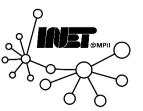


Homework 8



Get the Slides here



URI



Data Networks

Homework Overview

- MAC Addressing
- Wireshark

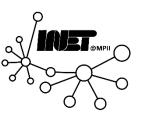




Question 1



We are given a topology containing four routers R1, R2, R3 and R4, together with two switches S1 and S2 and multiple hosts. Each host has only one networking interface, the router interfaces are labelled eth_i and ports of the switches as $port_i$.



Question 1



We are given a topology containing four routers R1, R2, R3 and R4, together with two switches S1 and S2 and multiple hosts. Each host has only one networking interface, the router interfaces are labelled eth_i and ports of the switches as $port_i$.







Consider the following topology and allocate unique MAC addresses to all devices. The 280 connected to S2 other hosts can be omitted. If a device does not have a MAC address, put a dash "-".

Device Name	MAC address
Web Server	xx:xx:xx:xx:xx



Data Networks





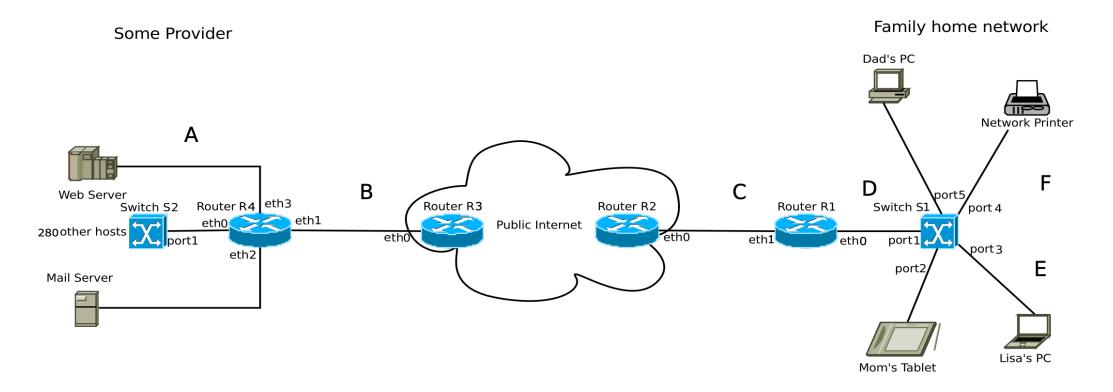
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Web Server	xx:xx:xx:xx:xx



Data Networks



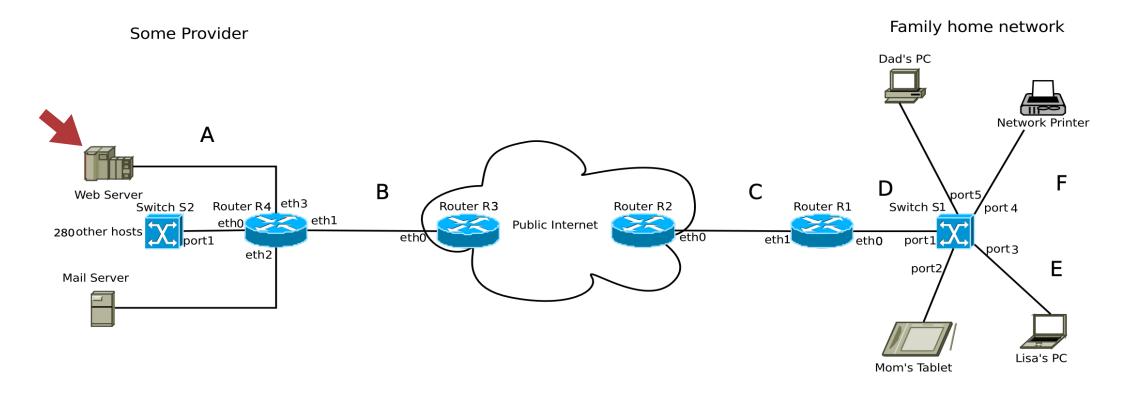




Data Networks

MAC Addressing

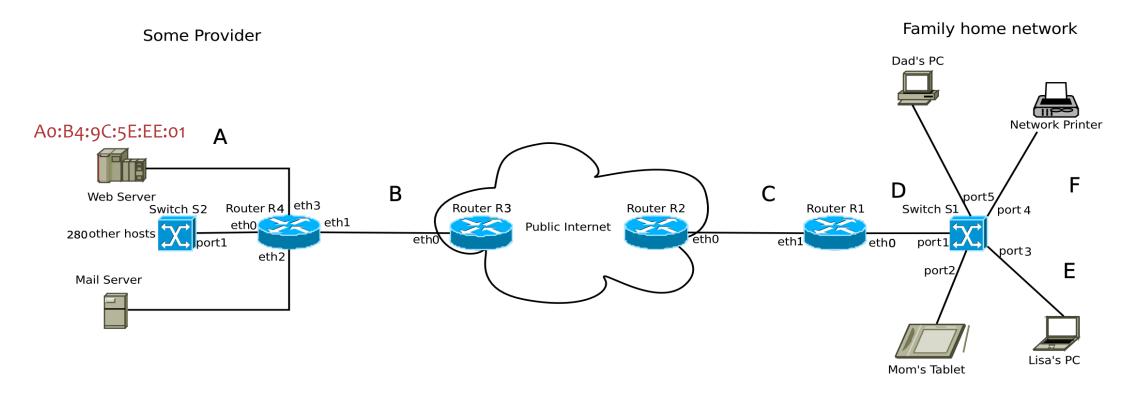






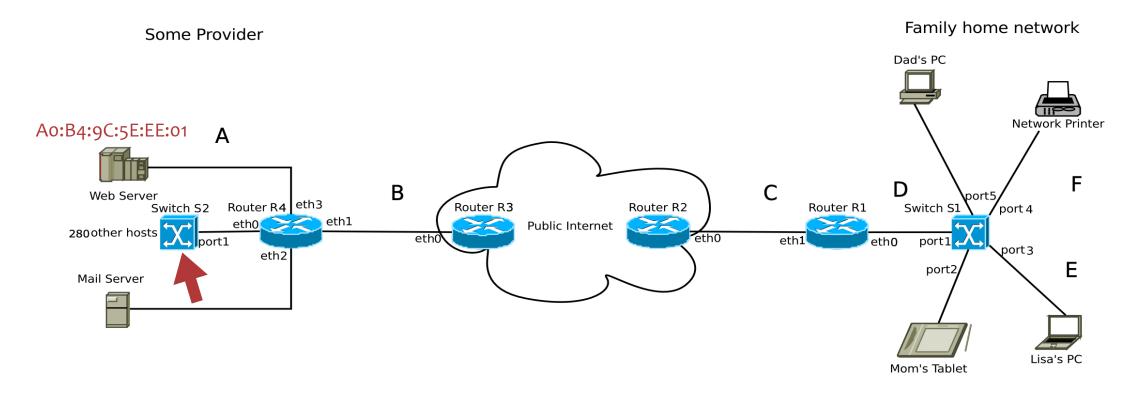
Data Networks









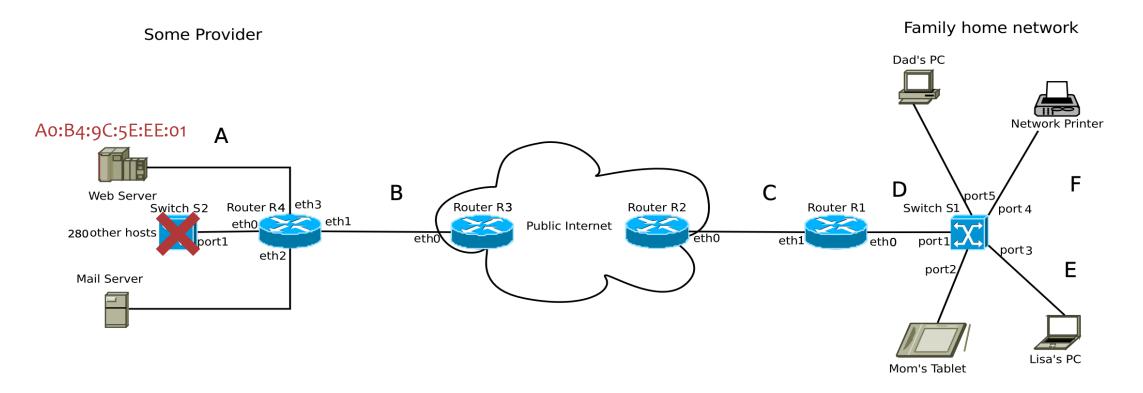




Data Networks

MAC Addressing

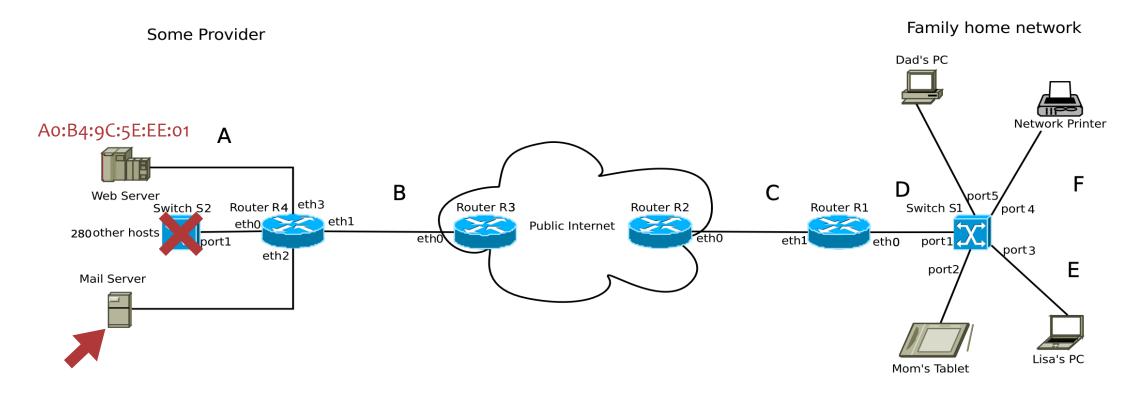






Data Networks

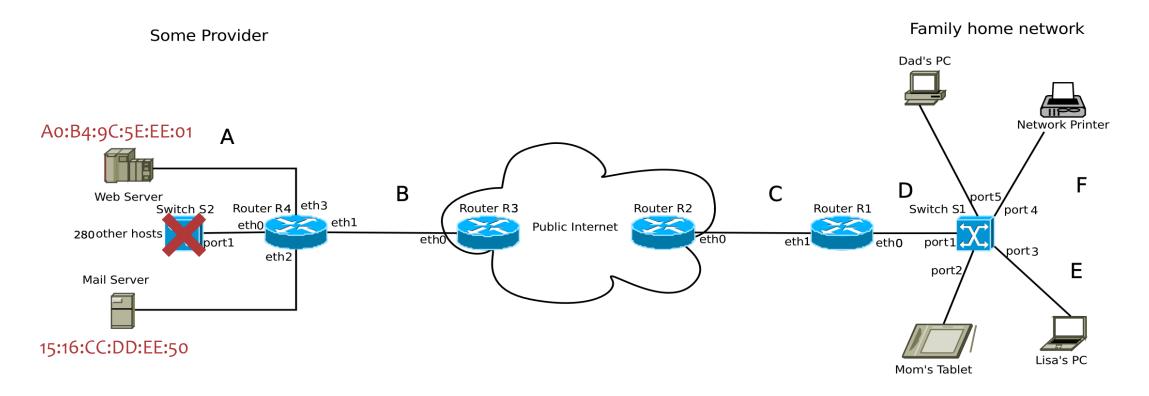


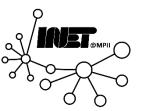




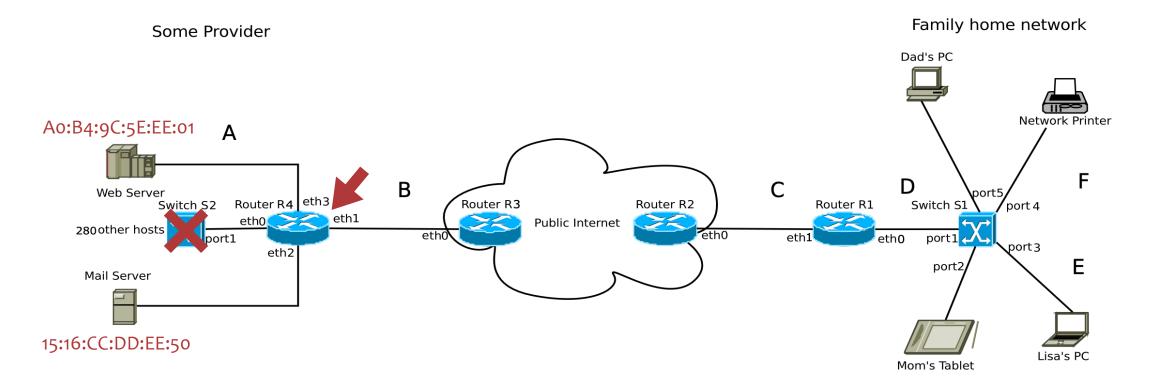
Data Networks





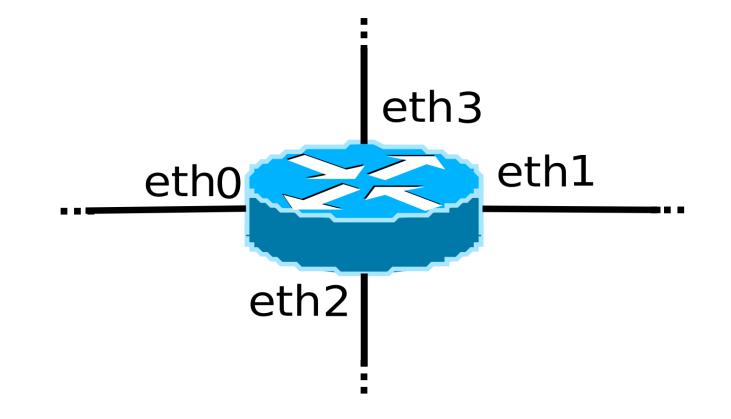


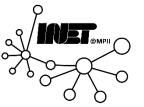




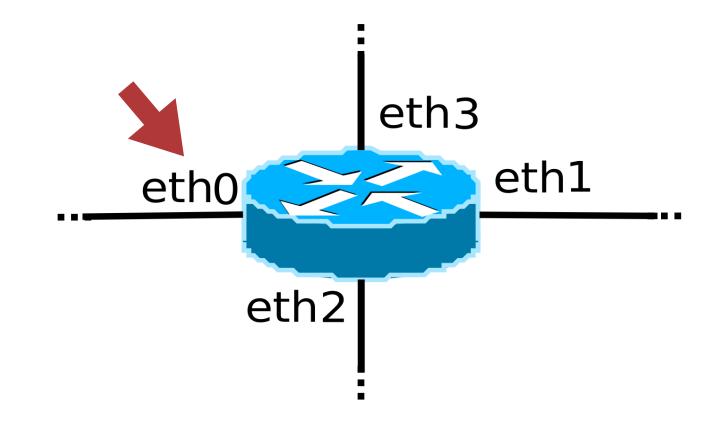


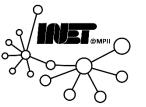




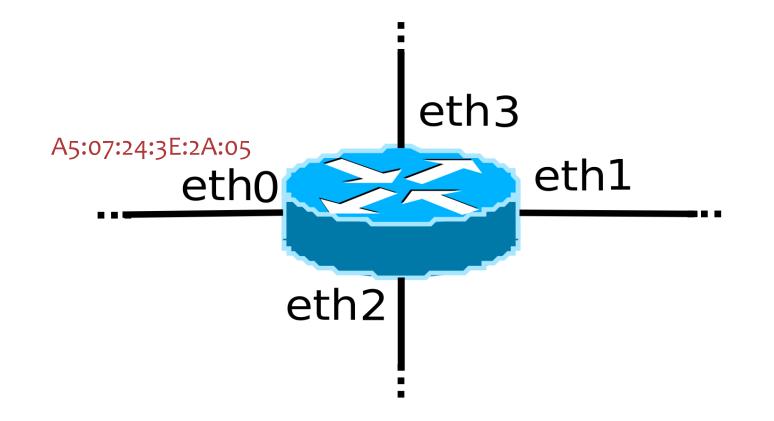


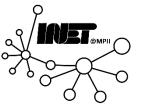




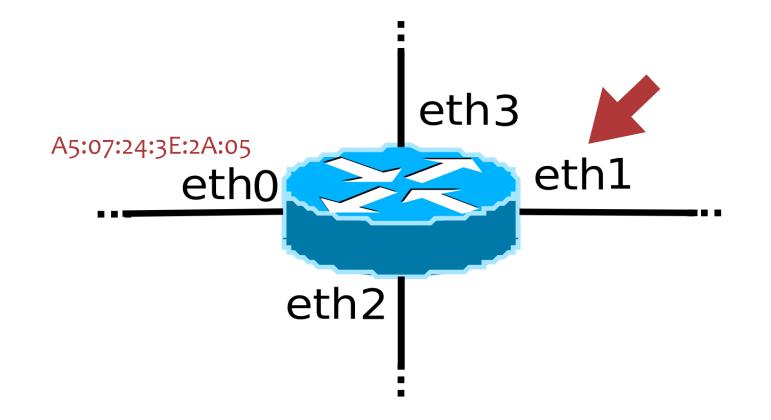


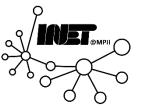




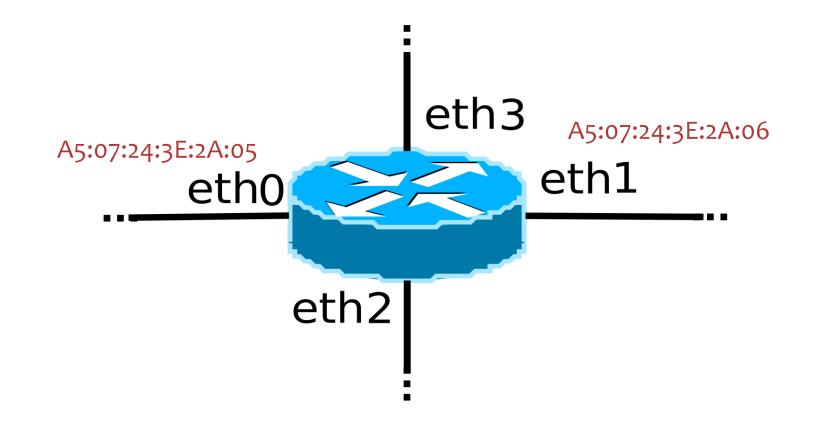




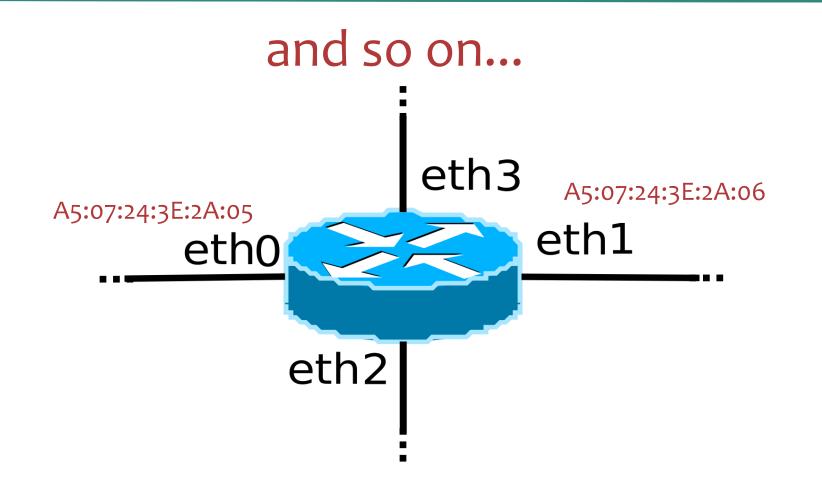






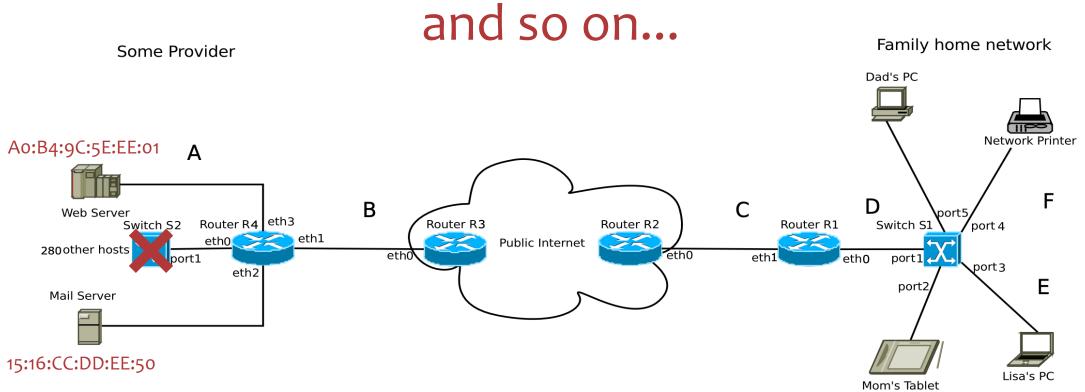








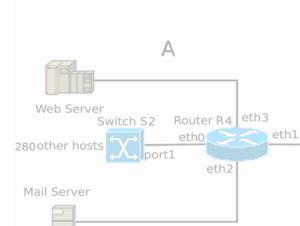




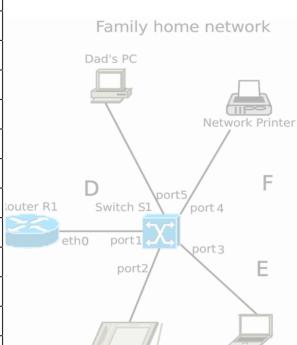


Some Provider

Question 1a



MAC address
A0:B4:9C:5E:EE:01
-
15:16:CC:DD:EE:50
A5:07:24:3E:2A:05
A5:07:24:3E:2A:06
2F:EC:05:00:01:ED
2F:EC:05:00:01:EC
55:00:11:DD:EE:01
55:00:11:DD:EE:02
55:00:11:DD:EE:03
55:00:11:DD:EE:04
-
07:44:3A:22:E0:84
AE:10:8E:BB:9A:05
07:44:3A:22:E0:85
E2:49:2A:34:E8:7A



Mom's Tablet



Data Networks

MAC Addressing

Lisa's PC





Enumerate all broadcast domains in the given topology and list the devices that belong to that domain.

Broadcast Domain Number	Domain's Devices
1	••••, •••



Data Networks





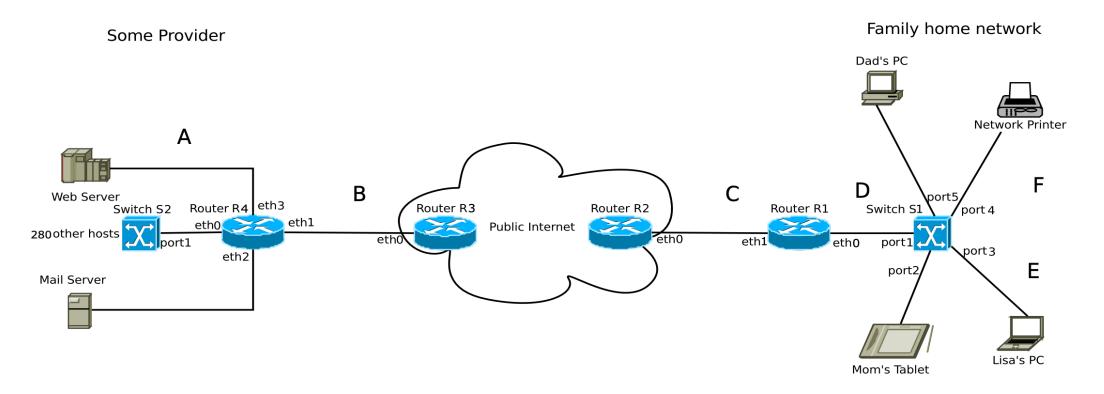
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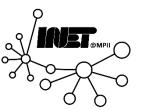
Broadcast Domain Number	Domain's Devices
1	,



Data Networks

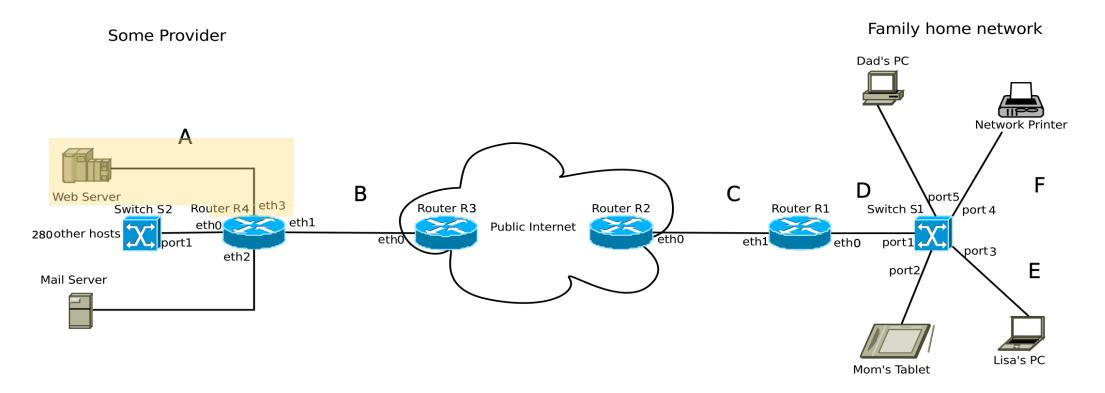






Data Networks

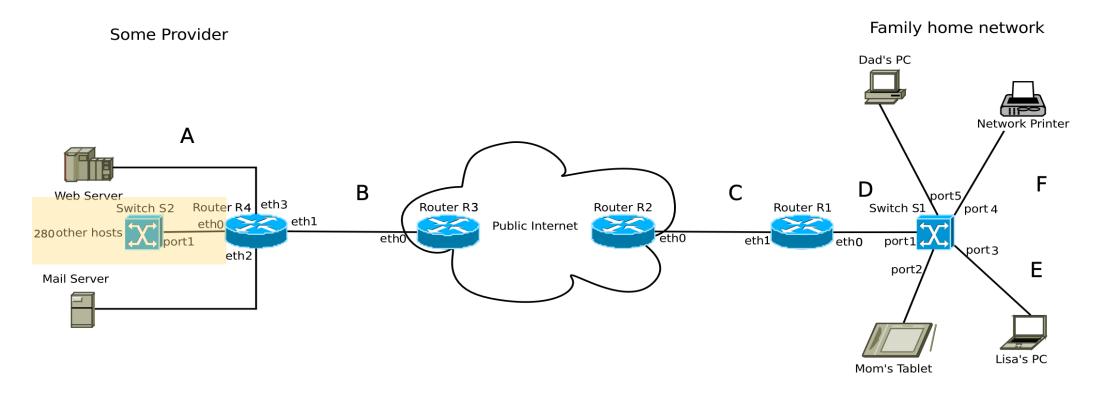






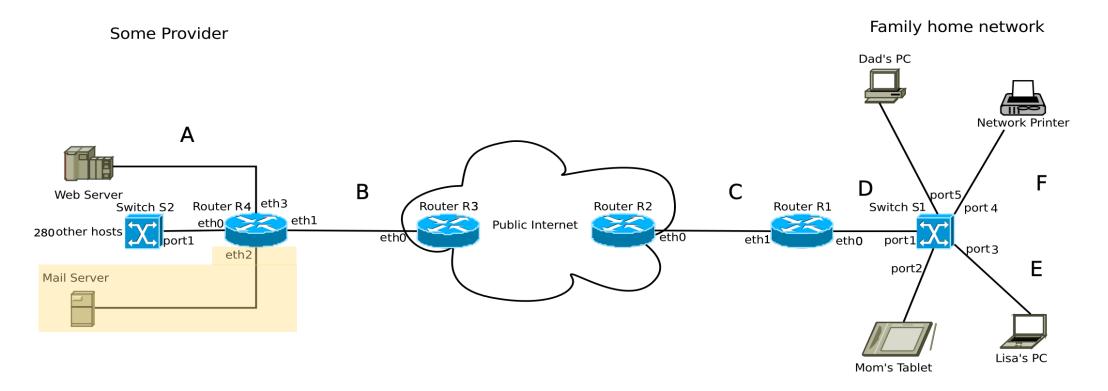
Data Networks







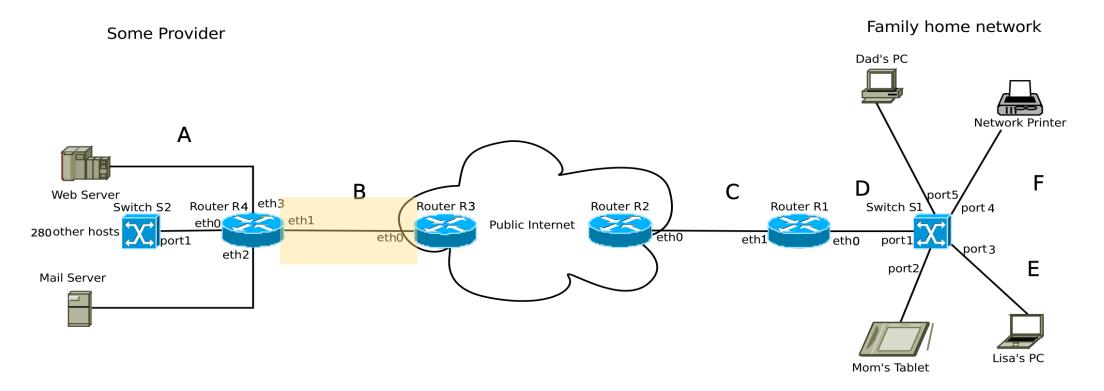






Data Networks



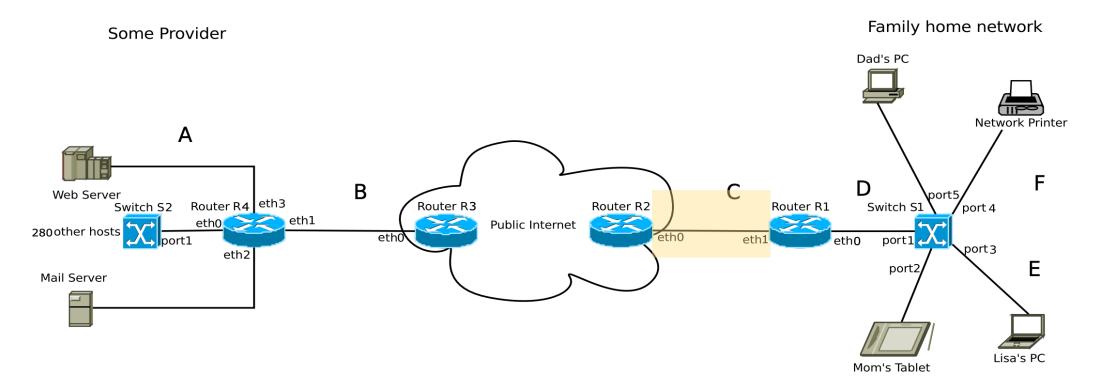




Data Networks

MAC Addressing



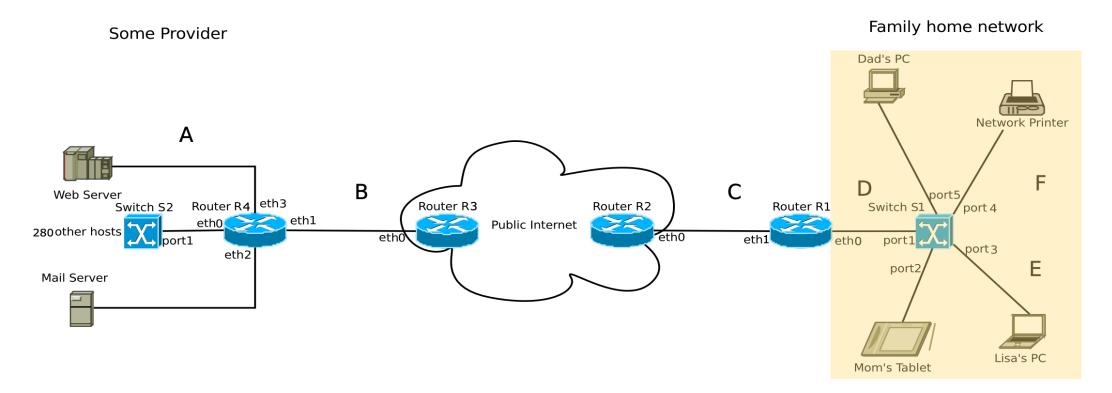




Data Networks

MAC Addressing



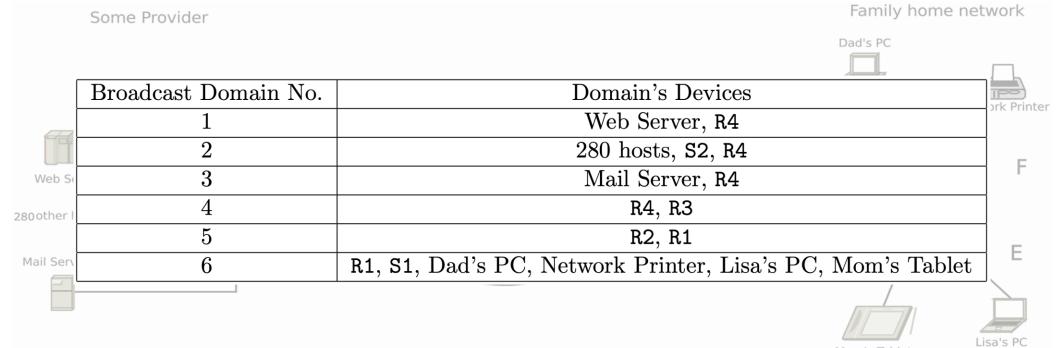




Data Networks

MAC Addressing





Mom's Tablet







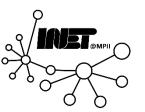
Assume that S1 is replaced by a hub H1 to form the same topology. How do the broadcast and collision domains change in that subnet?







Assume that S1 is replaced by a hub H1 to form the same topology. How do the broadcast and collision domains change in that subnet?







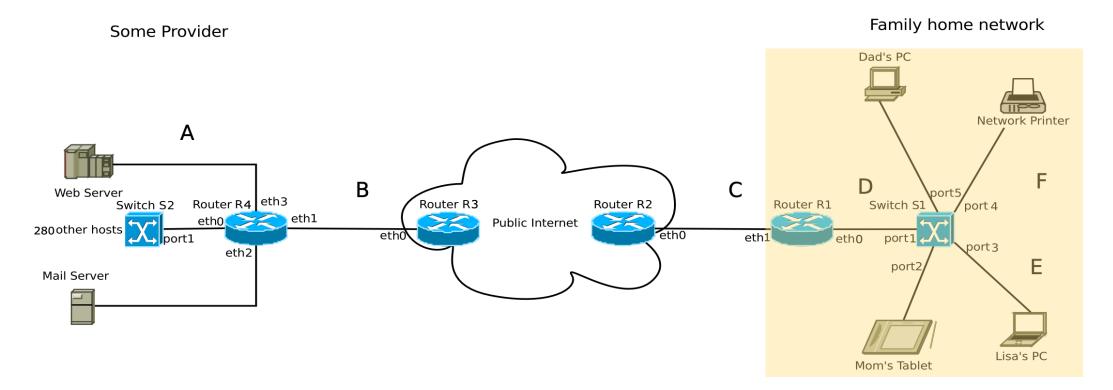
Assume that S1 is replaced by a hub H1 to form the same topology. How do the broadcast and collision domains change in that subnet?

Answer:

No changes to broadcast domain. The connected devices R1, H1, Dad's PC, Network Printer, Lisa's PC and Mom's Tablet do now form a collision domain.









Data Networks



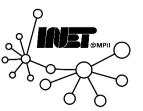








i) Router R1:







i) Router R1:

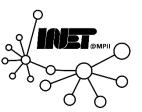
Strips the Ethernet frame and passes the packet to layer 3. The IP packet is encapsulated in an Ethernet frame with a modified MAC address. The TCP header is not changed (unless fragmentation is needed).







ii) Switch S1:







ii) Switch S1:

The switch does not change the packet, it is transparent to the devices in the network.







Lisa wants to connect to the Network Printer via IP using her PC. Assume that all ARP caches in the network are empty. Enter the IP and MAC address fields of the ARP messages into the following table:

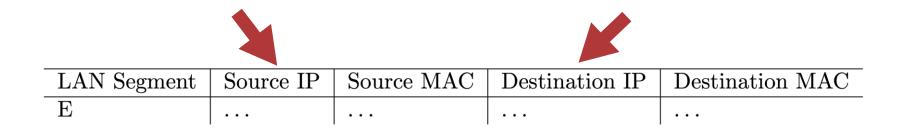
LAN Segment	Source IP	Source MAC	Destination IP	Destination MAC
Е	•••			







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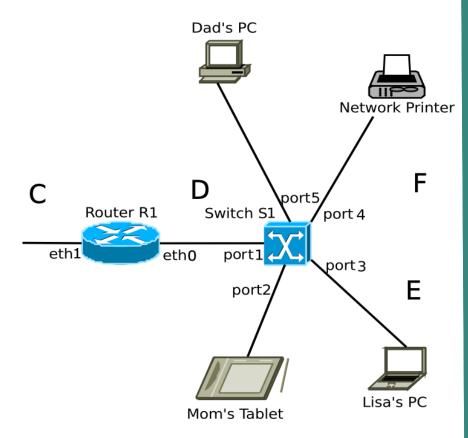


We used IP addresses from Homework 6!





Family home network

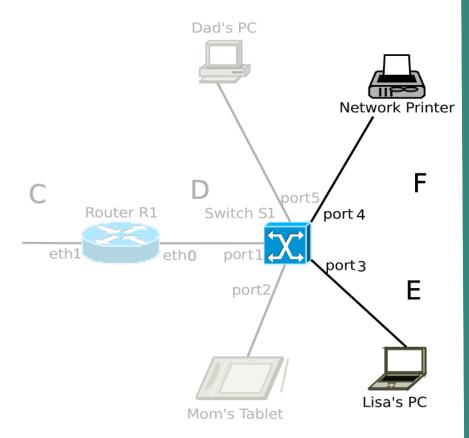


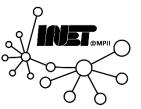


Data Networks

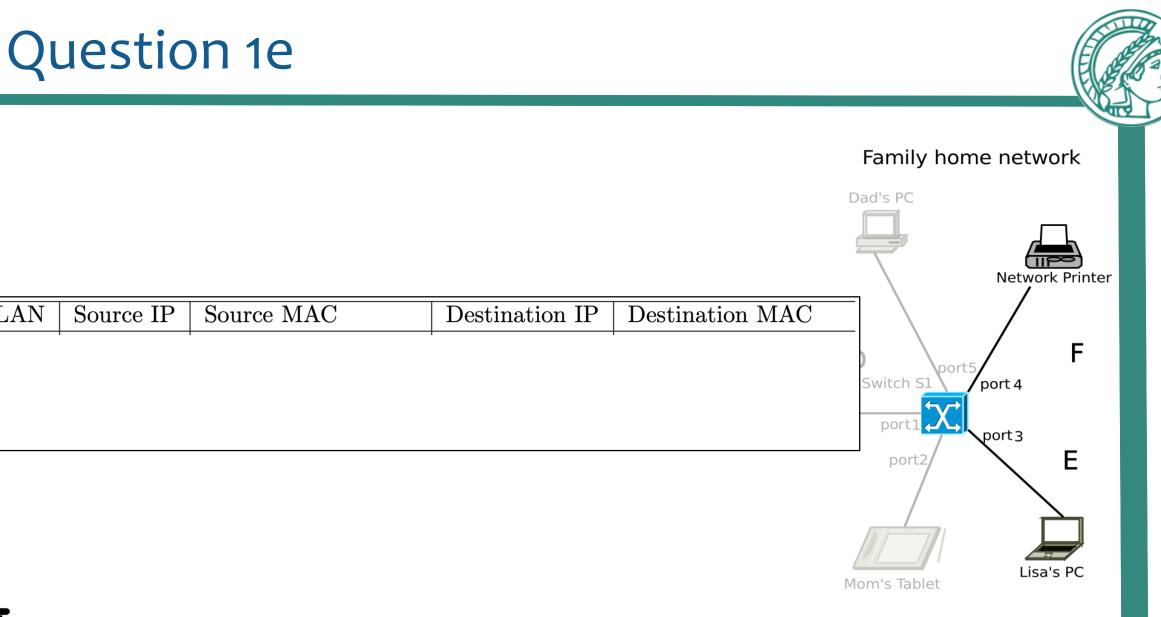


Family home network



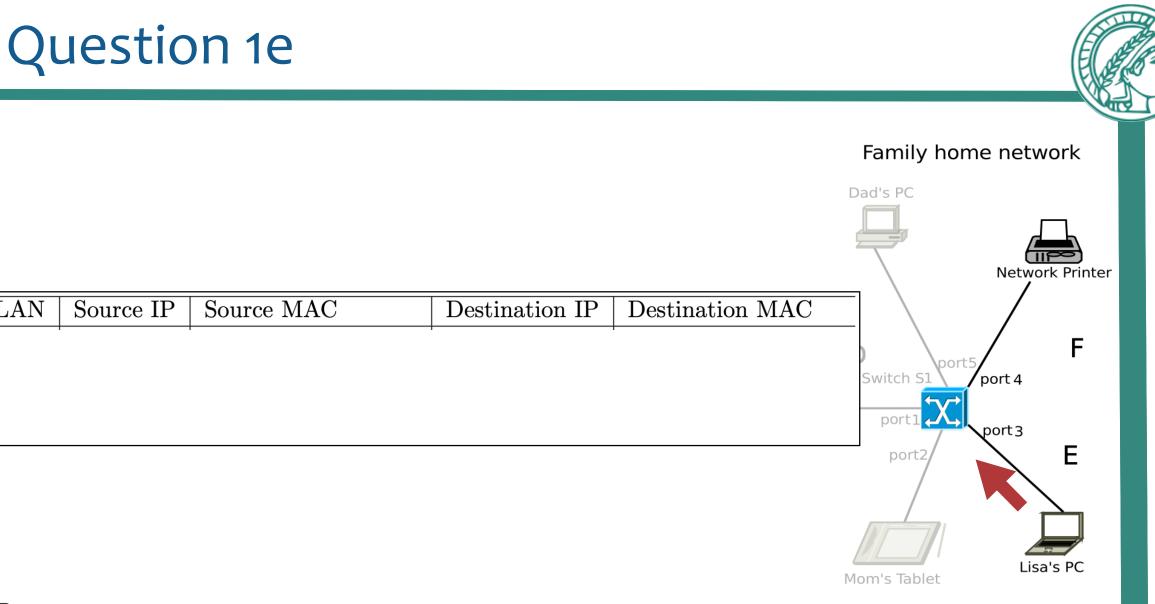


Data Networks





LAN

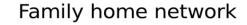


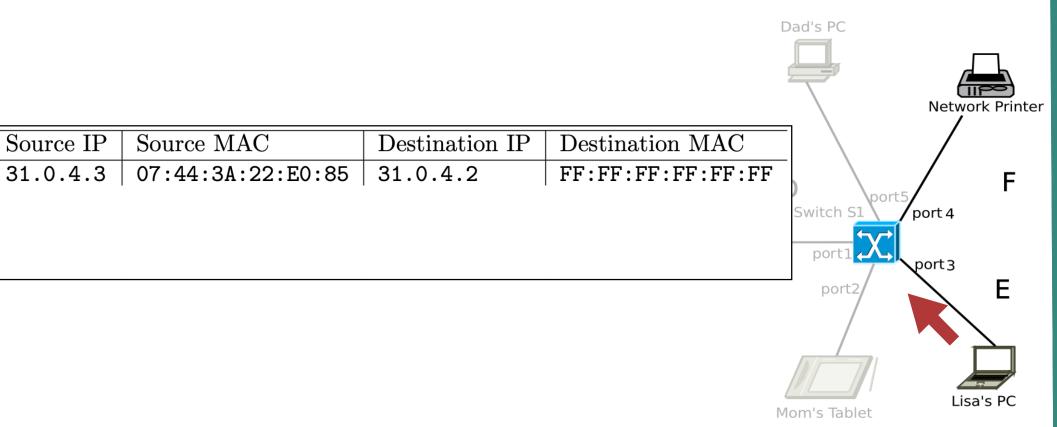


LAN











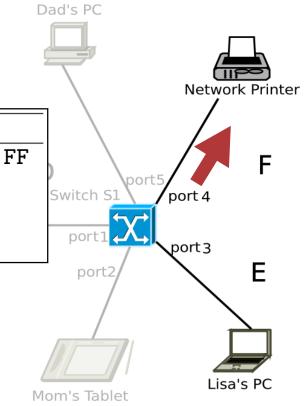
LAN

Ε





Family home network

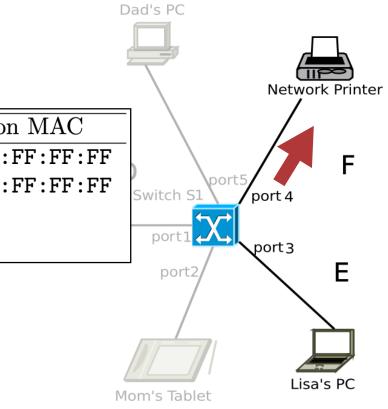


LAN	Source IP	Source MAC	Destination IP	Destination MAC	
Е	31.0.4.3	07:44:3A:22:E0:85	31.0.4.2	FF:FF:FF:FF:FF	
					Switch S
					port1
					port

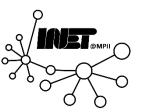




Family home network

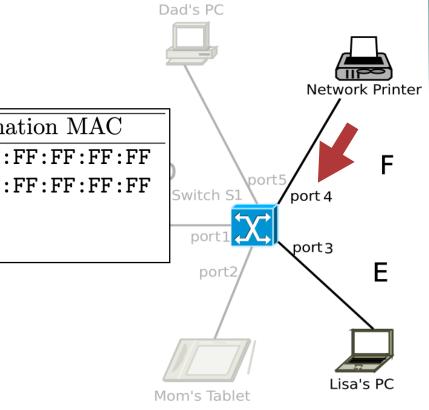


LAN	Source IP	Source MAC	Destination IP	Destination MAC	
Е	31.0.4.3	07:44:3A:22:E0:85	31.0.4.2	FF:FF:FF:FF:FF	
\mathbf{F}	31.0.4.3	07:44:3A:22:E0:85	31.0.4.2	FF:FF:FF:FF:FF) Switch S
					port1
					port

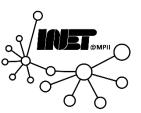




Family home network



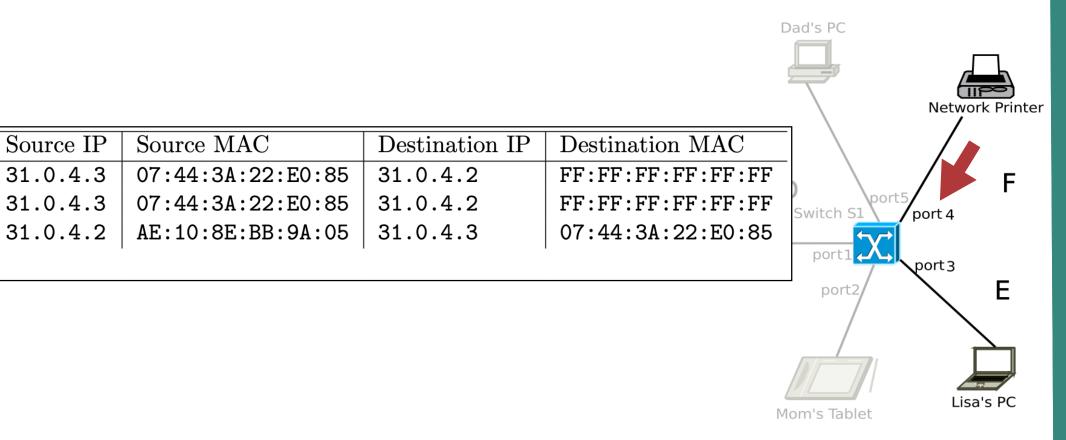
LAN	Source IP	Source MAC	Destination IP	Destination MAC	
Е	31.0.4.3	07:44:3A:22:E0:85	31.0.4.2	FF:FF:FF:FF:FF	
F	31.0.4.3	07:44:3A:22:E0:85	31.0.4.2	FF:FF:FF:FF:FF) Switch S
					port1



Data Networks



Family home network





LAN

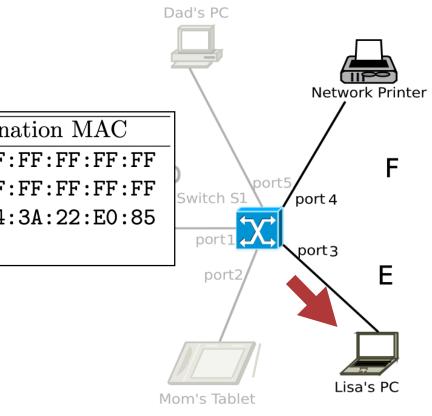
Ε

 \mathbf{F}

F



Family home network

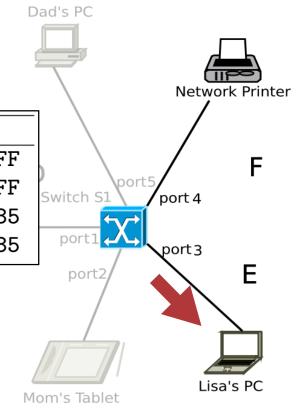


LAN	Source IP	Source MAC	Destination IP	Destination MAC	
Е	31.0.4.3	07:44:3A:22:E0:85	31.0.4.2	FF:FF:FF:FF:FF	
F	31.0.4.3	07:44:3A:22:E0:85	31.0.4.2	FF:FF:FF:FF:FF) Switcl
F	31.0.4.2	AE:10:8E:BB:9A:05	31.0.4.3	07:44:3A:22:E0:85	0 11 10
· · · · ·	I	I	I	1	por

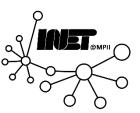




Family home network



LAN	Source IP	Source MAC	Destination IP	Destination MAC
Е	31.0.4.3	07:44:3A:22:E0:85	31.0.4.2	FF:FF:FF:FF:FF
F	31.0.4.3	07:44:3A:22:E0:85	31.0.4.2	FF:FF:FF:FF:FF
F	31.0.4.2	AE:10:8E:BB:9A:05	31.0.4.3	07:44:3A:22:E0:85
E	31.0.4.2	AE:10:8E:BB:9A:05	31.0.4.3	07:44:3A:22:E0:85





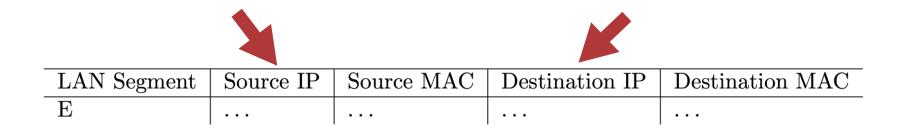
What are the IP and MAC address fields of a response sent by the Web Server to the Network Printer? Consider the response traversing the LAN segments A, B, C, D, and F. Enter your results in the table once again.

LAN Segment	Source IP	Source MAC	Destination IP	Destination MAC
Е	•••			•••





What are the IP and MAC address fields of a response sent by the Web Server to the Network Printer? Consider the response traversing the LAN segments A, B, C, D, and F. Enter your results in the table once again.

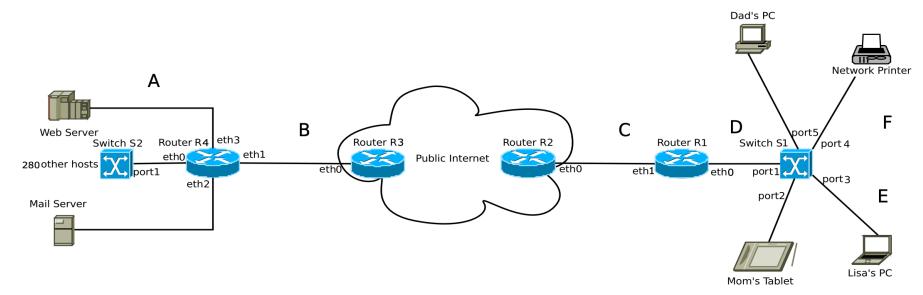


We used IP addresses from Homework 6!



Some Provider

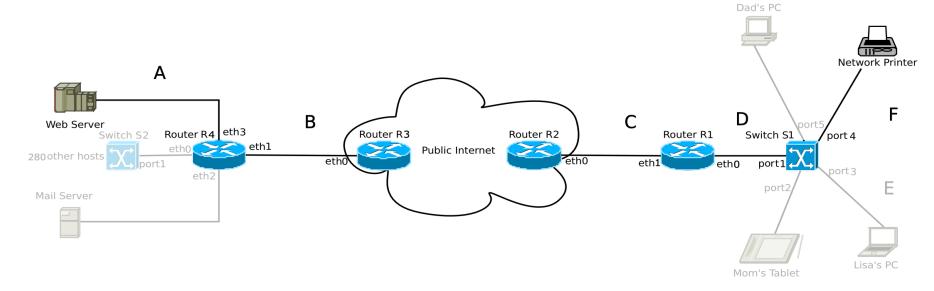
Family home network





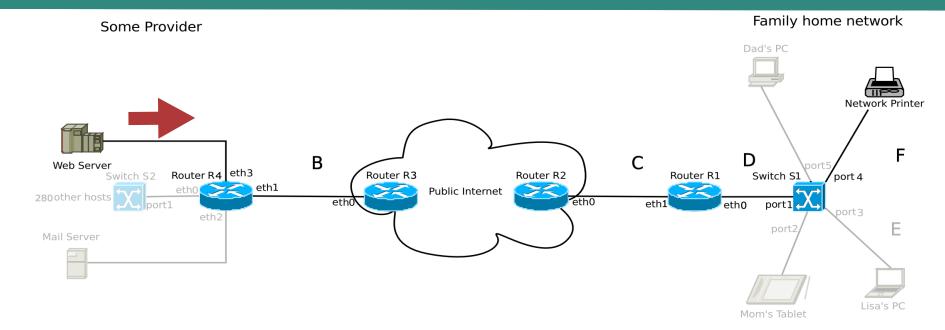
Some Provider

Family home network



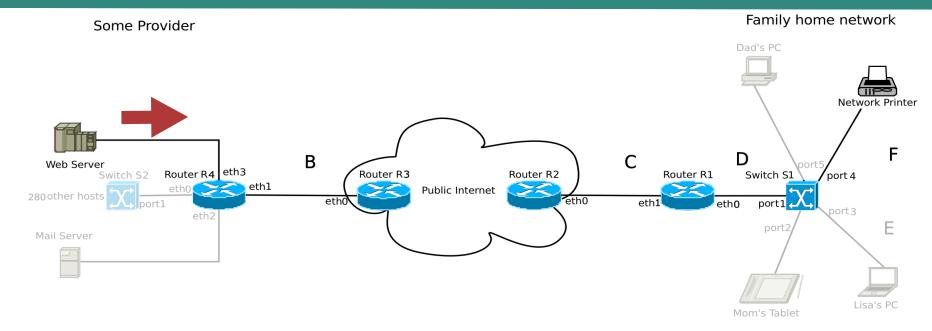
LAN	Source IP	Source MAC	Destination IP	Destination MAC





 LAN
 Source IP
 Source MAC
 Destination IP
 Destination MAC



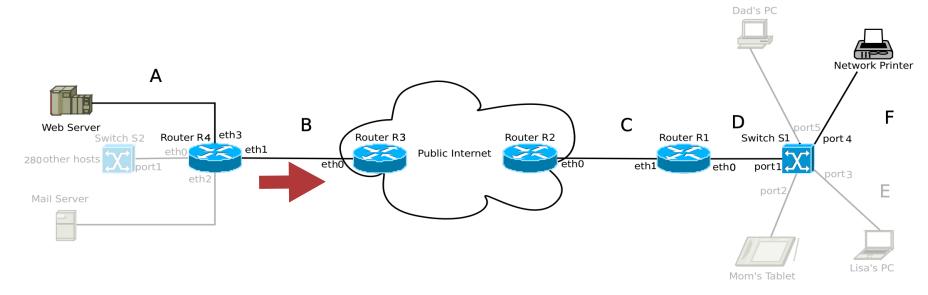


LAN	Source IP	Source MAC	Destination IP	Destination MAC
A	31.0.4.9	A0:B4:9C:5E:EE:01	31.0.4.2	55:00:11:DD:EE:04



Some Provider

Family home network

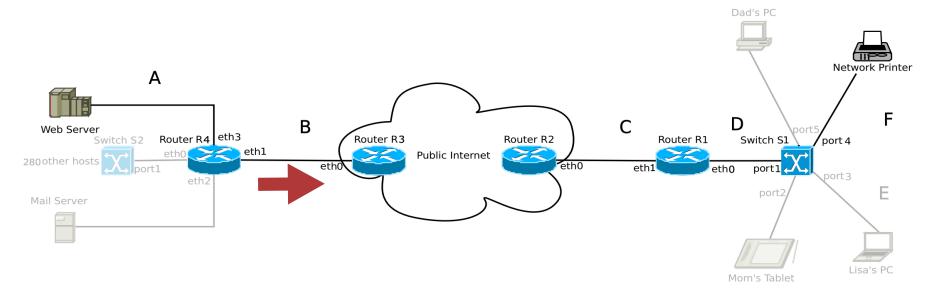


LAN	Source IP	Source MAC	Destination IP	Destination MAC
А	31.0.4.9	A0:B4:9C:5E:EE:01	31.0.4.2	55:00:11:DD:EE:04



Some Provider

Family home network

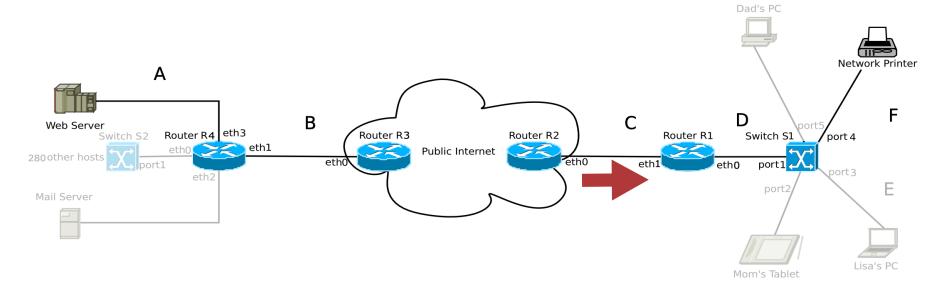


LAN	Source IP	Source MAC	Destination IP	Destination MAC
А	31.0.4.9	A0:B4:9C:5E:EE:01	31.0.4.2	55:00:11:DD:EE:04
В	31.0.4.9	55:00:11:DD:EE:02	31.0.4.2	2F:EC:05:00:01:EC



Some Provider

Family home network

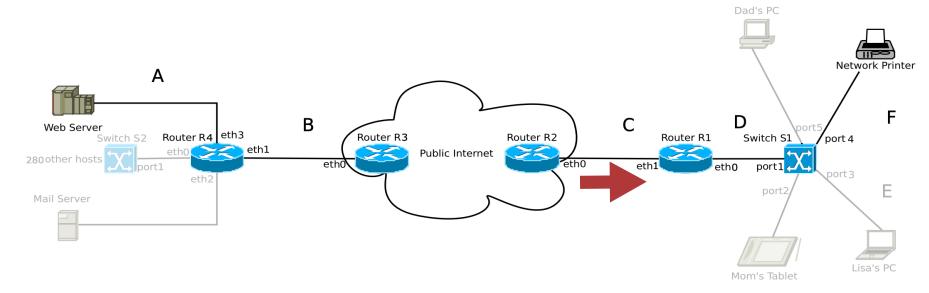


LAN	Source IP	Source MAC	Destination IP	Destination MAC
А	31.0.4.9	A0:B4:9C:5E:EE:01	31.0.4.2	55:00:11:DD:EE:04
В	31.0.4.9	55:00:11:DD:EE:02	31.0.4.2	2F:EC:05:00:01:EC



Some Provider

Family home network



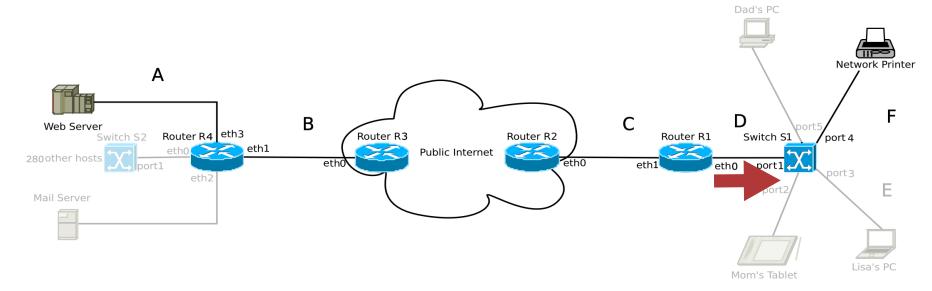
LAN	Source IP	Source MAC	Destination IP	Destination MAC
А	31.0.4.9	A0:B4:9C:5E:EE:01	31.0.4.2	55:00:11:DD:EE:04
В	31.0.4.9	55:00:11:DD:EE:02	31.0.4.2	2F:EC:05:00:01:EC
С	31.0.4.9	2F:EC:05:00:01:ED	31.0.4.2	A5:07:24:3E:2A:06



Data Networks

Some Provider

Family home network

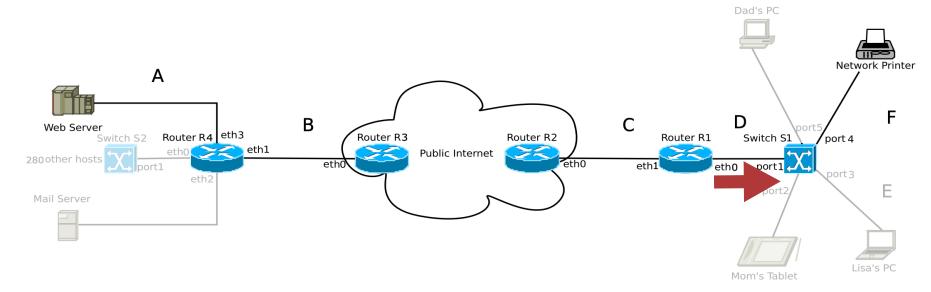


LAN	Source IP	Source MAC	Destination IP	Destination MAC
A	31.0.4.9	A0:B4:9C:5E:EE:01	31.0.4.2	55:00:11:DD:EE:04
В	31.0.4.9	55:00:11:DD:EE:02	31.0.4.2	2F:EC:05:00:01:EC
С	31.0.4.9	2F:EC:05:00:01:ED	31.0.4.2	A5:07:24:3E:2A:06



Some Provider

Family home network

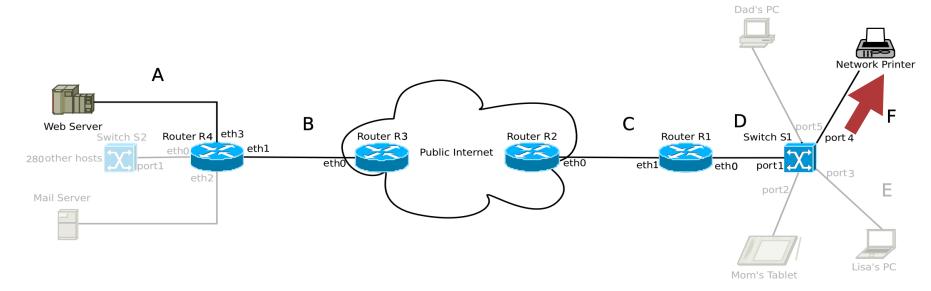


LAN	Source IP	Source MAC	Destination IP	Destination MAC
Α	31.0.4.9	A0:B4:9C:5E:EE:01	31.0.4.2	55:00:11:DD:EE:04
В	31.0.4.9	55:00:11:DD:EE:02	31.0.4.2	2F:EC:05:00:01:EC
С	31.0.4.9	2F:EC:05:00:01:ED	31.0.4.2	A5:07:24:3E:2A:06
D	31.0.4.9	A5:07:24:3E:2A:05	31.0.4.2	AE:10:8E:BB:9A:05



Some Provider

Family home network

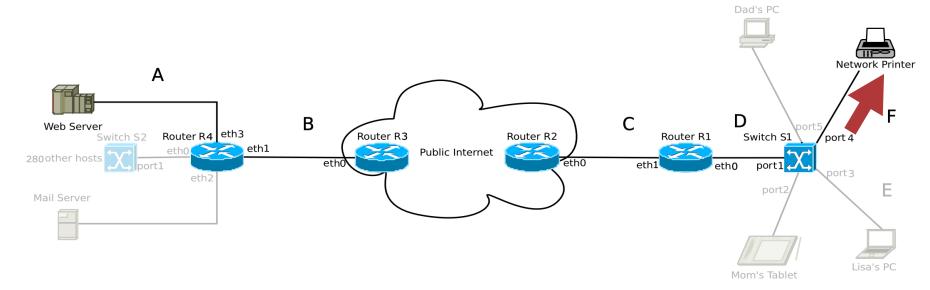


LAN	Source IP	Source MAC	Destination IP	Destination MAC
А	31.0.4.9	A0:B4:9C:5E:EE:01	31.0.4.2	55:00:11:DD:EE:04
В	31.0.4.9	55:00:11:DD:EE:02	31.0.4.2	2F:EC:05:00:01:EC
С	31.0.4.9	2F:EC:05:00:01:ED	31.0.4.2	A5:07:24:3E:2A:06
D	31.0.4.9	A5:07:24:3E:2A:05	31.0.4.2	AE:10:8E:BB:9A:05



Some Provider

Family home network

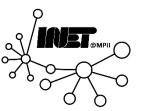


LAN	Source IP	Source MAC	Destination IP	Destination MAC
A	31.0.4.9	A0:B4:9C:5E:EE:01	31.0.4.2	55:00:11:DD:EE:04
В	31.0.4.9	55:00:11:DD:EE:02	31.0.4.2	2F:EC:05:00:01:EC
С	31.0.4.9	2F:EC:05:00:01:ED	31.0.4.2	A5:07:24:3E:2A:06
D	31.0.4.9	A5:07:24:3E:2A:05	31.0.4.2	AE:10:8E:BB:9A:05
\mathbf{F}	31.0.4.9	A5:07:24:3E:2A:05	31.0.4.2	AE:10:8E:BB:9A:05





Questions?

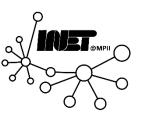


Data Networks





You work for a local internet provider "SmallNet" that purchases transit from "InernetWorks". "InternetWorks" is implementing some new routing technique, it is your task to look into this.





You conducted some traceroute measurements using UDP. Use Wireshark to open the trace (assignmento8first.pcapng) and answer the following questions:

- What protocols are used in traceroute?
- What type of packets should you inspect?
- What route do the packets take?





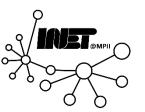
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3 10.291326	2042:a1::a	ff02::1:ff00:1	ICMPv6	86	Neighbor Solicitation for 2042:a1::1 from e6:d0:7d:e9:9f:9d
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6 10.291416	2042:a1::1	2042:a1::a	ICMPv6	142	Time Exceeded (hop limit exceeded in transit)
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13 15.360031	fe80::a41c:12ff:	2042:a1::a	ICMPv6	86	Neighbor Solicitation for 2042:a1::a from a6:1c:12:12:2f:bc
14 15.360139	2042:a1::a	fe80::a41c:12ff:…	ICMPv6	78	Neighbor Advertisement 2042:a1::a (sol)
15 20.302852	2042:a1::a	2042:5b::b	UDP	94	38219 → 33438 Len=32
16 20.302993	2042:46::6	2042:a1::a	ICMPv6	182	Time Exceeded (hop limit exceeded in transit)
17 20.303136	2042:a1::a	2042:5b::b	UDP	94	34051 → 33439 Len=32
18 20.303218	2042:35::5	2042:a1::a	ICMPv6	182	Time Exceeded (hop limit exceeded in transit)
19 20.303303	2042:a1::a	2042:5b::b	UDP	94	34257 → 33440 Len=32
20 20.303462	2042:5b::b	2042:a1::a	ICMPv6	182	Destination Unreachable (Port unreachable)
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24 25.600058	fe80::e4d0:7dff:	fe80::a41c:12ff:	ICMPv6	78	Neighbor Advertisement fe80::e4d0:7dff:fee9:9f9d (sol)
25 26.111996	fe80::e4d0:7dff:	ff02::2	ICMPv6	70	Router Solicitation from e6:d0:7d:e9:9f:9d





					_
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ICMPv6 and UDP



Data Networks



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25 26.111996	fe80::e4d0:7dff:	ff02::2	ICMPv6	70	Router Solicitation from e6:d0:7d:e9:9f:9d





Packets that had a timeout



Data Networks



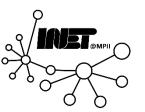
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24 25.600058	fe80::e4d0:7dff:	fe80::a41c:12ff:	ICMPv6	78	Neighbor Advertisement fe80::e4d0:7dff:fee9:9f9d (sol)
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We now know about the topology (will be shown on next slide).

- What route should the packets usually take?
- The host is the source of the traceroute
 - What special IPv6 headers can you find?
 - What is the type of the header?
 - What routing technique is used?



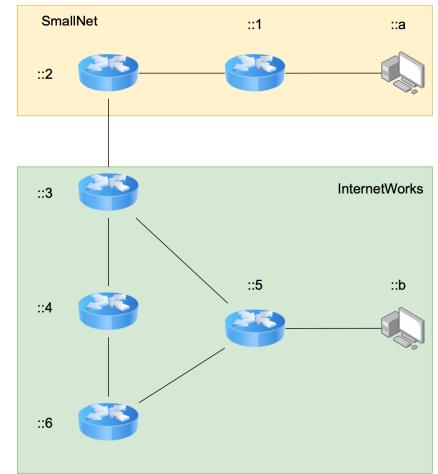


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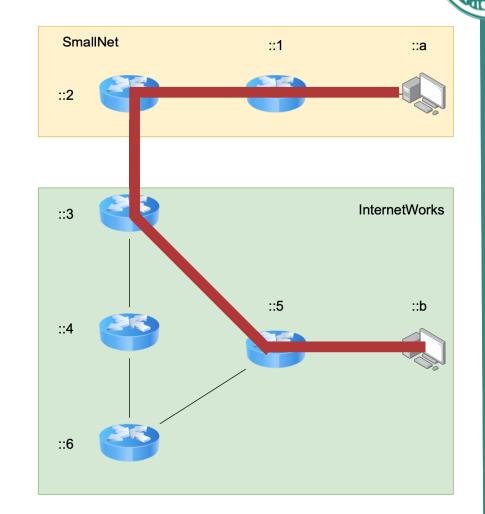






Data Networks

• Route should be 1, 2, 3, 5, b







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Frame 10: 182 bytes on wire (1456 bits), 182 bytes captured (1456 bits) Ethernet II, Src: a6:1c:12:12:2f:bc (a6:1c:12:12:2f:bc), Dst: e6:d0:7d:e9:9f:9d (e6:d0:7d:e9:9f:9d) Internet Protocol Version 6, Src: 2042:23::3, Dst: 2042:a1::a

Internet Control Message Protocol v6

Data (32 bytes)





Internet Control Message Protocol v6

Type: Time Exceeded (3)

Code: 0 (hop limit exceeded in transit)

Checksum: 0xfc6a [correct]

[Checksum Status: Good]

Reserved: 00000000

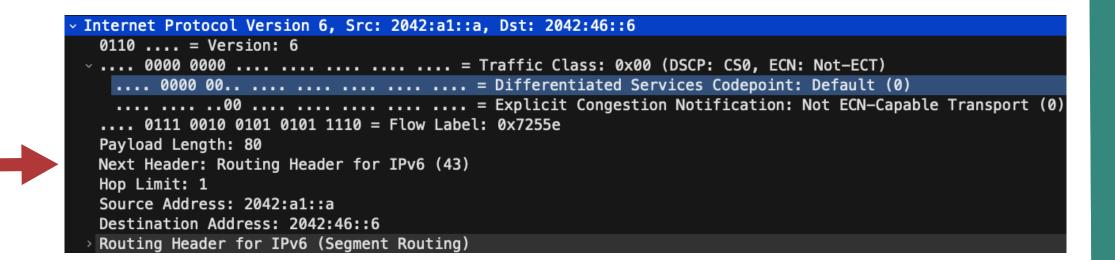
> Internet Protocol Version 6, Src: 2042:a1::a, Dst: 2042:46::6

>User Datagram Protocol, Src Port: 48000, Dst Port: 33436

Data (32 bytes)

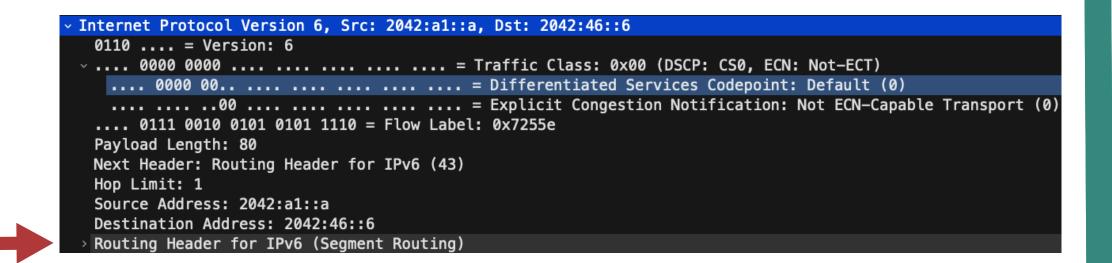












Routing Header for IPv6, Segment Routing is used



Data Networks





- What part of the path can you see now?
- Can you still see traces of the secret technique?







- What part of the path can you see now?
- Can you still see traces of the secret technique?





1 0.000000	fe80::b02b:f	ff02::2	ICMPv6	70 Router Solicitation from b2:2b:ff:64:dc:17
2 7.168014	fe80::b02b:f	ff02::2	ICMPv6	70 Router Solicitation from b2:2b:ff:64:dc:17
3 11.6176	2042:a1::a	ff02::1:ff00	ICMPv6	86 Neighbor Solicitation for 2042:a1::1 from b2:2b:ff:64:dc:17
4 11.6176	2042:a1::1	2042:a1::a	ICMPv6	86 Neighbor Advertisement 2042:a1::1 (rtr, sol, ovr) is at 8e:01:0d:64:c5:f2
5 11.6177	2042:a1::a	2042:5b::b	UDP	94 56055 → 33434 Len=32
6 11.6177	2042:a1::1	2042:a1::a	ICMPv6	142 Time Exceeded (hop limit exceeded in transit)
7 11.6180	2042:a1::a	2042:5b::b	UDP	94 37841 → 33435 Len=32
8 11.6181	2042:12::2	2042:a1::a	ICMPv6	142 Time Exceeded (hop limit exceeded in transit)
9 11.6181	2042:a1::a	2042:5b::b	UDP	94 39355 → 33436 Len=32
10 16.6234	2042:a1::a	2042:5b::b	UDP	94 55249 → 33437 Len=32
11 16.6399	fe80::8c01:d	2042:a1::a	ICMPv6	86 Neighbor Solicitation for 2042:a1::a from 8e:01:0d:64:c5:f2
12 16.6400	2042:a1::a	fe80::8c01:d	ICMPv6	78 Neighbor Advertisement 2042:a1::a (sol)
13 21.6287	2042:a1::a	2042:5b::b	UDP	94 53940 → 33438 Len=32
14 21.6290	2042:5b::b	2042:a1::a	ICMPv6	142 Destination Unreachable (Port unreachable)
15 21.7600	fe80::b02b:f	fe80::8c01:d	ICMPv6	86 Neighbor Solicitation for fe80::8c01:dff:fe64:c5f2 from b2:2b:ff:64:dc:17
16 21.7600	fe80::8c01:d	fe80::b02b:f	ICMPv6	78 Neighbor Advertisement fe80::8c01:dff:fe64:c5f2 (rtr, sol)
17 22.0160	fe80::b02b:f	ff02::2	ICMPv6	70 Router Solicitation from b2:2b:ff:64:dc:17





1 0.000000	fe80::b02b:f	ff02::2	ICMPv6	70 Router Solicitation from b2:2b:ff:64:dc:17
2 7.168014	fe80::b02b:f	ff02::2	ICMPv6	70 Router Solicitation from b2:2b:ff:64:dc:17
3 11.6176	2042:a1::a	ff02::1:ff00	ICMPv6	86 Neighbor Solicitation for 2042:a1::1 from b2:2b:ff:64:dc:17
4 11.6176	2042:a1::1	2042:a1::a	ICMPv6	86 Neighbor Advertisement 2042:a1::1 (rtr, sol, ovr) is at 8e:01:0d:64:c5:f2
5 11.6177	2042:a1::a	2042:5b::b	UDP	94 56055 → 33434 Len=32
6 11.6177	2042:a1:: <mark>1</mark>	2042:a1::a	ICMPv6	142 Time Exceeded (hop limit exceeded in transit)
7 11.6180	2042:a1::a	2042:5b::b	UDP	94 37841 → 33435 Len=32
8 11.6181	2042:12::2	2042:a1::a	ICMPv6	142 Time Exceeded (hop limit exceeded in transit)
9 11.6181	2042:a1::a	2042:5b::b	UDP	94 39355 → 33436 Len=32
10 16.6234	2042:a1::a	2042:5b::b	UDP	94 55249 → 33437 Len=32
11 16.6399	fe80::8c01:d	2042:a1::a	ICMPv6	86 Neighbor Solicitation for 2042:a1::a from 8e:01:0d:64:c5:f2
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13 21.6287	2042:a1::a	2042:5b::b	UDP	94 53940 → 33438 Len=32
14 21.6290	2042:5b::b	2042:a1::a	ICMPv6	142 Destination Unreachable (Port unreachable)
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16 21.7600	fe80::8c01:d	fe80::b02b:f	ICMPv6	<pre>78 Neighbor Advertisement fe80::8c01:dff:fe64:c5f2 (rtr, sol)</pre>
17 22.0160	fe80::b02b:f	ff02::2	ICMPv6	70 Router Solicitation from b2:2b:ff:64:dc:17

We can see 1, 2, and b



Data Networks





- What part of the path can you see now?
- Can you still see traces of the secret technique?







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NOPE!







While the traceroute was issued by a, the node 4 recorded network traces as well (open assignmento8-third.pcapng). Look at the packet concerning traceroute.

- Can you see traces of the secret routing technique?
- Is there something special about the IPv6 packets?
- What are their sources and destinations?
- Why can't you see the secret technique locally?







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> Frame 209: 158 bytes on wire (1264 bits), 158 bytes captured (1264 bits)
> Ethernet II, Src: 92:cf:a1:53:97:60 (92:cf:a1:53:97:60), Dst: c2:a6:54:3f:bf:cc (c2:a6:54:3f:bf:cc)
> Internet Protocol Version 6, Src: 2042:34::3, Dst: 2042:46::6
> Internet Protocol Version 6, Src: 2042:a1::a, Dst: 2042:5b::b
> User Datagram Protocol, Src Port: 55899, Dst Port: 33438
> Data (32 bytes)



> Frame 209: 158 bytes on wire (1264 bits), 158 bytes captured (1264 bits) > Ethernet II, Src: 92:cf:a1:53:97:60 (92:cf:a1:53:97:60), Dst: c2:a6:54:3f:bf:cc (c2:a6:54:3f:bf:cc) > Internet Protocol Version 6, Src: 2042:34::3, Dst: 2042:46::6 0110 ... = Version: 6 > ... 0000 0000 = Traffic Class: 0x00 (DSCP: CS0, ECN: Not-ECT) ... 1110 0111 1000 0100 0101 = Flow Label: 0xe7845 Payload Length: 104 Next Header: Routing Header for IPv6 (43) Hop Limit: 1 Source Address: 2042:34::3 Destination Address: 2042:46::6 > Routing Header for IPv6 (Segment Routing) > Internet Protocol Version 6, Src: 2042:a1::a, Dst: 2042:5b::b > User Datagram Protocol, Src Port: 55899, Dst Port: 33438 > Data (32 bytes)







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> User Datagram Protocol, Src Port: 55899, Dst Port: 33438
> Data (32 bytes)

There are nested IPv6 packets



Data Networks





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> Internet Protocol Version 6, Src: 2042:34::3, Dst: 2042:46::6
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Outer: 3 and 6 Inner: a and b



Data Networks





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While the traceroute was issued by a, the node 4 recorded network traces as well (open assignmento8-third.pcapng). Look at the packet concerning traceroute.

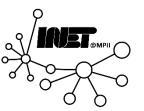
- Can you see traces of the secret routing technique?
- Is there something special about the IPv6 packets?
- What are their sources and destinations?
- Why can't you see the secret technique locally?





Why can't you see the secret technique locally?

Answer:

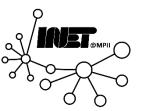




Why can't you see the secret technique locally?

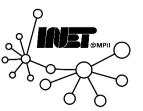
Answer:

- The source is no longer a
- The TTL has changed





Questions?



Data Networks



Feedback?



Data Networks