0 gateway 192.168.1.1

PC1> ping 192.168.1.101

84 bytes from 192.168.1.101 icmp_seq=1 ttl=64 time=0.380 ms
84 bytes from 192.168.1.101 icmp_seq=2 ttl=64 time=0.347 ms
84 bytes from 192.168.1.101 icmp_seq=3 ttl=64 time=0.573 ms
84 bytes from 192.168.1.101 icmp_seq=4 ttl=64 time=0.366 ms
84 bytes from 192.168.1.101 icmp_seq=5 ttl=64 time=0.434 ms
```

PC1 to PC3 : Failed to reach

```
PC1> ping 192.168.2.100

*192.168.1.1 icmp_seq=1 ttl=255 time=12.811 ms (ICMP type:3, code:1, Destination
 host unreachable)
*192.168.1.1 icmp_seq=2 ttl=255 time=11.320 ms (ICMP type:3, code:1, Destination
 host unreachable)
*192.168.1.1 icmp_seq=3 ttl=255 time=15.674 ms (ICMP type:3, code:1, Destination
 host unreachable)
*192.168.1.1 icmp_seq=4 ttl=255 time=16.340 ms (ICMP type:3, code:1, Destination
 host unreachable)
*192.168.1.1 icmp_seq=5 ttl=255 time=10.925 ms (ICMP type:3, code:1, Destination
 host unreachable)
```

R1 to PC-1 : Succeed to reach

```
R1#ping 192.168.1.100

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.100, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/10/16 ms
```

R1 to R3 : Failed to reach

```
R1#ping 10.0.0.14

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.0.0.14, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
```

Some ping do not succeed because the routes have not been set yet.

c) NM-1FE-TX, NM-16ESW and WIC-1T

- NM-1FE-TX means network module with 1 fast ethernet connection using 10/100TX referring to the capacity of transfer. [12]
- NM-16ESW means network module with 16 entries Ethernet Switch. [13]
- WIC-1T is a WAN interface card with one serial port that supports T1 serial port connectivity.

Those products have been chosen to guarantee the real connectivity between devices and simulate real world settings.

d) Practical difference between /24 and /30

The practical difference between a /24 and /30 is that /30 allows an addressing with only 2 addresses which is the best option to not waste addresses when one works with routers. It provides 2 usable IP and it is perfect for router to router connection.[1]

2 Problem 2

a) Description

Here is a description of all the elements from the ip route command:

i) [ip] : refers to the IP of the network we aim to reach. Here, this refers to the local network B which is 192.168.2.0
ii) [mask] : Is the mask of the local network we aim to reach. Here, this refers to 255.255.255.0
iii) [router_interface] : refers to the next hop we need to reach in order to attain our goal.
iv) [metric]: is the “coefficient” in case several routes are instantiated. It helps to manually moderate routes’ weights.

Descriptions of those commands have been fetched on the references [2] and [3].

b) Pings

From PC1 to PC3

```
PC1> ping 192.168.2.100

84 bytes from 192.168.2.100 icmp_seq=1 ttl=62 time=62.084 ms
84 bytes from 192.168.2.100 icmp_seq=2 ttl=62 time=67.643 ms
84 bytes from 192.168.2.100 icmp_seq=3 ttl=62 time=60.533 ms
84 bytes from 192.168.2.100 icmp_seq=4 ttl=62 time=59.989 ms
84 bytes from 192.168.2.100 icmp_seq=5 ttl=62 time=64.108 ms
```

```
PC1> trace 192.168.2.100
trace to 192.168.2.100, 8 hops max, press Ctrl+C to stop
 1   192.168.1.1   2.303 ms  11.021 ms  15.613 ms
 2   10.0.0.6   47.909 ms  *  42.179 ms
 3   *192.168.2.100   54.680 ms (ICMP type:3, code:3, Destination port unreachab
le)
```

From PC3 to PC2

```
PC3> ping 192.168.1.101

84 bytes from 192.168.1.101 icmp_seq=1 ttl=62 time=82.584 ms
84 bytes from 192.168.1.101 icmp_seq=2 ttl=62 time=53.613 ms
84 bytes from 192.168.1.101 icmp_seq=3 ttl=62 time=81.939 ms
84 bytes from 192.168.1.101 icmp_seq=4 ttl=62 time=58.213 ms
84 bytes from 192.168.1.101 icmp_seq=5 ttl=62 time=75.101 ms
```

```
PC3> trace 192.168.1.101
trace to 192.168.1.101, 8 hops max, press Ctrl+C to stop
 1   192.168.2.1   16.133 ms  15.621 ms  12.438 ms
 2   10.0.0.5   39.917 ms  43.839 ms  51.683 ms
 3   *192.168.1.101   67.724 ms (ICMP type:3, code:3, Destination port unreachab
le)
```

The route between R1 and R5 has been used due to its simplicity and the necessity to not send a high volume of data. Other paths could have been R1-R4-R5 or R1-R2-R3-R5 but it would have added complexity.

c) Behavior

If the router are shut, the pings do not reach past the router as stated in this capture:

```
84 bytes from 192.168.2.100 icmp_seq=20 ttl=62 time=43.665 ms
84 bytes from 192.168.2.100 icmp_seq=21 ttl=62 time=93.712 ms
84 bytes from 192.168.2.100 icmp_seq=22 ttl=62 time=63.293 ms
84 bytes from 192.168.2.100 icmp_seq=23 ttl=62 time=62.981 ms
84 bytes from 192.168.2.100 icmp_seq=24 ttl=62 time=62.666 ms
84 bytes from 192.168.2.100 icmp_seq=25 ttl=62 time=61.943 ms
84 bytes from 192.168.2.100 icmp_seq=26 ttl=62 time=62.734 ms
192.168.2.100 icmp_seq=27 timeout
*192.168.1.1 icmp_seq=28 ttl=255 time=30.623 ms (ICMP type:3, code:1, Destinatio
n host unreachable)
*192.168.1.1 icmp_seq=29 ttl=255 time=15.694 ms (ICMP type:3, code:1, Destinatio
n host unreachable)
*192.168.1.1 icmp_seq=30 ttl=255 time=14.716 ms (ICMP type:3, code:1, Destinatio
n host unreachable)
*192.168.1.1 icmp_seq=31 ttl=255 time=15.911 ms (ICMP type:3, code:1, Destinatio
```

From PC3 to PC 2 by shutting down R5:

```
84 bytes from 192.168.1.101 icmp_seq=23 ttl=62 time=63.076 ms
84 bytes from 192.168.1.101 icmp_seq=24 ttl=62 time=57.231 ms
84 bytes from 192.168.1.101 icmp_seq=25 ttl=62 time=44.584 ms
84 bytes from 192.168.1.101 icmp_seq=26 ttl=62 time=48.754 ms
84 bytes from 192.168.1.101 icmp_seq=27 ttl=62 time=64.033 ms
*192.168.2.1 icmp_seq=28 ttl=255 time=13.128 ms (ICMP type:3, code:1, De
n host unreachable)
*192.168.2.1 icmp_seq=29 ttl=255 time=21.115 ms (ICMP type:3, code:1, De
n host unreachable)
*192.168.2.1 icmp_seq=30 ttl=255 time=10.138 ms (ICMP type:3, code:1, De
n host unreachable)
*192.168.2.1 icmp_seq=31 ttl=255 time=12.256 ms (ICMP type:3, code:1, De
n host unreachable)
```

3 Problem 3

a) Traces

To navigate into how to set up RIP, a guide has been used [4].

Here is the path between PC1 to PC3

```
PC1> trace 192.168.2.100
trace to 192.168.2.100, 8 hops max, press Ctrl+C to stop
 1   192.168.1.1   16.790 ms  2.457 ms  16.326 ms
 2   10.0.0.6   37.999 ms  32.342 ms  35.228 ms
 3   *192.168.2.100   79.065 ms (ICMP type:3, code:3, Dest
ination port unreachable)
```

Here is the path between PC3 to PC2

```
PC3> trace 192.168.1.101
trace to 192.168.1.101, 8 hops max, press Ctrl+C to stop
 1   192.168.2.1   15.319 ms  15.344 ms  15.762 ms
 2   10.0.0.5   46.940 ms  47.098 ms  47.438 ms
 3   *192.168.1.101   62.897 ms (ICMP type:3, code:3, Destination port unreachable)
```

The choice of this path can be explained because the RIP protocol tends to choose the route with the least administrative costs which refers to the lowest hop count [5].

b) Routes change

Time taken to change the route using RIPv2:

```
84 bytes from 192.168.2.100 icmp_seq=32 ttl=62 time=77.523
 ms
84 bytes from 192.168.2.100 icmp_seq=33 ttl=62 time=63.583
 ms
*192.168.1.1 icmp_seq=34 ttl=255 time=1.405 ms (ICMP type:
3, code:1, Destination host unreachable)
*192.168.1.1 icmp_seq=35 ttl=255 time=16.460 ms (ICMP type
:3, code:1, Destination host unreachable)
*192.168.1.1 icmp_seq=36 ttl=255 time=15.918 ms (ICMP type
:3, code:1, Destination host unreachable)
```

```
192.168.2.100 icmp_seq=144 timeout
192.168.2.100 icmp_seq=145 timeout
192.168.2.100 icmp_seq=146 timeout
192.168.2.100 icmp_seq=147 timeout
84 bytes from 192.168.2.100 icmp_seq=148 ttl=60 time=89.47
2 ms
84 bytes from 192.168.2.100 icmp_seq=149 ttl=60 time=91.14
3 ms
84 bytes from 192.168.2.100 icmp_seq=150 ttl=61 time=56.22
6 ms
```

It takes from sequence number 34 to sequence number 147 to change one network to another.

New route taken after shutting down the path between R1 and R5.

Here is the path between PC1 to PC3

```
PC1> trace 192.168.2.100
trace to 192.168.2.100, 8 hops max, press Ctrl+C to stop
 1   192.168.1.1   25.797 ms  19.993 ms  9.532 ms
 2   10.0.0.10   47.589 ms  47.006 ms  47.130 ms
 3   10.0.0.22   51.781 ms  61.691 ms  47.511 ms
 4   *192.168.2.100   63.149 ms (ICMP type:3, code:3, Dest
ination port unreachable)
```

Here is the path between PC3 to PC2

```
PC3> trace 192.168.1.101
trace to 192.168.1.101, 8 hops max, press Ctrl+C to stop
 1   192.168.2.1   13.640 ms  15.619 ms  15.700 ms
 2   10.0.0.21   12.137 ms  15.661 ms  15.638 ms
 3   10.0.0.9   32.746 ms  50.233 ms  62.754 ms
 4   *192.168.1.101   78.833 ms (ICMP type:3, code:3, Dest
ination port unreachable)
```

The second chosen path is the path R1-R4-R5. It is chosen because it is the one with the least hop count compared to the path R1-R2-R3-R5. Even if the throughput appears to be lower between R4 and R5.

4 Problem 4

a) OSPF routers

The configuration of the router has been made with the help of this article [6]. The system has been thought of as only one area due to its simplicity.
According to this article [8], Cisco uses the bandwidth as a cost for choosing a path. The other metric that we took into consideration is the hop count [9] which is the number of devices before reaching to a. It explained for instance why the RIP choosed the previous path (R1 to R5) first and why it changed from to R1 - R4 - R5 despite the small exchange of data between R4 and R5 (1544 kbps)

b) Testings

Path between PC1 to PC3 before shutting the route

```
PC1> trace 192.168.2.100
trace to 192.168.2.100, 8 hops max, press Ctrl+C to stop
 1   192.168.1.1   16.540 ms  16.409 ms  7.883 ms
 2   10.0.0.2   35.885 ms  45.737 ms  48.362 ms
 3   10.0.0.14   64.605 ms  69.510 ms  58.657 ms
 4   10.0.0.18   94.713 ms  113.892 ms  93.633 ms
 5   *192.168.2.100   189.744 ms (ICMP type:3, code:3, Des
tination port unreachable)
```

Path between PC3 to PC2 before shutting the route

```
PC3> trace 192.168.1.101
trace to 192.168.1.101, 8 hops max, press Ctrl+C to stop
 1   192.168.2.1   7.169 ms  12.856 ms  12.436 ms
 2   10.0.0.17   43.139 ms  43.681 ms  43.269 ms
 3   10.0.0.13   78.495 ms  78.476 ms  79.752 ms
 4   10.0.0.1   126.654 ms  107.931 ms  125.867 ms
 5   *192.168.1.101   156.549 ms (ICMP type:3, code:3, Des
tination port unreachable)
```

Time taken to operate a change:

```
84 bytes from 192.168.1.101 icmp_seq=38 ttl=60 time=125.56
7 ms
84 bytes from 192.168.1.101 icmp_seq=39 ttl=60 time=125.17
8 ms
192.168.1.101 icmp_seq=40 timeout
192.168.1.101 icmp_seq=41 timeout
192.168.1.101 icmp_seq=42 timeout
192.168.1.101 icmp_seq=43 timeout
84 bytes from 192.168.1.101 icmp_seq=44 ttl=62 time=63.193
 ms
84 bytes from 192.168.1.101 icmp_seq=45 ttl=62 time=51.945
 ms
84 bytes from 192.168.1.101 icmp_seq=46 ttl=62 time=61.882
```

We can see here that it took only 4 timeouts to change compared to more than 100 with the previous test using RIP.

New PC1 to PC3 road:

```
PC1> trace 192.168.2.100
trace to 192.168.2.100, 8 hops max, press Ctrl+C to stop
 1   192.168.1.1   13.849 ms  13.820 ms  13.906 ms
 2   10.0.0.6   45.137 ms  28.602 ms  28.693 ms
 3   *192.168.2.100   44.195 ms (ICMP type:3, code:3, Dest
ination port unreachable)
```

New PC3 to PC2 road:

```
PC3> trace 192.168.1.101
trace to 192.168.1.101, 8 hops max, press Ctrl+C to stop
 1   192.168.2.1   29.410 ms  28.820 ms  30.754 ms
 2   10.0.0.5   62.521 ms  63.213 ms  46.431 ms
 3   *192.168.1.101   93.176 ms (ICMP type:3, code:3, Dest
ination port unreachable)
```

As we can see, the new path chosen is R1 to R5 and this can be explained due to the fact that R5 and R4 have only 1544 kbps of throughput which makes it less suitable according to the OSPF standard.

5 Problem 5

To conclude, we have seen in this report that three different techniques for setting paths have been used: static, by using RIPv2 and by using OSPF. Static consisted in hardcoding a path between routers. RIPv2 is a protocol that learns about routing information through other routers and OSPF is a routing protocol that uses area of routing and throughput to establish paths.
Here are different scenarios where each of those allocation techniques would be beneficial:

- Static: This configuration could be efficient if the network administrator knows every device on the network (so a relatively small network) as well as their configuration and does not suffer from negative outcomes when the connection is interrupted. In static routing, the paths are attributed manually. Hence, networks can be set according to the network administrator's choices of metric he or she has decided to apply. However, if one path is interrupted, the time to repair or change it can be substantially high.
- RIPv2: is suitable for small to medium networks as it has a maximum hop count of 15 hops [11] and is not extensively scalable. It is also suitable for networks that do not have as a metric throughput but rather hops or administrative cost. One can think, unlike the example we had, that setting up RIP would be enough for a network that has the same throughput everywhere. However, we saw that using RIPv2 for a network that has different types of throughput was not maximizing the resources of the network.
- OSPF: it is suitable for bigger networks that need autonomy and efficiency. OSPF seems to be scalable, easily recoverable and maximize path to have the most throughput to gain speed defined in terms of volume of data exchanged. The overhead of setting areas can be time-consuming and complex. However, we saw that OSPF was very efficient when routes were shut, which limited the amount of lost packets.

Here is a small sheet to compare the three types of configuration:

	Static	**RIPv2**	**OSPF**
Configuration complexity	Simple	Average	Complex
Configuration time	Low	Middle	Long
Efficiency	Low	Average	Efficient
Packet lost	Huge number if the problem is not found	Substantially but recover quite fast	Fast recovery

Reference:

1 . How /30 and /32 Bit IP Subnet Masks Can Help You With Cisco Networking.
2. How to configure static routing on Cisco - Grandmetric
3. ip route commands - Cisco
4. Configuring RIPv2 - Study CCNA
5. RFC 1058 - Routing Information Protocol
6. How to Configure OSPF on Cisco Router in GNS3
7. Understand OSPF Areas and Virtual Links - Cisco
8. Learning OSPF Path Selection
9. What is a Hop Count? - Definition from Techopedia
10. Learning IPv4 Routes with RIPv2 - Internold Networks
11. RIP and RIPv2, The Routing Information Protocol - Upskilld
12. Cisco NM-1FE-TX Fast Ethernet Network Module Genuine.
13 . CISCO NM-16ESW-PWR - 16-port 10/100 EtherSwitch Network
14. Cisco 1-Port Serial WAN Interface Card - WIC-1T | Begagnad | Azalea IT