2020

Network topology and routing

Practical work #4

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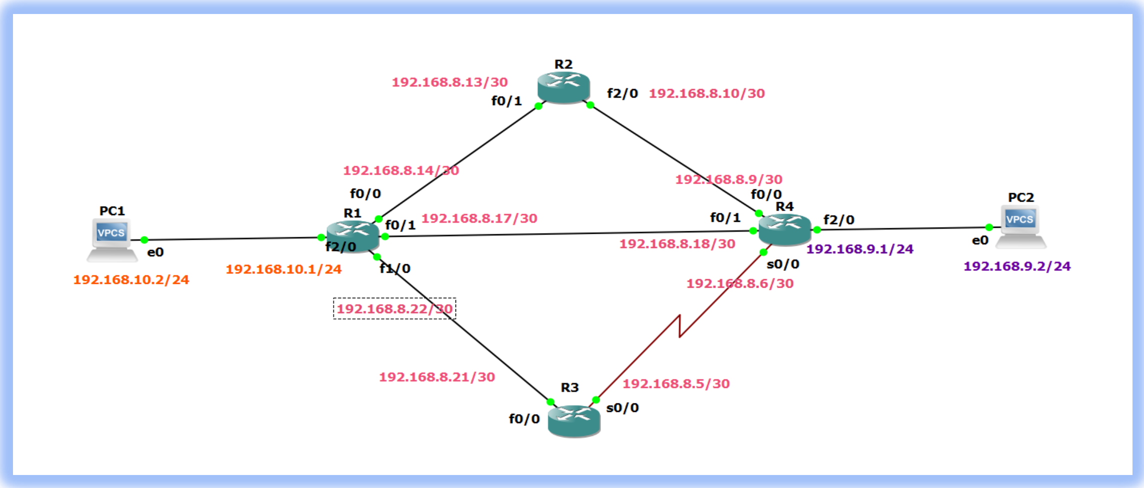
Problem 1



Network typology

```
R1#ping 192.168.10.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.10.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/31/64 ms
R1#ping 192.168.8.18

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.8.18, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 52/74/96 ms
R1#
```

Pings from R1 to PC-1 and R1 to R4

```
PC1> ping 192.168.9.2
*192.168.10.1 icmp_seq=1 ttl=255 time=36.175 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=2 ttl=255 time=35.366 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=3 ttl=255 time=10.886 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=4 ttl=255 time=10.003 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=5 ttl=255 time=6.036 ms (ICMP type:3, code:1, Destination host unreachable)

PC1>
```

Ping PC-1 to PC-2.

WIC is a network interface card, it includes a built-in Channel Service Unit/Dara Unit/Data Service Unit (CSU/DSU) interface which gives the possibility to the card to communicate with a router that is connected to WAN. WIC-T1 has only 1-port serial while WIC-2T has two smart serial connectors. The reason that we use WIC-1T support sync serial at a maximum of 2Mbps while WIC-2T support 8Mbps on each port.

NM-1FE-TX is typically used for a wide range of LAN applications, it has 1-port fast Ethernet and supports 10/100 TX connection via an RJ-45 connector. This model was ideal for this lab and supports all what we need on other hand the rest of models have some issues like NM-16ESW has 16 ports which we don't need and NM-4T does not offer support for an asyce mode.

The issues with using /24 subnet in the backbone is wasting much more IPs than what we need. So, we use CIDR that allows more flexible allocation of IPs than was possible with the original IP address classes which in this case is class C for subnet /24. Moreover when we use /30 subnet we are only allowed to use 2 IPs due the other two IPs are used for broadcasting and network.

Problem 2

a)

[IP] is the IP of the interface we want to connect to.

[mask] is the subnet mask of that interface.

[router_interface] is the interface path that connects directly to the router we can assign either the name of the interface like f0/0 or the IP attached to that interface, we can show by using IP route.

[metric] an optional parameter, used to specify the administrative cost.

b) Based on the speed of the router I prioritize my paths as the following:

1- R1→ R2→R4

2- R1→ R4

3-R1 → R3→ R4

```
PC1> trace 192.168.9.2
trace to 192.168.9.2, 8 hops max, press Ctrl+C to stop
 1   192.168.10.1   8.808 ms  8.992 ms  8.053 ms
 2   192.168.8.13   29.982 ms  26.551 ms  30.603 ms
 3   192.168.8.9   54.830 ms  50.033 ms  48.971 ms
 4   *192.168.9.2   61.051 ms (ICMP type:3, code:3, Destination port unreachable)

PC1> ping  192.168.9.2
84 bytes from 192.168.9.2 icmp_seq=1 ttl=61 time=57.894 ms
84 bytes from 192.168.9.2 icmp_seq=2 ttl=61 time=47.463 ms
84 bytes from 192.168.9.2 icmp_seq=3 ttl=61 time=51.005 ms
84 bytes from 192.168.9.2 icmp_seq=4 ttl=61 time=73.929 ms
84 bytes from 192.168.9.2 icmp_seq=5 ttl=61 time=36.693 ms

PC1>
```

C)

```
PC1> trace 192.168.9.2
trace to 192.168.9.2, 8 hops max, press Ctrl+C to stop
 1   192.168.10.1   21.285 ms  21.944 ms  20.249 ms
 2   192.168.8.13   42.700 ms  58.156 ms  66.563 ms
 3   192.168.8.9   181.019 ms  134.989 ms  133.428 ms
 4   *192.168.9.2   108.948 ms (ICMP type:3, code:3, Destination port unreachable)

PC1> ping  192.168.9.2 -t
84 bytes from 192.168.9.2 icmp_seq=1 ttl=61 time=48.367 ms
84 bytes from 192.168.9.2 icmp_seq=2 ttl=61 time=52.717 ms
84 bytes from 192.168.9.2 icmp_seq=3 ttl=61 time=49.085 ms
84 bytes from 192.168.9.2 icmp_seq=4 ttl=61 time=57.917 ms
192.168.9.2 icmp_seq=5 timeout
192.168.9.2 icmp_seq=6 timeout
192.168.9.2 icmp_seq=7 timeout
192.168.9.2 icmp_seq=8 timeout
192.168.9.2 icmp_seq=9 timeout

PC1>
```

d)

```
PC1> trace 192.168.9.2
trace to 192.168.9.2, 8 hops max, press Ctrl+C to stop
 1   192.168.10.1   10.176 ms  10.151 ms  35.660 ms
 2   192.168.8.13   43.199 ms  68.991 ms  64.967 ms
 3   192.168.8.9   136.945 ms  81.407 ms  121.982 ms
 4   *192.168.9.2   120.720 ms (ICMP type:3, code:3, Destination port unreachable)

PC1> ping 192.168.9.2 -t
84 bytes from 192.168.9.2 icmp_seq=1 ttl=61 time=109.192 ms
84 bytes from 192.168.9.2 icmp_seq=2 ttl=61 time=45.054 ms
84 bytes from 192.168.9.2 icmp_seq=3 ttl=61 time=85.011 ms
84 bytes from 192.168.9.2 icmp_seq=4 ttl=61 time=40.069 ms
84 bytes from 192.168.9.2 icmp_seq=5 ttl=61 time=85.900 ms
192.168.9.2 icmp_seq=6 timeout
192.168.9.2 icmp_seq=7 timeout
192.168.9.2 icmp_seq=8 timeout
192.168.9.2 icmp_seq=9 timeout
192.168.9.2 icmp_seq=10 timeout
192.168.9.2 icmp_seq=11 timeout
192.168.9.2 icmp_seq=12 timeout
192.168.9.2 icmp_seq=13 timeout
192.168.9.2 icmp_seq=14 timeout
192.168.9.2 icmp_seq=15 timeout
192.168.9.2 icmp_seq=16 timeout
192.168.9.2 icmp_seq=17 timeout
192.168.9.2 icmp_seq=18 timeout
192.168.9.2 icmp_seq=19 timeout
192.168.9.2 icmp_seq=20 timeout
192.168.9.2 icmp_seq=21 timeout
192.168.9.2 icmp_seq=22 timeout
192.168.9.2 icmp_seq=23 timeout
192.168.9.2 icmp_seq=24 timeout
192.168.9.2 icmp_seq=25 timeout
192.168.9.2 icmp_seq=26 timeout
192.168.9.2 icmp_seq=27 timeout
192.168.9.2 icmp_seq=28 timeout
192.168.9.2 icmp_seq=29 timeout
192.168.9.2 icmp_seq=30 timeout
192.168.9.2 icmp_seq=31 timeout
192.168.9.2 icmp_seq=32 timeout
192.168.9.2 icmp_seq=33 timeout
192.168.9.2 icmp_seq=34 timeout
192.168.9.2 icmp_seq=35 timeout
192.168.9.2 icmp_seq=36 timeout
192.168.9.2 icmp_seq=37 timeout
192.168.9.2 icmp_seq=38 timeout
192.168.9.2 icmp_seq=39 timeout
192.168.9.2 icmp_seq=40 timeout
192.168.9.2 icmp_seq=41 timeout
192.168.9.2 icmp_seq=42 timeout
84 bytes from 192.168.9.2 icmp_seq=43 ttl=62 time=25.828 ms
84 bytes from 192.168.9.2 icmp_seq=44 ttl=62 time=43.758 ms
84 bytes from 192.168.9.2 icmp_seq=45 ttl=62 time=69.176 ms
84 bytes from 192.168.9.2 icmp_seq=46 ttl=62 time=58.208 ms
84 bytes from 192.168.9.2 icmp_seq=47 ttl=62 time=40.336 ms
84 bytes from 192.168.9.2 icmp_seq=48 ttl=62 time=53.085 ms
84 bytes from 192.168.9.2 icmp_seq=49 ttl=62 time=69.423 ms
84 bytes from 192.168.9.2 icmp_seq=50 ttl=62 time=45.049 ms

PC1> trace 192.168.9.2
trace to 192.168.9.2, 8 hops max, press Ctrl+C to stop
 1   192.168.10.1   6.027 ms  10.115 ms  4.915 ms
 2   192.168.8.18   30.573 ms  21.309 ms  19.708 ms
 3   *192.168.9.2   38.239 ms (ICMP type:3, code:3, Destination port unreachable)
```

Problem 3

a)

```
PC1> trace 192.168.9.2
trace to 192.168.9.2, 8 hops max, press Ctrl+C to stop
 1   192.168.10.1   6.681 ms  9.128 ms  5.942 ms
 2   192.168.8.18   18.843 ms  14.727 ms  13.990 ms
 3   *192.168.9.2   23.318 ms (ICMP type:3, code:3, Destination port unreachable)

PC1> ping 192.168.9.2
84 bytes from 192.168.9.2 icmp_seq=1 ttl=62 time=62.710 ms
84 bytes from 192.168.9.2 icmp_seq=2 ttl=62 time=27.380 ms
84 bytes from 192.168.9.2 icmp_seq=3 ttl=62 time=17.336 ms
84 bytes from 192.168.9.2 icmp_seq=4 ttl=62 time=67.932 ms
84 bytes from 192.168.9.2 icmp_seq=5 ttl=62 time=50.533 ms

PC1>
```

RIP2 protocol choose the path with least hop count which is between R1—> R4. According to RIP description, RIP use distance vector algorithm that choose the path with least hops count and not the speed.

b)

In the second step, I start a continues ping then turn down interface f0/1 on both routers. In this time the chosen path was though R1→ R3 → R4. The chosen path this time selected randomly by RIP because both paths have the same hop count.

R1 R3 R3 R2 R2 R4 R4 PC1

```
192.168.9.2 icmp_seq=1 timeout
192.168.9.2 icmp_seq=2 timeout
84 bytes from 192.168.9.2 icmp_seq=3 ttl=62 time=39.991 ms
84 bytes from 192.168.9.2 icmp_seq=4 ttl=62 time=124.204 ms
84 bytes from 192.168.9.2 icmp_seq=5 ttl=62 time=110.826 ms

PC1> trace 192.168.9.2
trace to 192.168.9.2, 8 hops max, press Ctrl+C to stop
 1   192.168.10.1   9.273 ms  6.424 ms  20.187 ms
 2   192.168.8.18   37.479 ms  31.967 ms  28.750 ms
 3   *192.168.9.2   43.198 ms (ICMP type:3, code:3, Destination port unreachable)

PC1> ping 192.168.9.2 -t
84 bytes from 192.168.9.2 icmp_seq=1 ttl=62 time=37.295 ms
84 bytes from 192.168.9.2 icmp_seq=2 ttl=62 time=58.201 ms
84 bytes from 192.168.9.2 icmp_seq=3 ttl=62 time=39.168 ms
84 bytes from 192.168.9.2 icmp_seq=4 ttl=62 time=37.132 ms
84 bytes from 192.168.9.2 icmp_seq=5 ttl=62 time=45.061 ms
*192.168.10.1 icmp_seq=6 ttl=255 time=43.427 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=7 ttl=255 time=33.684 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=8 ttl=255 time=7.643 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=9 ttl=255 time=15.737 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=10 ttl=255 time=19.525 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=11 ttl=255 time=36.714 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=12 ttl=255 time=33.727 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=13 ttl=255 time=56.792 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=14 ttl=255 time=13.872 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=15 ttl=255 time=24.502 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=16 ttl=255 time=31.689 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=17 ttl=255 time=1.838 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=18 ttl=255 time=6.741 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=19 ttl=255 time=2.762 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=20 ttl=255 time=9.438 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=21 ttl=255 time=6.278 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=22 ttl=255 time=2.946 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=23 ttl=255 time=3.718 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=24 ttl=255 time=35.797 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=25 ttl=255 time=34.159 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=26 ttl=255 time=33.310 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=27 ttl=255 time=33.498 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=28 ttl=255 time=44.228 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=29 ttl=255 time=8.413 ms (ICMP type:3, code:1, Destination host unreachable)
84 bytes from 192.168.9.2 icmp_seq=30 ttl=61 time=72.808 ms
84 bytes from 192.168.9.2 icmp_seq=31 ttl=61 time=66.795 ms
84 bytes from 192.168.9.2 icmp_seq=32 ttl=61 time=323.646 ms
84 bytes from 192.168.9.2 icmp_seq=33 ttl=61 time=38.096 ms
84 bytes from 192.168.9.2 icmp_seq=34 ttl=61 time=76.560 ms
84 bytes from 192.168.9.2 icmp_seq=35 ttl=61 time=36.002 ms
84 bytes from 192.168.9.2 icmp_seq=36 ttl=61 time=50.267 ms
84 bytes from 192.168.9.2 icmp_seq=37 ttl=61 time=45.323 ms
84 bytes from 192.168.9.2 icmp_seq=38 ttl=61 time=31.110 ms
84 bytes from 192.168.9.2 icmp_seq=39 ttl=61 time=45.090 ms

PC1> trace 192.168.9.2
trace to 192.168.9.2, 8 hops max, press Ctrl+C to stop
 1   192.168.10.1   9.842 ms  8.929 ms  10.561 ms
 2   192.168.8.21   13.102 ms  43.959 ms  20.673 ms
 3   192.168.8.6   14.932 ms  12.905 ms  19.055 ms
 4   *192.168.9.2   11.705 ms (ICMP type:3, code:3, Destination port unreachable)
```

Problem 4

a) The first path selected by OSPF is though R1→ R2→ R4. OSPF use Link status algorithm which choose the most efficiency path.

```
PC1> trace 192.168.9.2
trace to 192.168.9.2, 8 hops max, press Ctrl+C to stop
 1   192.168.10.1   1.999 ms  8.048 ms  3.891 ms
 2   192.168.8.13   21.852 ms  13.861 ms  23.509 ms
 3   192.168.8.9   42.965 ms  27.041 ms  26.491 ms
 4   *192.168.9.2   54.029 ms (ICMP type:3, code:3, Destination port unreachable)

PC1> ping 192.168.9.2
84 bytes from 192.168.9.2 icmp_seq=1 ttl=61 time=59.008 ms
84 bytes from 192.168.9.2 icmp_seq=2 ttl=61 time=47.172 ms
84 bytes from 192.168.9.2 icmp_seq=3 ttl=61 time=116.676 ms
84 bytes from 192.168.9.2 icmp_seq=4 ttl=61 time=104.697 ms
84 bytes from 192.168.9.2 icmp_seq=5 ttl=61 time=99.324 ms

PC1>
```

b) In the next step, I teardown interface f0/0 on R1 and interface f0/0 on R4. The next chosen path was though R1→R4. The OSPF move to the second efficiency path.

```
PC1> trace 192.168.9.2
trace to 192.168.9.2, 8 hops max, press Ctrl+C to stop
 1   192.168.10.1   11.946 ms  8.160 ms  10.879 ms
 2   192.168.8.13   27.735 ms  31.087 ms  28.008 ms
 3   192.168.8.9   49.041 ms  73.699 ms  49.698 ms
 4   *192.168.9.2   82.073 ms (ICMP type:3, code:3, Destination port unreachable)

PC1> ping 192.168.9.2 -t
84 bytes from 192.168.9.2 icmp_seq=1 ttl=61 time=67.868 ms
84 bytes from 192.168.9.2 icmp_seq=2 ttl=61 time=60.424 ms
84 bytes from 192.168.9.2 icmp_seq=3 ttl=61 time=116.950 ms
84 bytes from 192.168.9.2 icmp_seq=4 ttl=61 time=61.878 ms
84 bytes from 192.168.9.2 icmp_seq=5 ttl=61 time=116.083 ms
*192.168.10.1 icmp_seq=6 ttl=255 time=28.741 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=7 ttl=255 time=5.907 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=8 ttl=255 time=24.878 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=9 ttl=255 time=30.222 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.1 icmp_seq=10 ttl=255 time=15.375 ms (ICMP type:3, code:1, Destination host unreachable)
84 bytes from 192.168.9.2 icmp_seq=11 ttl=62 time=81.358 ms
84 bytes from 192.168.9.2 icmp_seq=12 ttl=62 time=37.693 ms
84 bytes from 192.168.9.2 icmp_seq=13 ttl=62 time=28.101 ms
84 bytes from 192.168.9.2 icmp_seq=14 ttl=62 time=42.617 ms
84 bytes from 192.168.9.2 icmp_seq=15 ttl=62 time=41.210 ms

PC1> trace 192.168.9.2
trace to 192.168.9.2, 8 hops max, press Ctrl+C to stop
 1   192.168.10.1   7.917 ms  6.157 ms  3.472 ms
 2   192.168.8.18   24.158 ms  40.997 ms  32.898 ms
 3   *192.168.9.2   42.894 ms (ICMP type:3, code:3, Destination port unreachable)

PC1>
```

Problem 5

Static route

- Time-consuming.

- Mistakes are common.

- Any change in the topology, neighbours' router will not be informed.

- It is suitable for a very small network with few routers.

RIP

- Very easy to configure

- It uses hop count as metric (distance vector algorithm), which is not always good. The reason is there may be a faster path we can use.

- It is more suitable for small-medium size network. Since it does not Broadcast periodically to check if any change occurs.

OSPF

- Very easy to configure.

- Use a link-status algorithm.

- Broadcast periodically to check if any change occurs.

- It is suitable for a medium-large network for two reasons, it is possible to divide AS to areas and as mentioned above, it adjacent router periodically. It is clear the in this work that OSPF didn’t take too long time to observe the new path.