1DV701 – Computer Networks - an introduction

Assignment 4

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Contents

1 Problem 1

1.1 a

The following screenshot is the result of my topology of the network using GNS3.

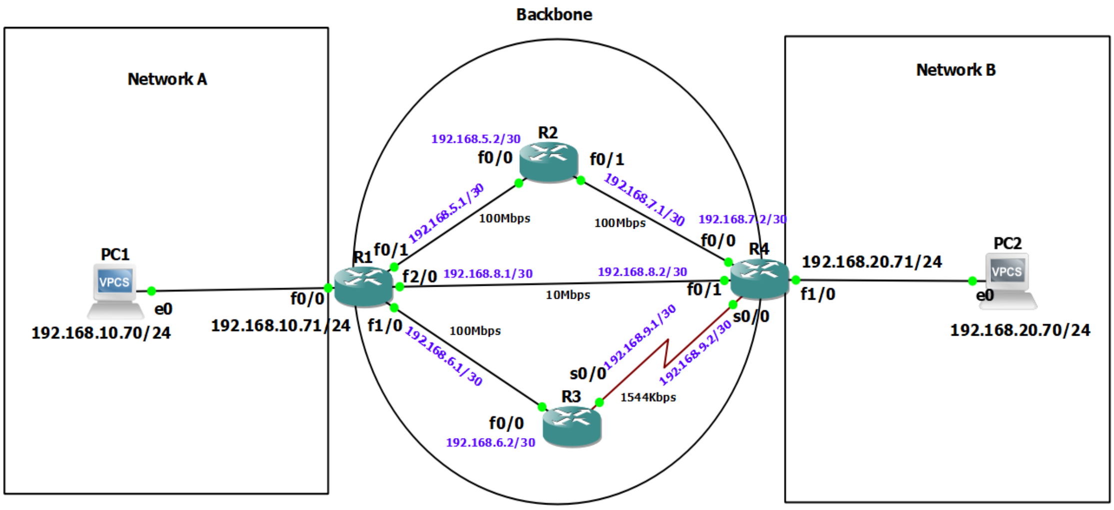

Figure 1 Network Topology

1.2 b

The fallowing screenshot is a ping from R1 to PC1.

```
R1#ping 192.168.10.70

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.10.70, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 8/10/12 ms
R1#
```

Figure 2 Ping From R1 to PC1

The fallowing screenshot is a ping from R1 to R4.

```
R1#ping 192.168.8.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.8.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 12/19/24 ms
R1#
```

Figure 3 Ping From R1 to R4

The fallowing screenshot is a failing ping from PC1 to PC2.

```
ping 192.168.20.70
*192.168.10.71 icmp_seq=1 ttl=255 time=8.591 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=2 ttl=255 time=2.415 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=3 ttl=255 time=2.593 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=4 ttl=255 time=10.606 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=5 ttl=255 time=12.424 ms (ICMP type:3, code:1, Destination host unreachable)

PC1>
```

Figure 4 Ping From PC1 to PC2

1.3 c

Abbreviation:

- NM-1FE-TX: network module with one port Fast Ethernet provided in 100BASE-TX interface.
- WIC-1T: WAN Interface Card with one port serial connection.

Properties and Usages:

- NM-1FE-TX: is supporting many LANs interfaces and have a higher bandwidth and this module has a processing power that can provide support for many internet-working standards.
- WIC-1T: is used for remote connection in the WAN network and is smaller in Bandwidth and can support a maximum of 2 Mbps.

1.4 d

The practical difference between them is the number of host's IP that each can provide. In the /24 subnet the total number of addresses that the network can support is 256 Unique IP addresses which is sufficient for small or medium LAN networks , but in the /30 subnet the total number of addresses that the network can support is 4 Unique IP addresses which is sufficient for PAN or routers.

2 Problem 2

2.1 a

[ip]: stands for the destination IP address that the command is going to set a static route for.
[mask]: subnet mask for the IP address destination.
[router-interface]: it refers to which interface is going to be used in the router for this static route.
[metric]: the wight of the route by default it is 0 and the router is going to choose the smallest wight if there are alternative routes to the same destination.

2.2 b

The following screenshot is for the ping and trace commands from PC1 to PC2 after setting the static route between them. I chose the route PC1-R1-R2-R4-PC2 in my opinion here we have two short links with high bandwidth each of 100Mbps, and is more efficient than long link with smaller bandwidth or a route with serial link.

```
PC1>  ping 192.168.20.70
84 bytes from 192.168.20.70 icmp_seq=1 ttl=61 time=54.870 ms
84 bytes from 192.168.20.70 icmp_seq=2 ttl=61 time=59.662 ms
84 bytes from 192.168.20.70 icmp_seq=3 ttl=61 time=61.528 ms
84 bytes from 192.168.20.70 icmp_seq=4 ttl=61 time=61.363 ms
84 bytes from 192.168.20.70 icmp_seq=5 ttl=61 time=64.303 ms

PC1> trace 192.168.20.70
trace to 192.168.20.70, 8 hops max, press Ctrl+C to stop
 1   192.168.10.71   2.970 ms  9.318 ms  9.383 ms
 2   192.168.5.2   30.189 ms  31.370 ms  30.374 ms
 3   192.168.7.2   52.456 ms  51.956 ms  51.366 ms
 4   *192.168.20.70   62.966 ms (ICMP type:3, code:3, Destination port unreachable)

PC1>
```

Figure 5 Ping and Trace From PC1 to PC2

2.3 c

In the following screenshot I send a continues ping from PC1 to PC2 and then I shut down the interfaces for the static route in router R1 and R4, and the we see that the ping is failing to reach out PC2 and vice versa.

```
PC1> ping 192.168.20.70 -t
192.168.20.70 icmp_seq=1 timeout
192.168.20.70 icmp_seq=2 timeout
84 bytes from 192.168.20.70 icmp_seq=3 ttl=61 time=62.284 ms
84 bytes from 192.168.20.70 icmp_seq=4 ttl=61 time=55.178 ms
84 bytes from 192.168.20.70 icmp_seq=5 ttl=61 time=55.288 ms
84 bytes from 192.168.20.70 icmp_seq=6 ttl=61 time=62.174 ms
84 bytes from 192.168.20.70 icmp_seq=7 ttl=61 time=60.068 ms
84 bytes from 192.168.20.70 icmp_seq=8 ttl=61 time=55.267 ms
84 bytes from 192.168.20.70 icmp_seq=9 ttl=61 time=59.106 ms
84 bytes from 192.168.20.70 icmp_seq=10 ttl=61 time=55.249 ms
*192.168.10.71 icmp_seq=11 ttl=255 time=13.248 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=12 ttl=255 time=4.561 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=13 ttl=255 time=3.404 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=14 ttl=255 time=10.312 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=15 ttl=255 time=2.287 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=16 ttl=255 time=9.249 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=17 ttl=255 time=1.266 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=18 ttl=255 time=2.391 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=19 ttl=255 time=5.522 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=20 ttl=255 time=8.675 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=21 ttl=255 time=11.444 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=22 ttl=255 time=6.168 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=23 ttl=255 time=2.316 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=24 ttl=255 time=11.447 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=25 ttl=255 time=3.667 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=26 ttl=255 time=7.437 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=27 ttl=255 time=10.593 ms (ICMP type:3, code:1, Destination host unreachable)

PC1>
```

Figure 6 Continues Ping From PC1 to PC2

2.4 d

In the following screenshot I send a continues ping from PC1 to PC2 and then I shut down the interfaces for the default static route that has 1 metric wight in router R1 and R4, and the we see that the ping is failing to reach out PC2 and after losing five packets the ping successfully find a new path which is PC1-R1-R4-PC2 which I manually set the metric wight for it as 2 so the router chose that route as second alternative.

```
PC1> ping 192.168.20.70
84 bytes from 192.168.20.70 icmp_seq=1 ttl=61 time=56.985 ms
84 bytes from 192.168.20.70 icmp_seq=2 ttl=61 time=62.080 ms
84 bytes from 192.168.20.70 icmp_seq=3 ttl=61 time=59.472 ms
84 bytes from 192.168.20.70 icmp_seq=4 ttl=61 time=58.490 ms
84 bytes from 192.168.20.70 icmp_seq=5 ttl=61 time=63.386 ms

PC1> trace 192.168.20.70
trace to 192.168.20.70, 8 hops max, press Ctrl+C to stop
 1   192.168.10.71   8.054 ms  9.098 ms  9.334 ms
 2   192.168.5.2   31.503 ms  31.391 ms  30.744 ms
 3   192.168.7.2   52.457 ms  52.425 ms  52.320 ms
 4   *192.168.20.70   61.017 ms (ICMP type:3, code:3, Destination port unreachable)

PC1> ping 192.168.20.70 -t
84 bytes from 192.168.20.70 icmp_seq=1 ttl=61 time=58.173 ms
84 bytes from 192.168.20.70 icmp_seq=2 ttl=61 time=59.488 ms
84 bytes from 192.168.20.70 icmp_seq=3 ttl=61 time=54.310 ms
84 bytes from 192.168.20.70 icmp_seq=4 ttl=61 time=59.259 ms
84 bytes from 192.168.20.70 icmp_seq=5 ttl=61 time=56.993 ms
192.168.20.70 icmp_seq=6 timeout
192.168.20.70 icmp_seq=7 timeout
192.168.20.70 icmp_seq=8 timeout
192.168.20.70 icmp_seq=9 timeout
192.168.20.70 icmp_seq=10 timeout
84 bytes from 192.168.20.70 icmp_seq=11 ttl=62 time=40.206 ms
84 bytes from 192.168.20.70 icmp_seq=12 ttl=62 time=34.422 ms
84 bytes from 192.168.20.70 icmp_seq=13 ttl=62 time=34.723 ms
84 bytes from 192.168.20.70 icmp_seq=14 ttl=62 time=42.089 ms
84 bytes from 192.168.20.70 icmp_seq=15 ttl=62 time=34.290 ms
84 bytes from 192.168.20.70 icmp_seq=16 ttl=62 time=36.425 ms
84 bytes from 192.168.20.70 icmp_seq=17 ttl=62 time=35.367 ms
84 bytes from 192.168.20.70 icmp_seq=18 ttl=62 time=37.136 ms

PC1> tarce 192.168.20.70
Bad command: "tarce 192.168.20.70". Use ? for help.

PC1> trace 192.168.20.70
trace to 192.168.20.70, 8 hops max, press Ctrl+C to stop
 1   192.168.10.71   31.229 ms  9.320 ms  10.204 ms
 2   192.168.8.2   31.288 ms  31.199 ms  30.193 ms
 3   *192.168.20.70   40.051 ms (ICMP type:3, code:3, Destination port unreachable)

PC1>
```

Figure 7 Continues Ping And Trace Before And After Shutting Down The Default Route From PC1 to PC2

3 Problem 3

3.1 a

In the following screenshot is for a ping and Trace from PC1 to PC2 and after configuring all the nodes with RIP. RIP chose the route PC1-R1-R4-PC2 as the most efficient route because it has the less number of hops.

```
PC1> ping 192.168.20.70
84 bytes from 192.168.20.70 icmp_seq=1 ttl=62 time=38.007 ms
84 bytes from 192.168.20.70 icmp_seq=2 ttl=62 time=41.264 ms
84 bytes from 192.168.20.70 icmp_seq=3 ttl=62 time=33.240 ms
84 bytes from 192.168.20.70 icmp_seq=4 ttl=62 time=35.288 ms
84 bytes from 192.168.20.70 icmp_seq=5 ttl=62 time=42.167 ms

PC1> trace 192.168.20.70
trace to 192.168.20.70, 8 hops max, press Ctrl+C to stop
 1   192.168.10.71   10.089 ms  9.362 ms  10.284 ms
 2   192.168.8.2   31.422 ms  30.554 ms  31.633 ms
 3   *192.168.20.70   42.713 ms (ICMP type:3, code:3, Destination port unreachable)

PC1>
```

Figure 8 Ping And Trace From PC1 to PC2

3.2 b

The following screenshot shows a Trace route from PC1 before I send a continuous ping to PC2 and after that I shut down the interface route of the default route in router R1 and R4. The ping lost 12 packets before it found a new route. The new route is PC1-R1-R2-R4-PC2.

```
PC1> trace 192.168.20.70
trace to 192.168.20.70, 8 hops max, press Ctrl+C to stop
 1   192.168.10.71   3.259 ms  8.328 ms  8.339 ms
 2   192.168.8.2   31.364 ms  31.560 ms  31.166 ms
 3   *192.168.20.70   40.313 ms (ICMP type:3, code:3, Destination port unreachable)

PC1> ping 192.168.20.70 -t
84 bytes from 192.168.20.70 icmp_seq=1 ttl=62 time=38.001 ms
84 bytes from 192.168.20.70 icmp_seq=2 ttl=62 time=39.309 ms
84 bytes from 192.168.20.70 icmp_seq=3 ttl=62 time=38.351 ms
84 bytes from 192.168.20.70 icmp_seq=4 ttl=62 time=34.467 ms
84 bytes from 192.168.20.70 icmp_seq=5 ttl=62 time=33.245 ms
84 bytes from 192.168.20.70 icmp_seq=6 ttl=62 time=34.265 ms
*192.168.10.71 icmp_seq=7 ttl=255 time=14.486 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=8 ttl=255 time=10.356 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=9 ttl=255 time=2.471 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=10 ttl=255 time=1.162 ms (ICMP type:3, code:1, Destination host unreachable)
192.168.20.70 icmp_seq=11 timeout
192.168.20.70 icmp_seq=12 timeout
192.168.20.70 icmp_seq=13 timeout
192.168.20.70 icmp_seq=14 timeout
192.168.20.70 icmp_seq=15 timeout
192.168.20.70 icmp_seq=16 timeout
192.168.20.70 icmp_seq=17 timeout
192.168.20.70 icmp_seq=18 timeout
84 bytes from 192.168.20.70 icmp_seq=19 ttl=61 time=48.365 ms
84 bytes from 192.168.20.70 icmp_seq=20 ttl=61 time=43.986 ms
84 bytes from 192.168.20.70 icmp_seq=21 ttl=61 time=54.241 ms
84 bytes from 192.168.20.70 icmp_seq=22 ttl=61 time=49.183 ms
84 bytes from 192.168.20.70 icmp_seq=23 ttl=61 time=47.192 ms
84 bytes from 192.168.20.70 icmp_seq=24 ttl=61 time=54.434 ms
84 bytes from 192.168.20.70 icmp_seq=25 ttl=61 time=44.429 ms

PC1> trace 192.168.20.70
trace to 192.168.20.70, 8 hops max, press Ctrl+C to stop
 1   192.168.10.71   12.198 ms  9.170 ms  10.199 ms
 2   192.168.5.2   31.144 ms  32.691 ms  32.237 ms
 3   192.168.7.2   53.000 ms  52.531 ms  52.576 ms
 4   *192.168.20.70   62.474 ms (ICMP type:3, code:3, Destination port unreachable)

PC1>
```

Figure 9 Continuous Ping And a Trace From PC1 to PC2 Before and After Shutting Down The Default Route Interfaces in The RIP

4 Problem 4

4.1 a

The following screenshot is for a ping and Trace from PC1 to PC2 and after configuring all the nodes with OSPF. It chose the route PC1-R1-R2-R4-PC2 as the most efficient route because of the Dijkstra algorithm that compute the best path depending on the link state of each route. I chose area 0 to make all routers seems in the same Autonomous System AS to share link state information. OSPF uses 100Mbps as a reference when calculating the link state of a route and by dividing 100Mbps by the bandwidth value we get the metric value that OSPF is setting for each route. My network topology has the following metric value for the different links. A 100Mbps has 1, and a 10Mbps has 10, and 1544kbps has a metric vlue of 64.

```
PC1> ping 192.168.20.70
84 bytes from 192.168.20.70 icmp_seq=1 ttl=61 time=59.312 ms
84 bytes from 192.168.20.70 icmp_seq=2 ttl=61 time=45.257 ms
84 bytes from 192.168.20.70 icmp_seq=3 ttl=61 time=46.072 ms
84 bytes from 192.168.20.70 icmp_seq=4 ttl=61 time=45.152 ms
84 bytes from 192.168.20.70 icmp_seq=5 ttl=61 time=47.275 ms

PC1> trace 192.168.20.70
trace to 192.168.20.70, 8 hops max, press Ctrl+C to stop
 1   192.168.10.71   3.546 ms  9.467 ms  10.492 ms
 2   192.168.5.2   31.658 ms  31.060 ms  31.354 ms
 3   192.168.7.2   53.271 ms  52.322 ms  52.213 ms
 4   *192.168.20.70   64.221 ms (ICMP type:3, code:3, Destination port unreachable)

PC1>
```

Figure 10 Ping And Trace Using OSPF From PC1 to PC2

4.2 b

The following screenshot shows a Trace route from PC1 before I send a continuous ping to PC2 the default route is PC1-R1-R2-R4-PC2, and after that I shut down the interface route of the default route in router R1 and R2. The ping lost 5 packets before it found a new path. The new route is PC1-R1-R4-PC2.

```
PC1> ping 192.168.20.70 -t
84 bytes from 192.168.20.70 icmp_seq=1 ttl=61 time=58.066 ms
84 bytes from 192.168.20.70 icmp_seq=2 ttl=61 time=63.291 ms

PC1> trace 192.168.20.70
trace to 192.168.20.70, 8 hops max, press Ctrl+C to stop
 1   192.168.10.71   9.515 ms  8.550 ms  9.425 ms
 2   192.168.5.2   31.371 ms  31.441 ms  30.500 ms
 3   192.168.7.2   51.311 ms  51.398 ms  51.333 ms
 4   *192.168.20.70   63.036 ms (ICMP type:3, code:3, Destination port unreachable)

PC1> ping 192.168.20.70 -t
84 bytes from 192.168.20.70 icmp_seq=1 ttl=61 time=59.966 ms
84 bytes from 192.168.20.70 icmp_seq=2 ttl=61 time=60.366 ms
84 bytes from 192.168.20.70 icmp_seq=3 ttl=61 time=60.217 ms
84 bytes from 192.168.20.70 icmp_seq=4 ttl=61 time=63.212 ms
84 bytes from 192.168.20.70 icmp_seq=5 ttl=61 time=63.460 ms
84 bytes from 192.168.20.70 icmp_seq=6 ttl=61 time=64.373 ms
*192.168.10.71 icmp_seq=7 ttl=255 time=15.250 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=8 ttl=255 time=8.463 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=9 ttl=255 time=7.187 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=10 ttl=255 time=8.639 ms (ICMP type:3, code:1, Destination host unreachable)
*192.168.10.71 icmp_seq=11 ttl=255 time=2.188 ms (ICMP type:3, code:1, Destination host unreachable)
84 bytes from 192.168.20.70 icmp_seq=12 ttl=62 time=35.771 ms
84 bytes from 192.168.20.70 icmp_seq=13 ttl=62 time=33.393 ms
84 bytes from 192.168.20.70 icmp_seq=14 ttl=62 time=41.354 ms
84 bytes from 192.168.20.70 icmp_seq=15 ttl=62 time=36.634 ms
84 bytes from 192.168.20.70 icmp_seq=16 ttl=62 time=36.631 ms
84 bytes from 192.168.20.70 icmp_seq=17 ttl=62 time=34.261 ms

PC1> trace 192.168.20.70
trace to 192.168.20.70, 8 hops max, press Ctrl+C to stop
 1   192.168.10.71   4.344 ms  9.392 ms  9.205 ms
 2   192.168.8.2   30.164 ms  31.364 ms  30.399 ms
 3   *192.168.20.70   42.231 ms (ICMP type:3, code:3, Destination port unreachable)

PC1>
```

Figure 11 Continuous Ping And a Trace From PC1 to PC2 Before and After Shutting Down The Default Route Interfaces in The OSPF

5 Problem 5

The following table shows the conclousion I got after applying the three routing methods (static/RIPv2/OSPF) the key differences between them according to my experience.

	Static	RIP	OSPF
Configuration Complexity	Hard to configure as we should manually write the static route for every router's interface	Easy to configure as we must write only one configuration for all interfaces without mentioning the metric values for each link	Easy to configure we do as the RIP, but we should provide the area as extra information
Configuration Time	It takes a long time	It takes less time than static	It takes less time than static and approximately the same as RIP
Efficiency and number of packets lost in case of failure	5 packets were lost in my situation	12 packets were lost before it found the alternative path	5 packets were lost
Most efficient to use	Taking in account the above information this protocol most efficient to use in very small networks	Small to medium networks where the speed of recovery of failure networks is not critical.	Medium to large networks where it is very important to find new paths fast in case of failure.

Figure 12 The key differences between (static/RIPv2/OSPF)