Universität des Saarlandes
Max Planck Institute for Informatics
Saarbrücken, Germany

Data Networks

Assignment 8

Niraj Premji Sorathiya (7002317, niso00001@stud.uni-saarland.de)
Mehrshad Lotfi Foroushani (2581840, mlotfi@mpi-sws.org)

30-06-2020

Data Networks

Summer Semester 2020

Max Planck Institute for Informatics

Prof. Anja Feldmann

Solution | Assignment 8 | Internet Architecture

Question I. MAC Addressing and ARP

1. Consider the topology above and assign MAC addresses. For simplicity, it is sufficient to provide the last 8 bits of the MAC address, i. e., two characters in HEX notation (e. g., AB) as long as they are unique. You do not have to assign MAC addresses to the “255 other hosts”.

> **Solution.**
> Figure 1 illustrates the topology given in the assignment with assigned MAC addresses and IP addresses. Only the last 8 bits of the MAC address varies in different interfaces.

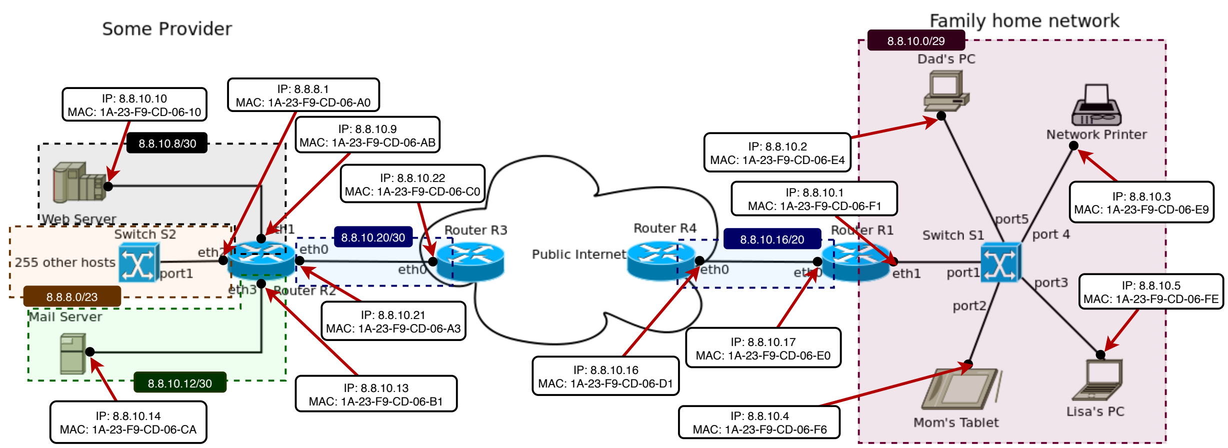

Figure 1: Topology with assigned MAC addresses and IP addresses.

2. In the topology, clearly mark any broadcast and collision domain. How do these domains change when switch S2 is replaced by a hub?

> **Solution.**
> Figure 2 demonstrates the broadcast domains in the topology. The broadcast domains will not change if we change switch S2 to a hub.
> Figure 3 illustrates the collision domains in the original topology. Note that each host (from the 255 other hosts) will form a separate collision domain. If switch S2 was replaced by a hub, then there would be only one collision domain for all of them (See Figure 4).

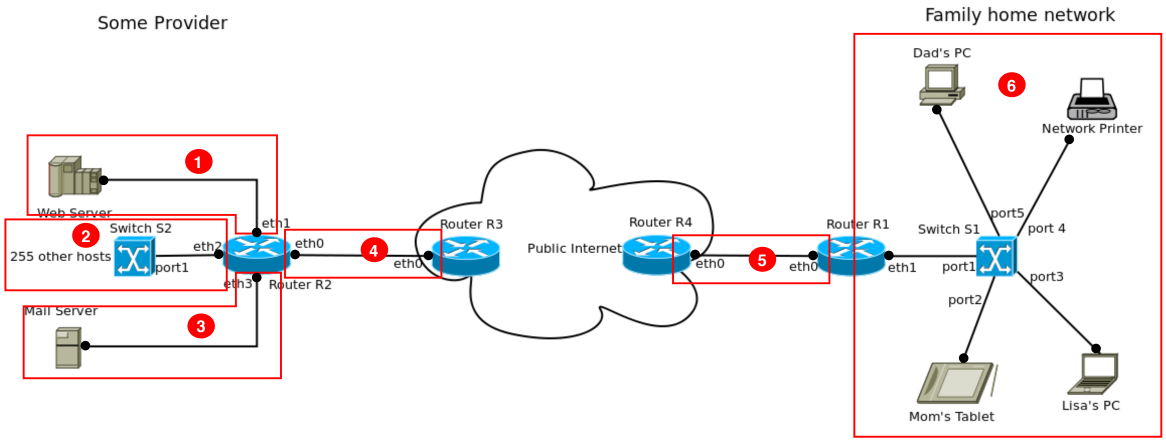

Figure 2: Broadcast domains in both the original topology and in the topology where switch S2 is replaced by a hub.

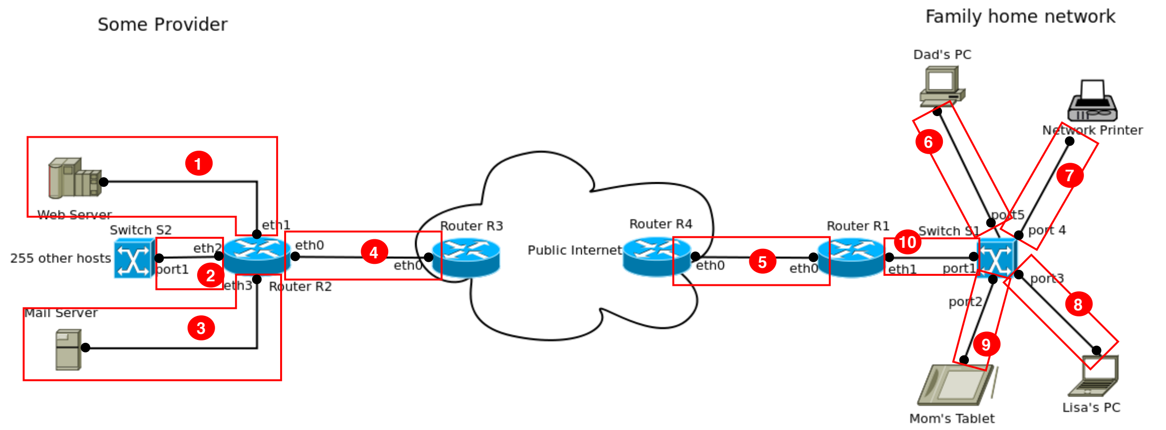

Figure 3: Collision domains the original topology.

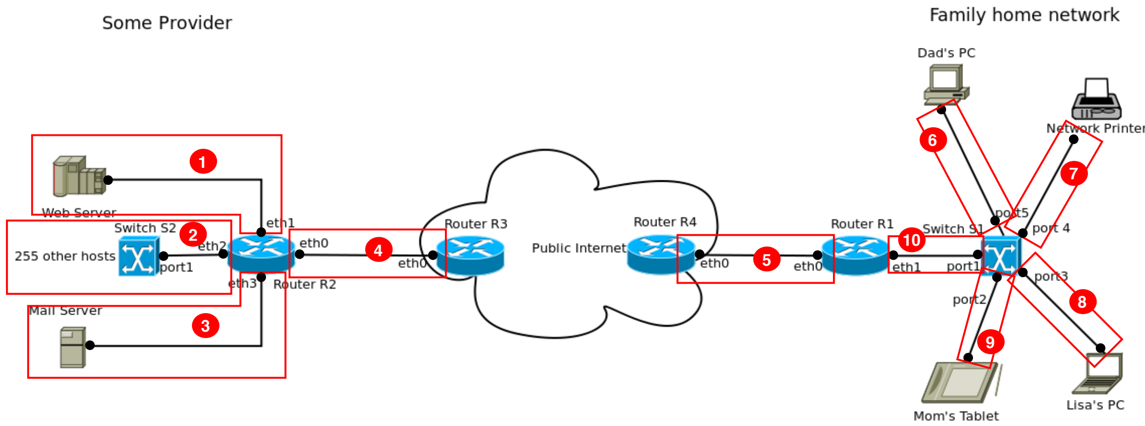

Figure 4: Collision domains when switch S2 is replaced by a hub.

3. Lisa wants to connect to the network printer via IP. Assume that all ARP caches in the network are empty. What are the IP and MAC address fields of the ARP messages exchanged to initiate the IP connection? Enter your results in a table as in Tab. 1 for LAN segments E and F.

Solution.
Table illustrates the messages exchanged to initiate the IP connection between Lisa and network printer in which Lisa starts the connection.

Table 1: ARP messages exchanged to initiate the IP connection when Lisa wants to connect to the network printer.

Index	LAN Segment	Source IP	Source MAC	Destination IP	Destination MAC
1	E	8.8.10.5	1A-23-F9-CD-06-FE	8.8.10.3	FF-FF-FF-FF-FF-FF
2	F, D, G, and H	8.8.10.5	1A-23-F9-CD-06-FE	8.8.10.3	FF-FF-FF-FF-FF-FF
3	F	8.8.10.3	1A-23-F9-CD-06-E9	8.8.10.5	1A-23-F9-CD-06-FE
4	E	8.8.10.3	1A-23-F9-CD-06-E9	8.8.10.5	1A-23-F9-CD-06-FE

4. What are the IP and MAC address fields of a response sent by the web server to Lisa's computer? Consider the response traversing all LAN segments drawn (A, B, C, D, E) and enter your result in a table as in Tab. 1.

Solution.
Table shows the packets exchanged in the network to send a response from the web server to Lisa's computer. We considered that all ARP cacehs in the network are empty.

Table 2: Packets exchanged in the topology to send a response from the web server to Lisa's computer, considering all ARP caches in the network are empty.

Index	LAN Segment	Source IP	Source MAC	Destination IP	Destination MAC
1	A	8.8.10.10	1A-23-F9-CD-06-10	8.8.10.9	FF-FF-FF-FF-FF-FF
2	A	8.8.10.9	1A-23-F9-CD-06-AB	8.8.10.10	1A-23-F9-CD-06-10
3	A	8.8.10.10	1A-23-F9-CD-06-10	8.8.10.5	1A-23-F9-CD-06-AB
4	B	8.8.10.21	1A-23-F9-CD-06-A3	8.8.10.22	FF-FF-FF-FF-FF-FF
5	B	8.8.10.22	1A-23-F9-CD-06-C0	8.8.10.21	1A-23-F9-CD-06-A3
6	B	8.8.10.21	1A-23-F9-CD-06-A3	8.8.10.22	1A-23-F9-CD-06-C0
7	C	8.8.10.16	1A-23-F9-CD-06-D1	8.8.10.17	FF-FF-FF-FF-FF-FF
8	C	8.8.10.17	1A-23-F9-CD-06-E0	8.8.10.16	1A-23-F9-CD-06-D1
9	C	8.8.10.16	1A-23-F9-CD-06-D1	8.8.10.17	1A-23-F9-CD-06-E0
10	D	8.8.10.1	1A-23-F9-CD-06-D1	8.8.10.5	FF-FF-FF-FF-FF-FF
11	E, F, G, and H	8.8.10.1	1A-23-F9-CD-06-D1	8.8.10.5	FF-FF-FF-FF-FF-FF
12	E	8.8.10.5	1A-23-F9-CD-06-FE	8.8.10.1	1A-23-F9-CD-06-D1
13	D	8.8.10.5	1A-23-F9-CD-06-FE	8.8.10.1	1A-23-F9-CD-06-D1
14	D	8.8.10.1	1A-23-F9-CD-06-D1	8.8.10.5	1A-23-F9-CD-06-FE
15	E	8.8.10.1	1A-23-F9-CD-06-D1	8.8.10.5	1A-23-F9-CD-06-FE

ASSIGNMENT-8

Question 2: (2 + 0.5 + 1 + 0.5 = 4 points) Neighbor Discovery in IPv6
We will now consider the Neighbor Discovery in IPv6. Use Wireshark to open the trace u08-ipv6nd.pcap1 and answer the following questions.

(a) Explain the purpose of each packet in the trace (except the packets that belong to TCP connections) with one or two short sentences. Give a short summary about the purpose of the TCP connections.
Solution :

1) ICMPv6 -Neighbor Solicitation(NS) – Host try's to find out neighbor by sending NS packet at the destination IP which is a Multicast IP
2) ICMPv6 -Neighbor Advertisement(NA)- Host responds to the NS packet by sending NA packet which includes mainly IP and MAC address
3) There are few TCP packets which are lost
4) The purpose of the TCP connection is to make a request for "hny.jpg"

```
GET /hny.jpg HTTP/1.1
Host: hedwig.inet.tu-berlin.de:8080
User-Agent: Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:20.0) Gecko/20100101 Firefox/20.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Connection: keep-alive
```

(b) How many Neighbor Discoveries are in the trace and where do they occur?
Solution:

1. There are two Neighbor Discovery in the trace and also they occur in LAN

npv6

	Time	Source	Seque	Destination	Protocol	Lengt	Info
1	17:10:45,821958	2001:470:96b9:1:20b2:e332:830f:c769		ff02::1:fff3:978c	ICMPv6	86	Neighbor Solicitation for 2001
2	17:10:45,822070	2001:470:96b9:1:816a:71c4:f4f3:978c		2001:470:96b9:1:20b2:e332:830f:c769	ICMPv6	86	Neighbor Advertisement 2001:47
163	17:10:51,058074	2001:470:96b9:1:816a:71c4:f4f3:978c		2001:470:96b9:1:20b2:e332:830f:c769	ICMPv6	86	Neighbor Solicitation for 2001
164	17:10:51,058297	2001:470:96b9:1:20b2:e332:830f:c769		2001:470:96b9:1:816a:71c4:f4f3:978c	ICMPv6	78	Neighbor Advertisement 2001:47

(c) Why are packets in the trace sufficient to populate the IPv6 neighbor cache of the hosts involved? Assume that the IPv6 neighbor cache was empty at the beginning of the trace.
Solution:
The data for the fields highlighted below is needed to populate neighbor cache table. Since both the hosts in the trace have sent NS packet and received NA packet they have all details to fill their own **neighbor cache** table. Hence, packets in the trace are **sufficient to populate the IPv6 neighbor cache**

Internet Address	Physical Address	Type

(d) Comparing Neighbor Discovery in IPv6 and ARP in IPv4, at which layer of the network stack do they operate?
Solution:
NDP and ARP operates at link layer.

Comparing Neighbor Discovery in IPv6 and ARP in IPv4 [1]:

1. Router discovery is the part of IPV6 whereas IPv4 uses ARP , ICMP for router discovery
2. IPv6 router advertisements consists local link address so no need to send any additional packet as in IPv4
3. IPv6 router advertisements consists MTU for hosts to use on link whereas IPV4 hosts might use different MTU
4. IPv6 router advertisements consists prefixes of the link and no separate mechanism is needed to configure netmask as in IPv4
5. NDP detects the reachability of the hosts and avoids sending packets if the host is unavailable whereas this is not possible in ARP

References:

1. https://docs.oracle.com/cd/E19082-01/819-3000/chapter1-41/index.html