Assignment 1 & 2, TCP/IP Internetworking

Adam Temmel (adte1700), Fredrik Sellgren (frse1700),
Oscar Fredriksson (osfr1701)

2020/12/07

1 Preparation: Subnetting

First, we had to determine our IP-range.

$$\text{Fredrik's birthday:}$$
$$(89 \cdot 02 + 08) \; mod \; 223 = 186$$
$$\text{Oscar's birthday:}$$
$$(9 \cdot 02 + 04) \; mod \; 255 = 200$$
$$\text{Adam's birthday:}$$
$$(9 \cdot 11 + 16) \; mod \; 255 = 85$$

This gave us the resulting IP-range of 186.200.85/20.

1.1 What is the network-ID of your groups subnet?

$$186.200.85.0 \; bitwise \; and \; 255.255.240.0 = 186.200.80.0$$

1.2 What is the broadcast address of your groups subnet?

$$186.200.85.0 \; bitwise \; or \; 0.0.15.255 = 186.200.95.255$$

1.3 How many hosts in total can this subnet hold?

$$2^{32-20} - 2 = 2^{12} - 2 = 4096 - 2 = 4094$$

2 Further network planning

The network requirements for this assignment is presented below.

Device	**Number of hosts**
RT-A	2100
RT-B	1000
RT-C	300
RT-D	600
Link nets	4

It then follows that our original subnet needs to be subnetted further in order to provide these specific requirements. Our proposed new subnets are as follows:

RT-A	2100 hosts
186.200.80.0/21	2046 hosts
186.200.95.0/26	62 hosts

RT-B	1000 hosts
186.200.88.0	1022 hosts

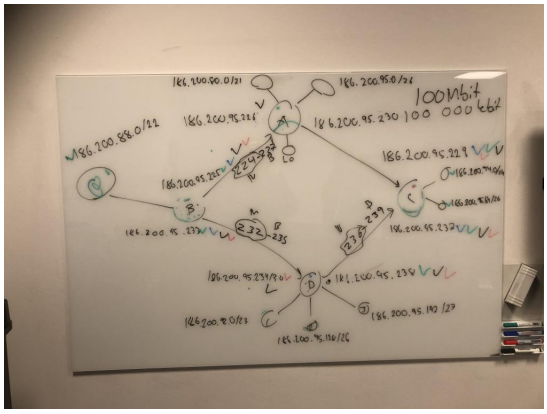
RT-C	300 hosts
186.200.94.0/24	254 hosts
186.200.95.64/26	62 hosts

RT-D	600 hosts
186.200.92.0/23	510 hosts
186.200.95.128/26	62 hosts
186.200.95.192/27	30 hosts

Connection	**Designated Address**
RT-A → RT-B	186.200.95.224/30
RT-A → RT-C	186.200.95.228/30
RT-D → RT-B	186.200.95.232/30
RT-D → RT-C	186.200.95.236/30

3 Building the network

3.1 Which group member was doing the configuration for this part?



We found it easiest to let one member connect to the system and mirror his screen on a large display. The idea here is that one group member could setup the network under the supervision of all other members. If all members could verify the validity of each command, the risk of misconfiguring the network should be minimized (This did not work out perfect in reality, we did mess up once). For this part, Fredrik Sellgren was responsible for typing in the requested commands.

3.2 Static routing

3.2.1 List the static routes configured:

Route	Hop	Explanation
A → 186.200.94.0	186.200.95.229	A → C's subnet with 254 hosts
A → 186.200.95.64	186.200.95.229	A → C's subnet with 62 hosts
A → 186.200.95.238	186.220.95.229	A → D via C
A → 186.200.95.234	186.200.95.225	A → D via B
A → 186.200.88.0	186.200.95.225	A → B's subnet with 1022 hosts
A → 186.200.92.0	186.200.95.238	A → D's subnet with 510 hosts via C
A → 186.200.95.128	186.200.95.238	A → D's subnet with 62 hosts via C
A → 186.200.95.192	186.200.95.238	A → D's subnet with 30 hosts via C
A → 186.200.92.0	186.200.95.234	A → D's subnet with 510 hosts via B
A → 186.200.95.128	186.200.95.234	A → D's subnet with 62 hosts via B
A→ 186.200.95.192	186.200.95.234	A → D's subnet with 30 hosts via B
B → 186.200.80.0	186.200.95.226	B → A's subnet with 2046 hosts
B → 186.200.95.0	186.200.95.226	B → A's subnet with 62 hosts
B → 186.200.92.0	186.200.95.234	B → D's subnet with 510 hosts
B → 186.200.95.128	186.200.95.234	B → D's subnet with 62 hosts
B → 186.200.95.192	186.200.95.234	B → D's subnet with 30 hosts
B → 186.200.95.237	186.200.95.234	B → C via D
B → 186.200.95.229	186.200.95.226	B → C via A
B → 186.200.95.64	186.200.95.234	B → C's subnet with 62 hosts via D
B → 186.200.94.0	186.200.95.234	B → C's subnet with 254 hosts via D
B → 186.200.95.64	186.200.95.226	B → C's subnet with 62 hosts via A
B → 186.200.94.0	186.200.95.226	B → C's subnet with 254 hosts via A
C → 186.200.92.0	186.200.95.238	C → D's subnet with 510 hosts
C → 186.200.95.128	186.200.95.238	C → D's subnet with 62 hosts
C → 186.200.95.192	186.200.95.238	C → D's subnet with 30 hosts
C → 186.200.80.0	186.200.95.230	C → A's subnet with 2048 hosts
C → 186.200.95.0	186.200.95.230	C → A's subnet with 62 hosts
C → 186.200.95.225	186.200.95.230	C → B via A
C → 186.200.95.233	186.200.95.238	C → B via D
C → 186.200.88.0	186.200.96.225	C → B's subnet with 1022 hosts via A
C → 186.200.88.0	186.200.96.233	C → B's subnet with 1022 hosts via D
D → 186.200.88.0	186.200.95.233	D → B's subnet with 1022 hosts
D → 186.200.94.0	186.200.95.237	D → C's subnet with 254 hosts
D → 186.200.95.64	186.200.95.237	D → C's subnet with 62 hosts
D → 186.200.95.230	186.200.95.237	D → A via C
D → 186.200.95.226	186.200.95.233	D → A via B
D → 186.200.80.0	186.200.95.230	D → A's subnet with 2046 hosts via C
D → 186.200..95.0	186.200.95.230	D → A's subnet with 62 hosts via C

D → 186.200.80.0	186.200.95.226	D → A's subnet with 2046 hosts via B
D → 186.200.95.0	186.200.95.226	D → A's subnet with 62 hosts via B
B → 200.169.248.12	186.200.95.226	B → A's loopback
C → 200.169.248.12	186.200.95.230	C → A's loopback
D → 200.169.248.12	186.200.95.230	D → A's loopback via C
D → 200.169.248.12	186.200.95.226	D → A's loopback via B

After this configuration we were able to ping all the subnets from all the routers across the board.

3.2.2 When issuing a ping from RT-D to the loopback on RT-A, what path will the ICMP-packet take and why?

The traceroute command shows the RTT for both the paths, but by summarising the partial time of the paths taken, we can gather that the packet goes from RT-D → RT-B → RT-A, as the ping command shows a time that is closer to the second path than the first.

```
RT-D#ping 200.169.248.12
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.169.248.12, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 40/41/44 ms

RT-D#traceroute ip 200.169.248.12
Type escape sequence to abort.
Tracing the route to 200.169.248.12
VRF info: (vrf in name/id, vrf out name/id)
  1 186.200.95.233 12 msec
    186.200.95.237 4 msec
    186.200.95.233 12 msec
  2 186.200.95.230 16 msec
    186.200.95.226 20 msec
    186.200.95.230 16 msec

Packet sent with a source address of 186.200.95.234
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 40/42/44 ms
```

Route	Path	Cost
A → A1	A → A1	1
A → A2	A → A2	1
A → AC	A → AC	0
A → C	A → AC → C	390,625
A → C1	A → AC → C → C1	391,625
A → C2	A → AC → C → C2	391,625
A → CD	A → AC → C → CD	390,625
A → D	A → AC → C → CD → D	1171,875
A → D1	A → AC → C → CD → D → D1	1172,875
A → D2	A → AC → C → CD → D → D2	1172,875
A → D3	A → AC → C → CD → D → D3	1172,875
A → BD	A → AB → B → BD	781,25
A → B	A → AB → B	781,25
A → B1	A → AB → B → B1	782,25
A → AB	A → AB	0

Figure 1: RT-A

3.2.3 Without removing a static route, force the ping packets to travel through router C (RT-C) when trying to reach the loopback on RT-A from RT-D. How did you achieve this?

When configuring the Ip route you can specify a cost for taking this route, this value is optional and is first set to its default value. To force the ping packets to travel through router C, we increased the cost for the path via RT-B to 255, so that the ping package prefers to travel via RT-C.

```
RT-D(config)#ip route 200.169.248.0 255.255.255.0 186.200.95.233 255

RT-D#ping 200.169.248.12
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.169.248.12, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 20/20/24 ms
```

3.2.4 Which group member was doing the configuration for this part?

During this part of the laboration we continued to discuss how to solve the configuration as a group, but this time Oscar Fredriksson was pushing the buttons.

Route	Path	Cost
B → B1	B → B1	1
B → AB	B → AB	0
B → A	B → AB → A	781,25
B → A1	B → AB → A → A1	782,25
B → A2	B → AB → A → A2	782,25
B → AC	B → AB → A → AC	781,25
B → C	B → AB → A → AC → C	1171,875
B → C1	B → AB → A → AC → C → C1	1172,875
B → C2	B → AB → A → AC → C → C2	1172,875
B → CD	B → AB → A → AC → C → CD	1171,875
B → D	B → BD → D	1582,5
B → D1	B → BD → D → D1	1583,5
B → D2	B → BD → D → D2	1583,5
B → D3	B → BD → D → D3	1583,5
B → BD	B → BD	0

Figure 2: RT-B

Route	Path	Cost
C → A1	C → AC → A1	391,625
C → A2	C → AC → A2	391,625
C → AC	C → AC	0
C → C1	C → C1	1
C → C2	C → C2	1
C → CD	C → CD	0
C → D	C → CD → D	781,25
C → D1	C → CD → D → D1	782,25
C → D2	C → CD → D → D2	782,25
C → D3	C → CD → D → D3	782,25
C → BD	C → CD → D → BD	781,25
C → B	C → AC → A → AB → B	1171,875
C → B1	C → AC → A → AB → B → B1	1172,875
C → AB	C → AC → A → AB → B → B2	1172,875
C → A	C → AC → A	390,625

Figure 3: RT-C

Route	Path	Cost
D → A1	D → CD → C → AC → A → A1	1172,875
D → A2	D → CD → C → AC → A → A2	1172,875
D → AC	D → CD → C → AC	781,25
D → C	D-CD → C	781,25
D → C1	D → CD → C → C1	782,25
D → C2	D → CD → C → C2	782,25
D → CD	D → CD	0
D → D1	D → D1	1
D → D2	D → D2	1
D → D3	D → D3	1
D → BD	D → BD	0
D → B	D → DB → B	1562,5
D → B1	D → DB → B → B1	1563,5
D → AB	D → CD → C → AC → A → AB	1171,875
D → A	D → CD → C → AC → A	1171,875

Figure 4: RT-D

3.2.5 Draw up the topology and write the cost on each link according to the given equation

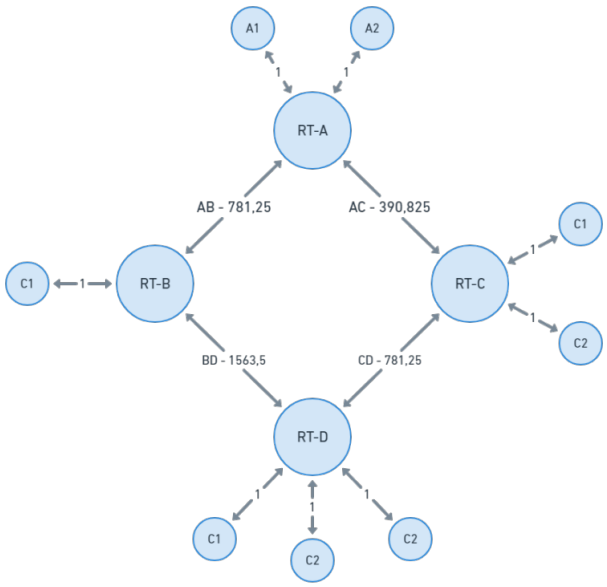


Figure 5: Network topology in regards to travel cost

3.2.6 **Each group member will now select one of the four routers, and from this router calculate the shortest path to all the sub-networks using Dijkstra's algorithm. What are the costs to reach the different networks?**

3.2.7 **Issue the command show ip route and look at the metric OPSF use for all the networks in the routing table. Are the metrics the same as the metrics you calculated in question 2?**

3.2.8 **Issue the ping command from RT-D to the loopback on RT-A. Which path does the ICMP-packet take to reach RT-A loopback?**

3.2.9 **Modify the OSPF-metric so that it prefers to send packages though RT-B instead of RT-C when sending packages from RT-D to RT-A. Show how you achieved this.**

3.2.10 **Which group member was doing the configuration for this part?**