Computer Networks Exercises

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IP Addressing: methodology

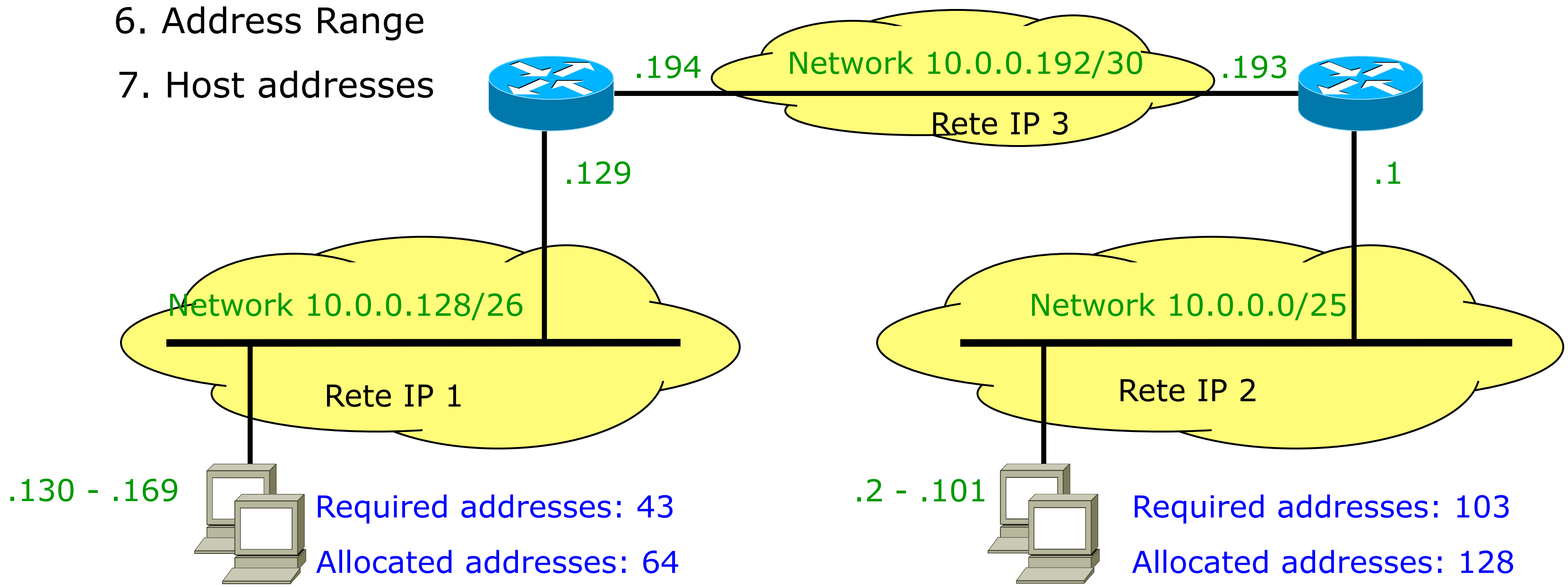
1. Location of IP networks
2. Amount of required addresses
3. Amount of allocated addresses
4. Address range validity
5. Netmask / Prefix Length
6. Address Range
7. Host addresses

Minimum amount of addresses: 196
Address range selected: 10.0.0.0/24 ➔ OK

Required addresses: 4

Allocated addresses: 4

NM (PL): 255.255.255.252 (/30)



Required addresses: 43

Allocated addresses: 64

NM (PL): 255.255.255.192 (/26)

Required addresses: 103

Allocated addresses: 128

NM (PL): 255.255.255.128 (/25)

LAN 1, 40 end-system

LAN 2, 100 end-system

Exercise 1

- Assuming a classless addressing plan, define the netmask and the prefix length that have to be assigned to possible networks in order to contain the given number of hosts.

Number of Hosts	Netmask	Prefix Length	Available Addresses
2			
27			
5			
100			
10			
300			
1010			
55			
167			
1540			

Exercise 1: solution

Number of Hosts	Netmask	Prefix Length	Available Addresses
2	255.255.255.252	/30	4 (-2)
27	255.255.255.224	/27	32 (-2)
5	255.255.255.248	/29	8 (-2)
100	255.255.255.128	/25	128 (-2)
10	255.255.255.240	/28	16 (-2)
300	255.255.254.0	/23	512 (-2)
1010	255.255.252.0	/22	1024 (-2)
55	255.255.255.192	/26	64 (-2)
167	255.255.255.0	/24	256 (-2)
1540	255.255.248.0	/21	2048 (-2)

Exercise 2

- Which “IP address / Prefix length” pairs identify a valid network?

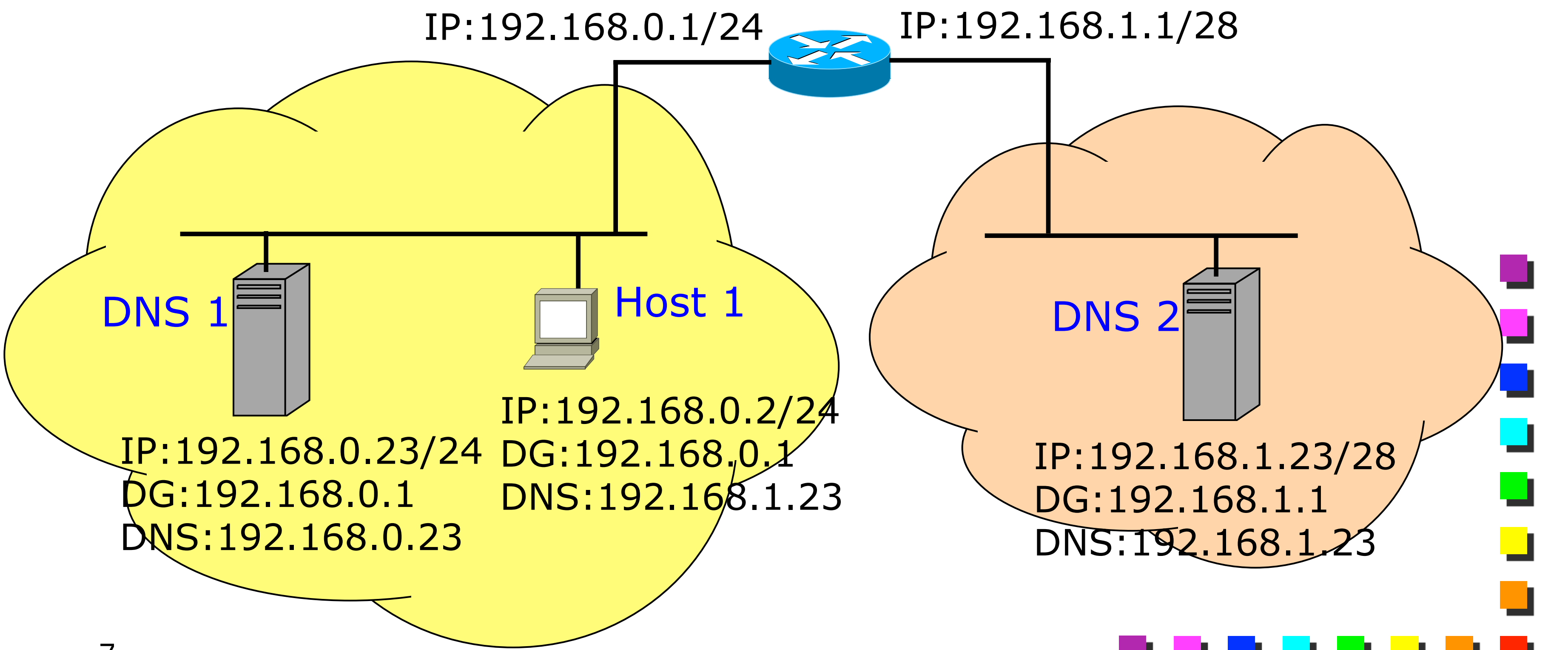
IP / Prefix Length pair	Valid network?
192.168.5.0/24	
192.168.4.23/24	
192.168.2.36/30	
192.168.2.36/29	
192.168.2.32/28	
192.168.2.32/27	
192.168.3.0/23	
192.168.2.0/31	
192.168.2.0/23	
192.168.16.0/21	
192.168.12.0/21	

Exercise 2: solution

IP / Prefix Length pair	Valid network?
192.168.5.0/24	YES
192.168.4.23/24	NO
192.168.2.36/30	YES
192.168.2.36/29	NO
192.168.2.32/28	YES
192.168.2.32/27	YES
192.168.3.0/23	NO
192.168.2.0/31	NO!!!
192.168.2.0/23	YES
192.168.16.0/21	YES
192.168.12.0/21	NO

Exercise 3

- Find out the configuration error in the below network setup and explain why the network does not work properly.



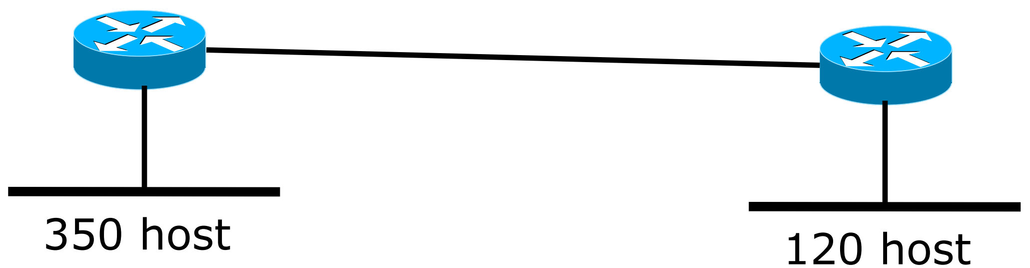
Exercise 3: solution

- The netmask configured in the portion of network including the router and DNS 2 is wrong because those two machines are not within the same IP network.
- In this network setup, the router could directly contact DNS 2 only if DNS 2 had an IP address in the range 192.168.1.2 / 192.168.1.14. Instead, DNS 2 is currently in the 192.168.1.16/28 network. Hence, DNS 2 cannot communicate with any external destination.

- NB: The configuration of DNS 2 as DNS server for Host 1 is not an error. The utilization of an external DNS server is perfectly fine.

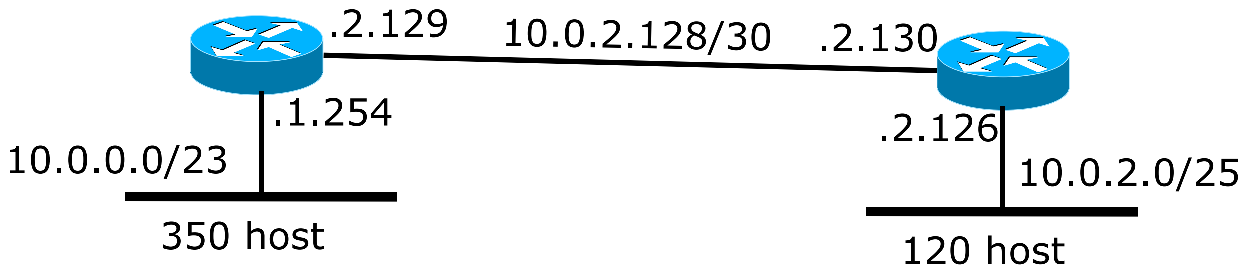
Exercise 4

- Define an IP addressing plan for the network in the figure. Consider both a "traditional" addressing plan and a solution that could minimize the number of deployed addresses. Assume to utilize the 10.0.0.0/16 address range.

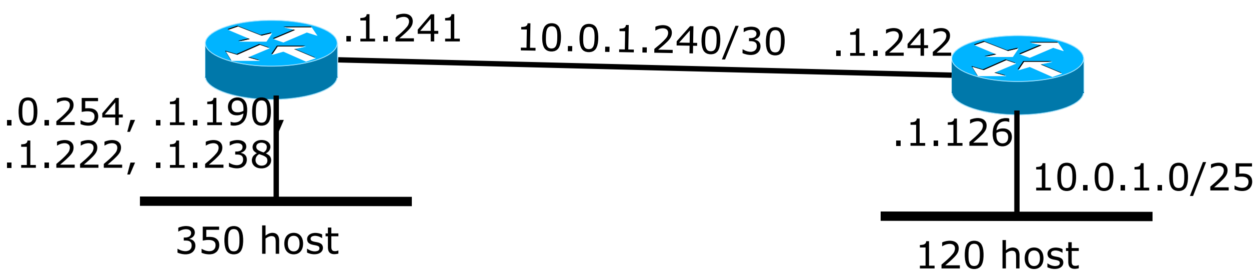


Exercise 4: solution (1)

Solution1



Solution2



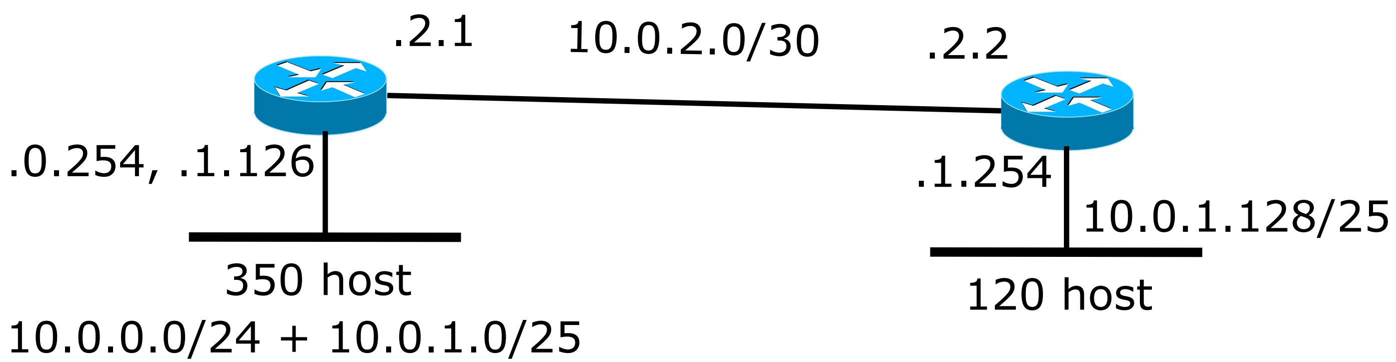
10.0.0.0/24 + 10.0.1.128/26 +
10.0.1.192/27 + 10.0.1.224/28

Further splits on more IP networks do not give benefits!!

Exercise 4: solution (2)

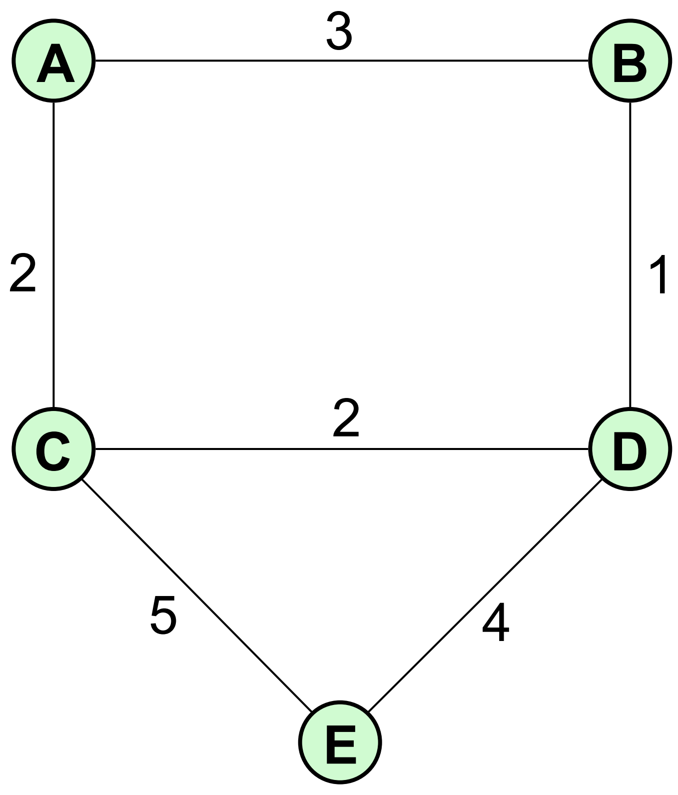
- All solutions are fine. The third one is a trade-off between the others, although the most rational is probably the first one!

Solution 3



Exercise 5

- Define the routing tree for all the nodes in the network below.



Exercise 5: solution

Node A

Destination	Next-hop
B	B
C	C
D	B/C
E	C

Node B

Destination	Next-hop
A	A
C	D
D	D
E	D

Node C

Destination	Next-hop
A	A
B	D
D	D
E	E

Node D

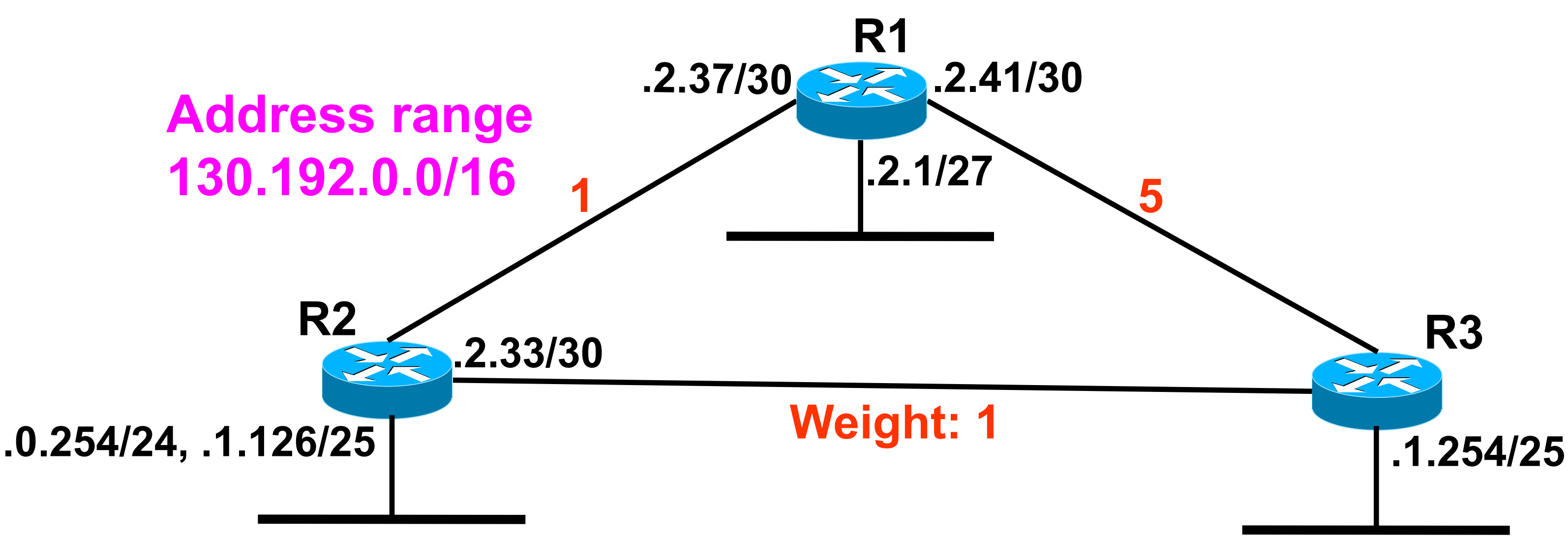
Destination	Next-hop
A	B/C
B	B
C	C
E	E

Node E

Destination	Next-hop
A	C
B	D
C	C
D	D

Exercise 6

- Given the network below, define the routing table of R1. Route aggregation has to be maximized. IP addresses in the figure are related to the closest interface of a given router.

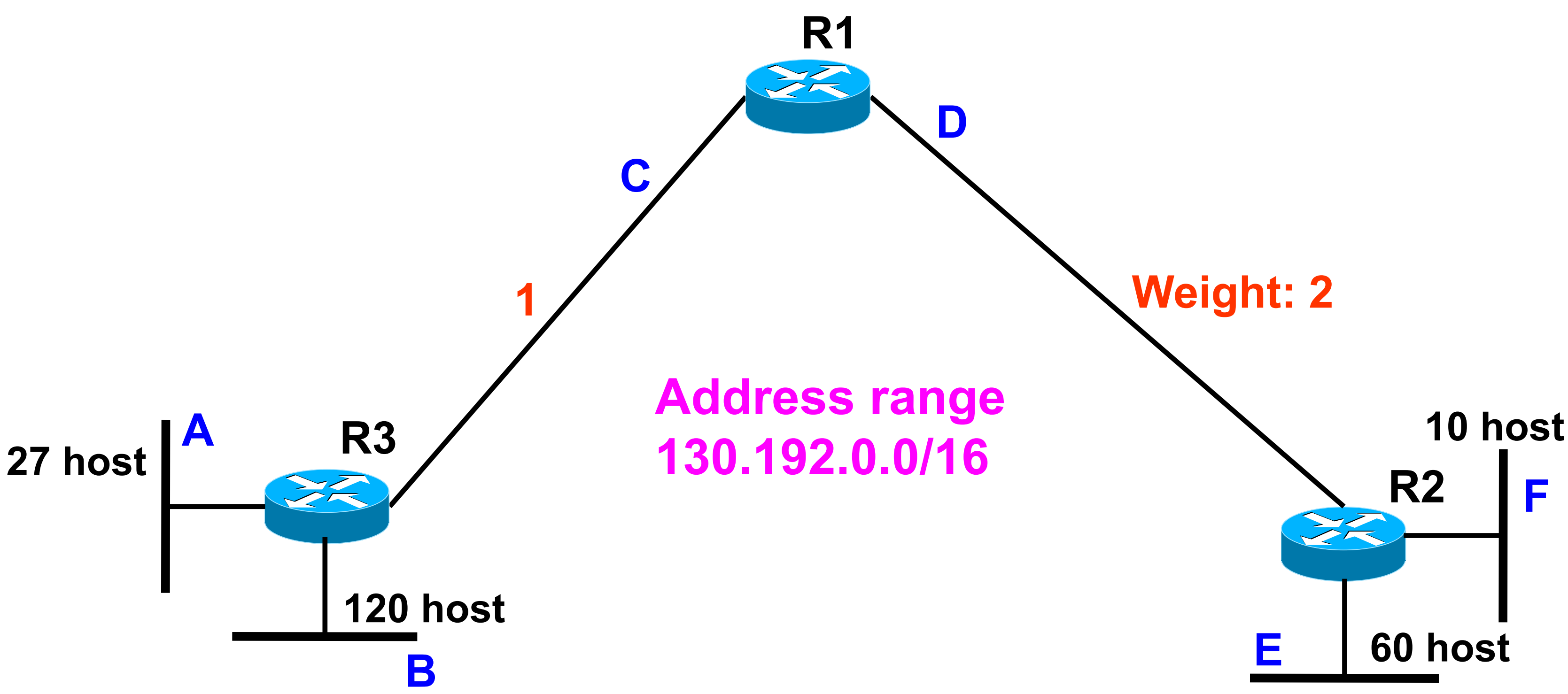


Exercise 6: solution

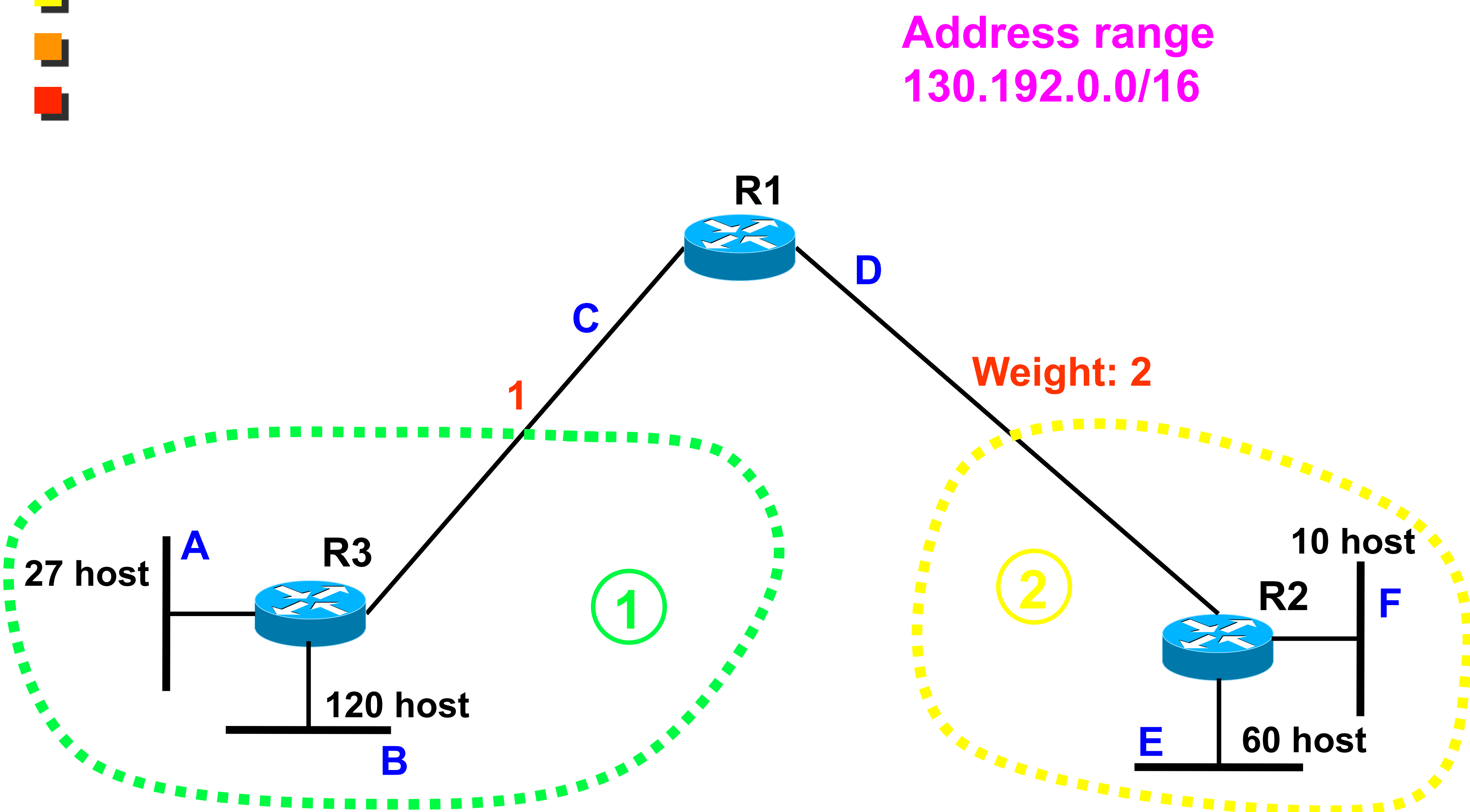
Type	*Destination*	*Next-hop*	*Cost*
S	0.0.0.0/0	130.192.2.38	2
D	130.192.2.0/27	130.192.2.1	1
D	130.192.2.36/30	130.192.2.37	1
D	130.192.2.40/30	130.192.2.41	1

Exercise 8

- Define an IP addressing plan that maximizes route aggregation on R1. Derive the resulting routing table of R1.



Exercise 8: solution



Exercise 8: solution

- Networks C and D are reachable from R1 using direct routes, thus not affecting aggregation on R1. Hence, we temporarily neglect them while evaluating the total amount of addresses required for the two defined areas.
  We obtain:
  - Area 1: 32 + 128 = 160 → 256 addresses
  - Area 2: 64 + 16 = 80 → 128 addresses
- We can therefore select the following address ranges:
  - Area 1: 130.192.0.0/24
  - Area 2: 130.192.1.0/25
- Networks C and D are now included in Area 1, which can contain two additional /30 networks.
  Notice that they would have been included in Area2 as well!

Exercise 8: solution

- By keeping in mind the general rule of minimizing the amount of deployed addresses (in this case within each area), we can apply the traditional methodology to define the following addressing plan:
- Area 1
  - B: 130.192.0.0/25
  - A: 130.192.0.128/27
  - C: 130.192.0.160/30
  - D: 130.192.0.164/30
- Area 2
  - E: 130.192.1.0/26
  - F: 130.192.1.64/28

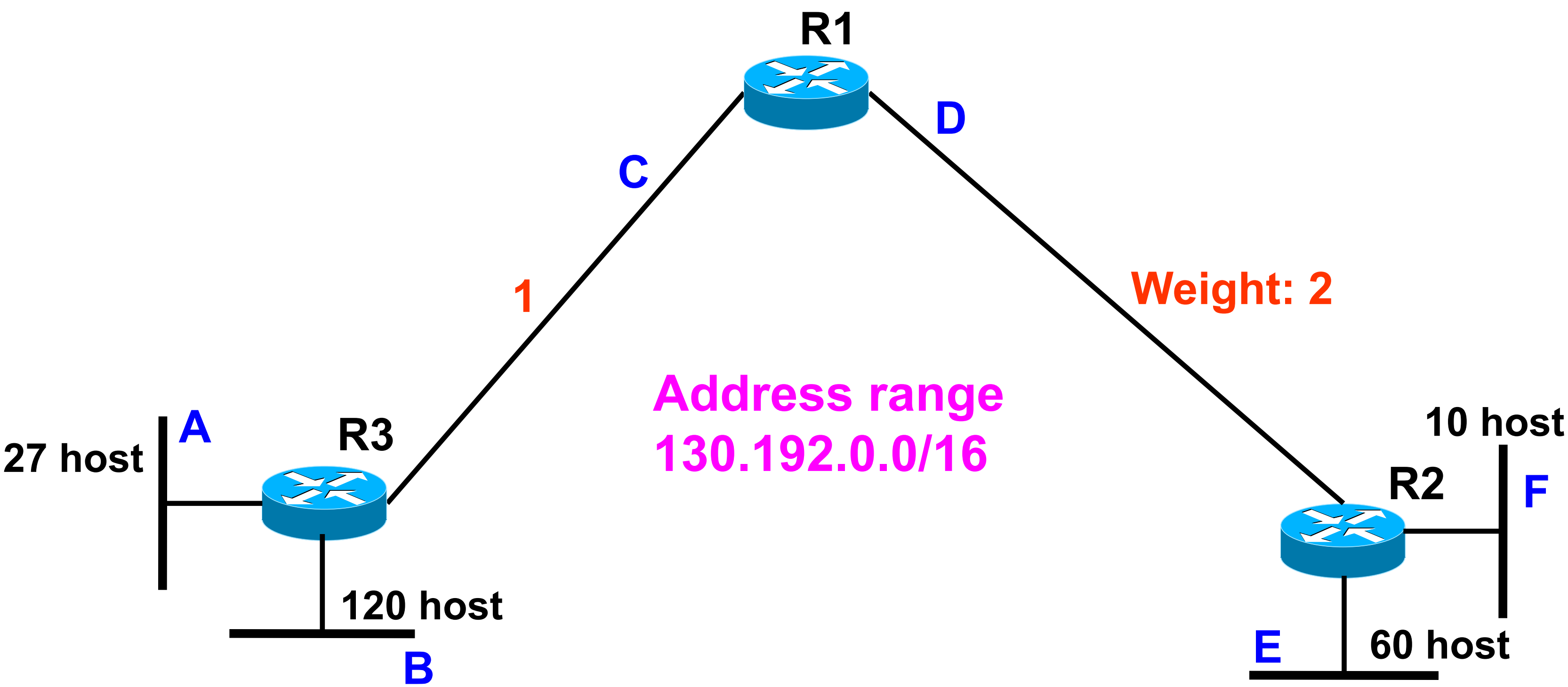
Exercise 8: solution

- We derive the following routing table for R1 (in this case we chose to avoid the utilization of the default route) :

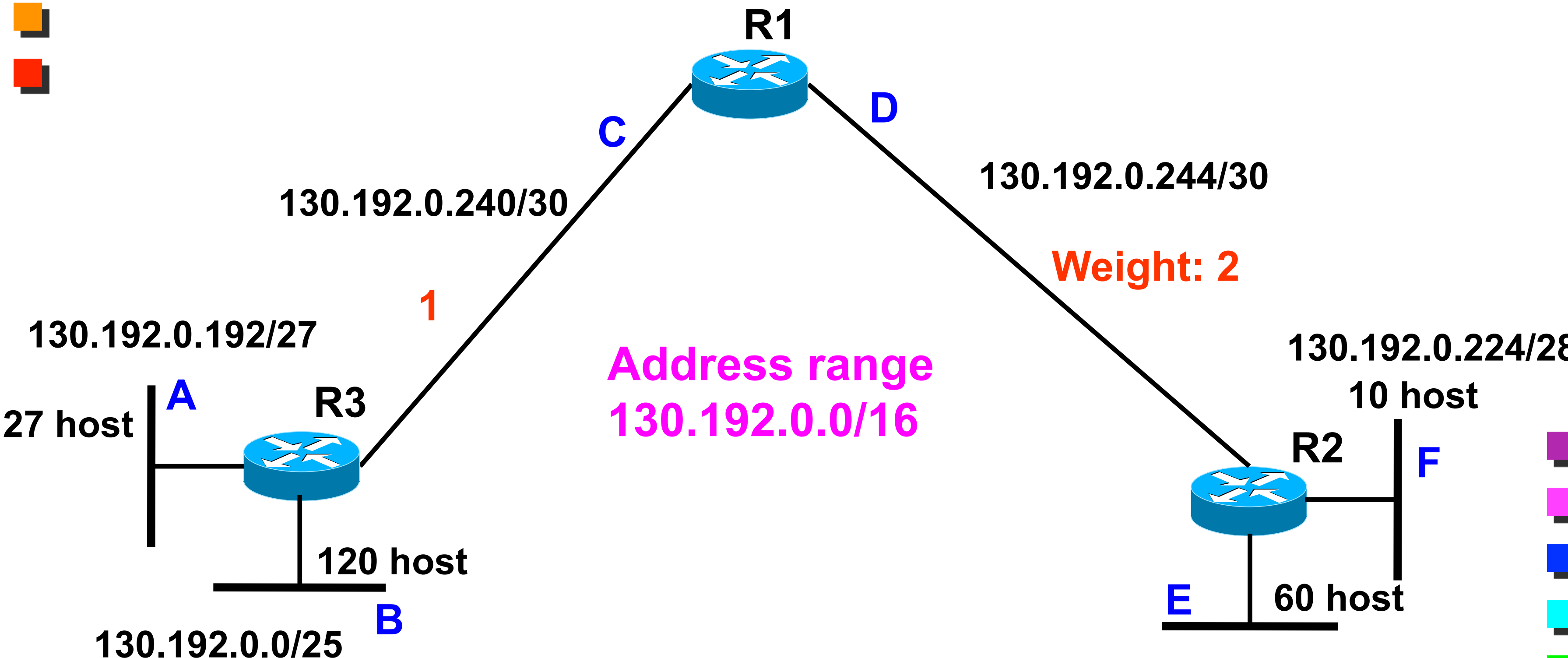
Type	*Destination*	*Next-hop*	*Cost*
S	130.192.0.0/24	130.192.0.161	2
S	130.192.1.0/25	130.192.0.165	2
D	130.192.0.160/30	130.192.0.162	1
D	130.192.0.164/30	130.192.0.166	1

Exercise 9

- Repeat the previous exercise by defining an IP addressing plan which minimizes the total amount of deployed addresses. Notice how the routing table of R1 changes with respect to the previous exercise.



Exercise 9: solution



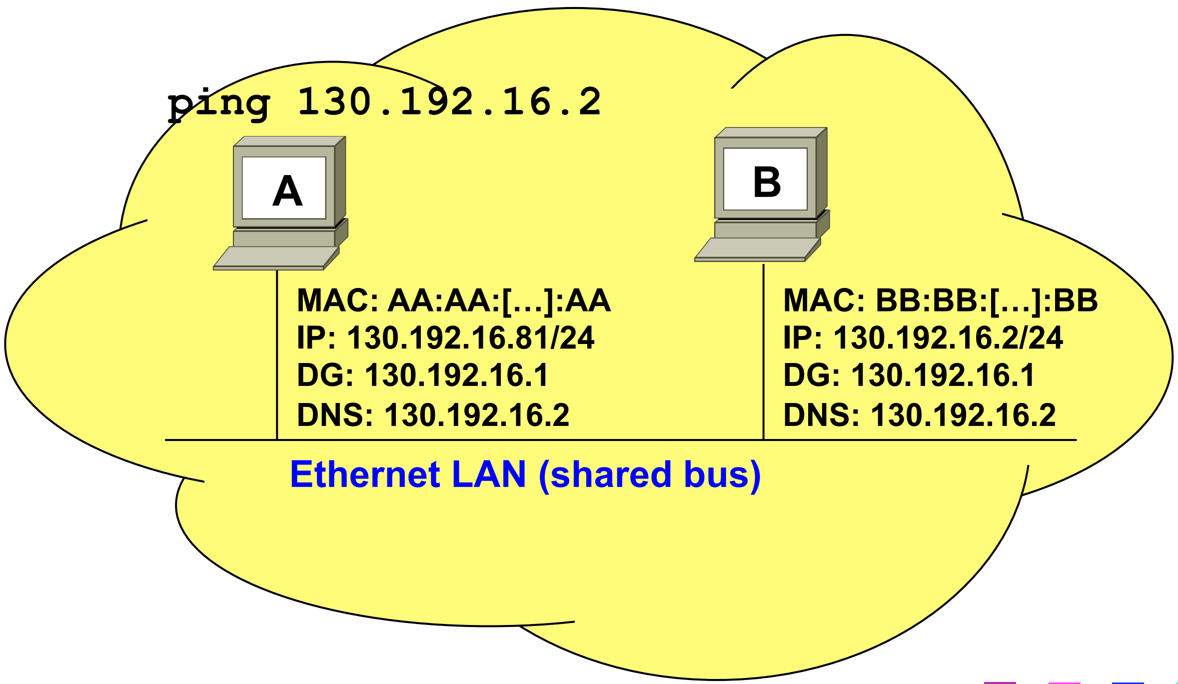
Exercise 9: solution

- R1 routing table:

Tipo	*Rete dest.*	*Gateway*	*Metrica*
S	**130.192.0.0/25**	**130.192.0.242**	**2**
S	**130.192.0.192/27**	**130.192.0.242**	**2**
S	**130.192.0.128/25**	**130.192.0.246**	**2**
D	**130.192.0.240/30**	**130.192.0.241**	**1**
D	**130.192.0.244/30**	**130.192.0.245**	**1**

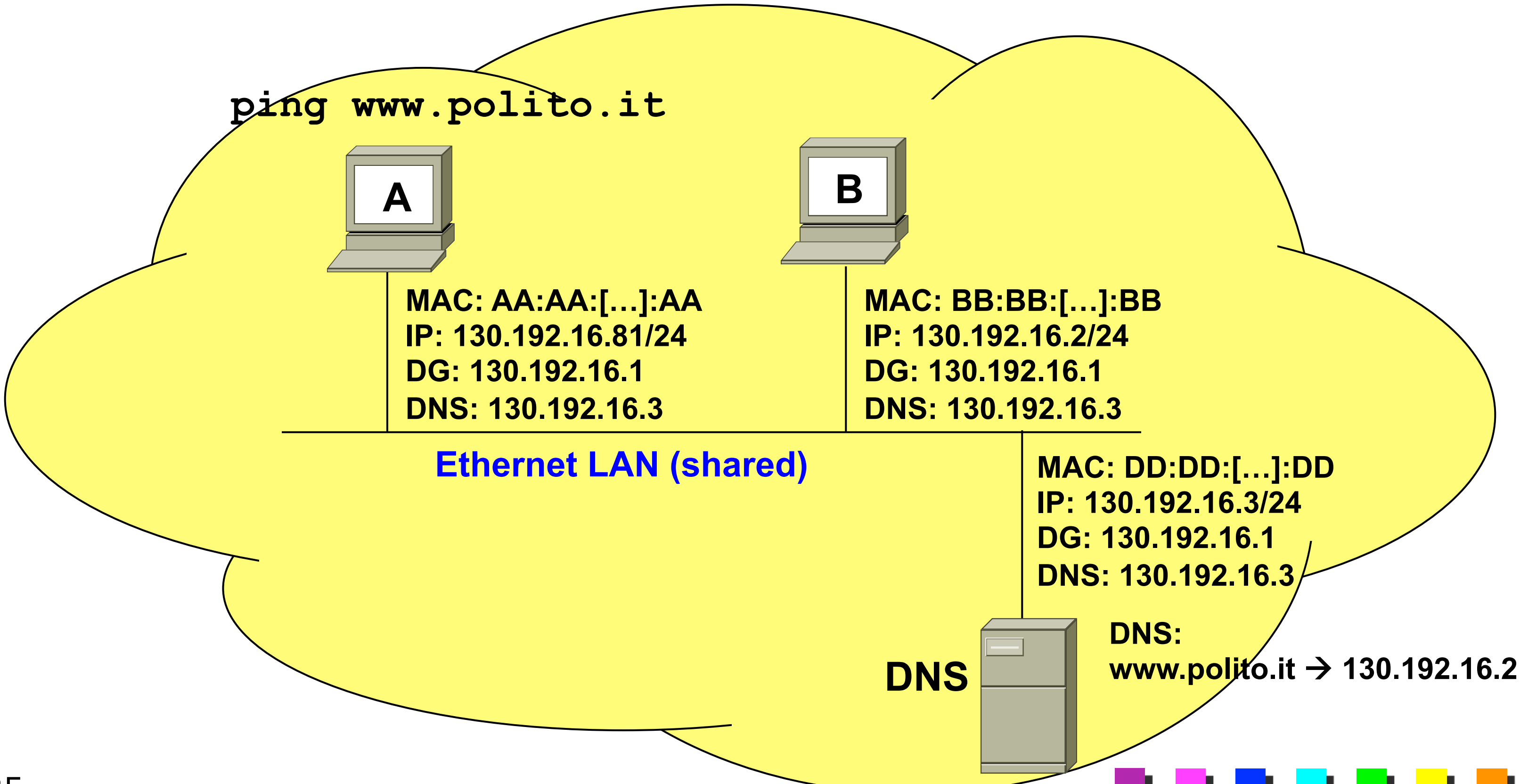
Exercise 10

- Assuming that all caches are empty, indicate the number and the type of the frames captured by a sniffer located on the network cable of Host A.
- Solution: 10 frames (if MS Windows host)



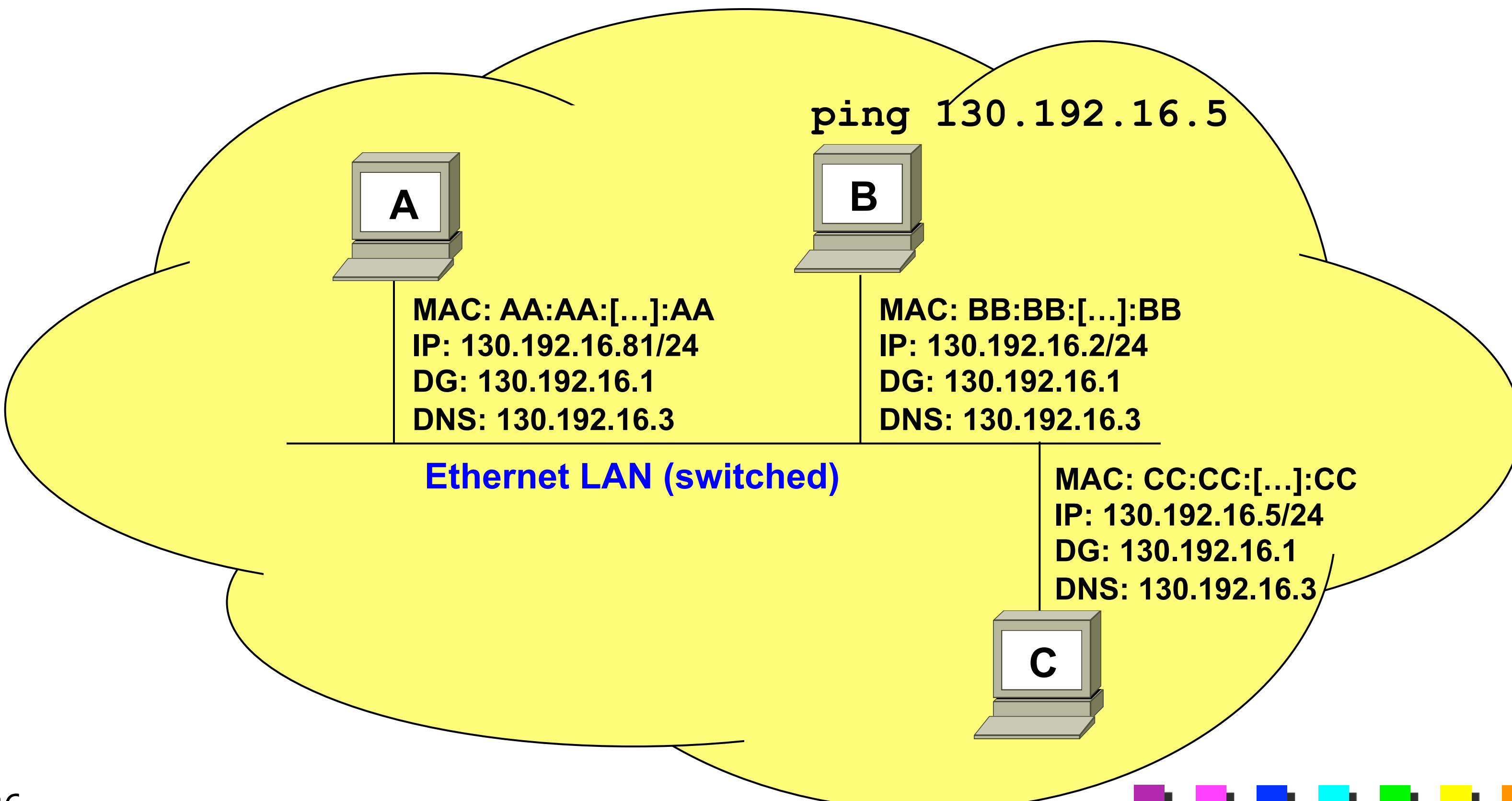
Exercise 10b

- Assuming that all caches are empty, indicate the number and the type of the frames captured by a sniffer located on the network cable of Host A.



Exercise 11

- Assuming that all caches are empty, indicate the number and the type of the frames captured by a sniffer located on the network cable of Host A.



Exercise 13

- Assuming that all caches are empty (except that of the DNS server), indicate the number and the type of the frames captured by a sniffer located on the network cable of Host A.
- Solution: 17 frames (if MS Windows host)