Exercise 2

Florian Tegeler

CRC checksums

- CRC checksums: Please calculate the CRC *R of D = 0101 1100 1010 0111 1110 1111. Please use the 4 bit generator G = 1001*

- *Please note, R is always of polynom-length (=if G has 4 bit, R is 3 bit long).*

$$G = 1 \cdot x^3 + 0 \cdot x^2 + 0 \cdot x^1 + 1 \cdot x^0$$

CRC Checksums

```
1  01011100101001111101111000
2   1001
3   001010
4     1001
5     001101
6       1001
7       01000
8        1001
9        0001100
0           1001
1           01011
2            1001
3            001011
4              1001
5              001011
6                1001
7                001010
8                  1001
9                  001111
0                    1001
1                    01101
2                     1001
3                     01001
4                      1001
5                      0000
```

```
31 01011100101001111101110000
32  1001
33  001010
34    1001
35    001101
36      1001
37      01000
38       1001
39       0001100
40          1001
41          01011
42           1001
43           001011
44             1001
45             001011
46               1001
47               001010
48                 1001
49                 001111
50                   1001
51                   01101
52                    1001
53                    01000
54                     1001
55                     001000
56                       1001
57                       0001
```

Identifiers

- Why do we need multiple identifiers for one entity such as IP-addresses, MAC addresses etc.?

- Answer: Multiple layers, transparent, nevertheless currently development to split e.g. ID and topological location

How does a switch learn?

- A question to prepare a bit for today's lecture…The switch is learning by observing the traffic:
  - It has a forwarding table mapping MAC addresses to ports.
  - If it does not know where to forward to, it sends the packet to all ports.
  - If it observes an answer on one port, it updates the forwarding table.

Hubs, Switches… (a bit vague)

- Hub: Dump device, operates as a broadcaster (no collision analysis, has to be done at NICs of attached hosts)
- Bridge: can connect different technologies like Ethernet, Token-Ring…
- Switch: Transparent bridge. Has forwarding table, connects hosts inside one broadcasting domain. If port A sends to port B, C and D can also send at full speed (no collisions inside the switch). Uses CSMA/CD for collision detection.
- Router: Layer 3. Connects different broadcast domains. (ARP can only work inside one broadcast domain, if the host is not in that domain, routing is required).

ARP

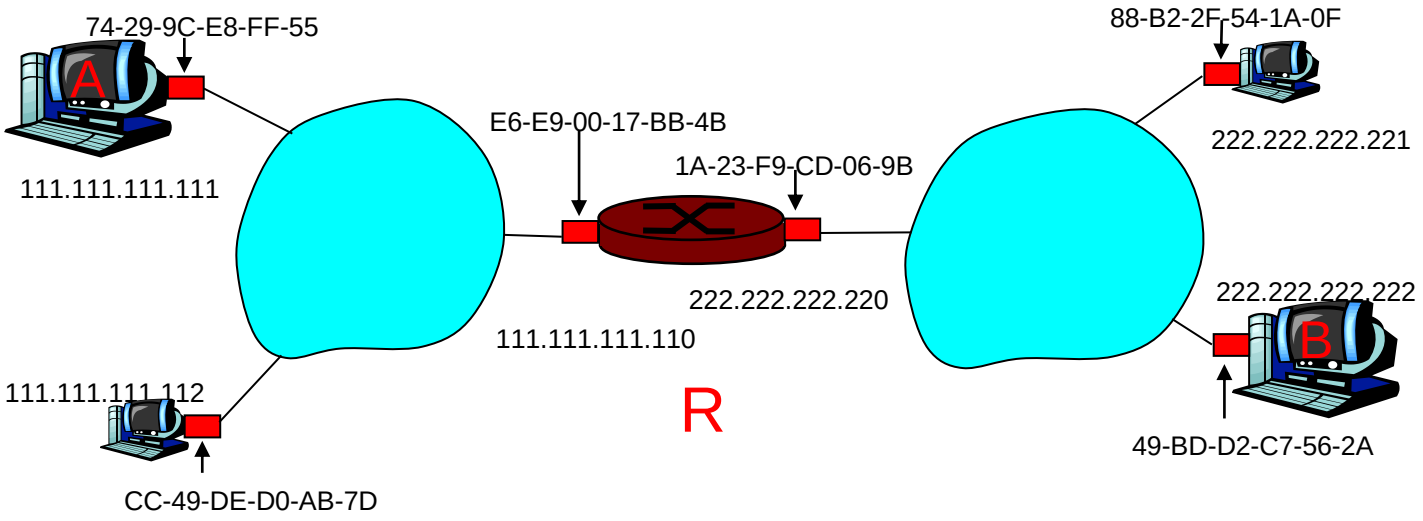
- Please look into the Ethernet frames using wireshark and, in the best case scenario, observe an ARP request. What happens, if you want to connect to a host that is not in your local area network?

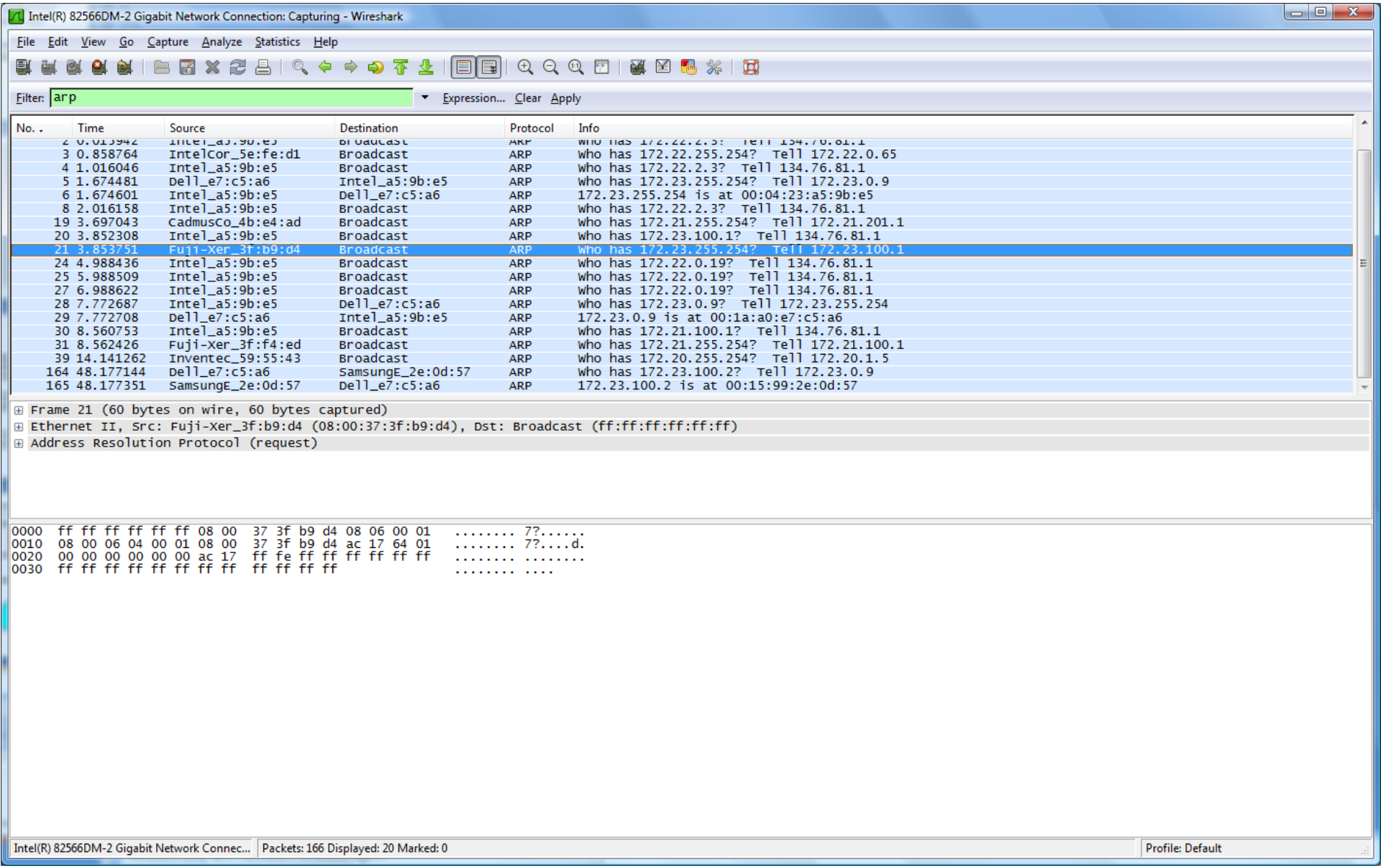
- Was a bit a trick question ;) Remember: ARP is layer 2, routers are layer 3. That is the job of the network layer, to connect different “broadcast domains” where ARP works.

- Answer: By having the router R as a default route in host A, host B is contacted via R so R’s MAC is looked up with ARP! Remember the example page.

- A creates IP datagram with source A, destination B
- A uses ARP to get R's MAC address for 111.111.111.110
- A creates link-layer frame with R's MAC address as dest, frame contains A-to-B IP datagram
- A's NIC sends frame
- R's NIC receives frame
- R removes IP datagram from Ethernet frame, sees its destined to B
- R uses ARP to get B's MAC address
- R creates frame containing A-to-B IP datagram sends to B

This is a really important example – make sure you understand!




Intel(R) 82566DM-2 Gigabit Network Connection: Capturing - Wireshark
File Edit View Go Capture Analyze Statistics Help
Filter: arp
Expression... Clear Apply
No. Time Source Destination Protocol Info
3 0.858764 IntelCor_5e:fe:d1 Broadcast ARP Who has 172.22.255.254? Tell 172.22.0.65
4 1.016046 Intel_a5:9b:e5 Broadcast ARP Who has 172.22.2.3? Tell 134.76.81.1
5 1.674481 Dell_e7:c5:a6 Intel_a5:9b:e5 ARP Who has 172.23.255.254? Tell 172.23.0.9
6 1.674601 Intel_a5:9b:e5 Dell_e7:c5:a6 ARP 172.23.255.254 is at 00:04:23:a5:9b:e5
8 2.016158 Intel_a5:9b:e5 Broadcast ARP Who has 172.22.2.3? Tell 134.76.81.1
19 3.697043 CadmusCo_4b:e4:ad Broadcast ARP Who has 172.21.255.254? Tell 172.21.201.1
20 3.852308 Intel_a5:9b:e5 Broadcast ARP Who has 172.23.100.1? Tell 134.76.81.1
21 3.853751 Fuji-Xer_3f:b9:d4 Broadcast ARP Who has 172.23.255.254? Tell 172.23.100.1
24 4.988436 Intel_a5:9b:e5 Broadcast ARP Who has 172.22.0.19? Tell 134.76.81.1
25 5.988509 Intel_a5:9b:e5 Broadcast ARP Who has 172.22.0.19? Tell 134.76.81.1
27 6.988622 Intel_a5:9b:e5 Broadcast ARP Who has 172.22.0.19? Tell 134.76.81.1
28 7.772687 Intel_a5:9b:e5 Dell_e7:c5:a6 ARP Who has 172.23.0.9? Tell 172.23.255.254
29 7.772708 Dell_e7:c5:a6 Intel_a5:9b:e5 ARP 172.23.0.9 is at 00:1a:a0:e7:c5:a6
30 8.560753 Intel_a5:9b:e5 Broadcast ARP Who has 172.21.100.1? Tell 134.76.81.1
31 8.562426 Fuji-Xer_3f:f4:ed Broadcast ARP Who has 172.21.255.254? Tell 172.21.100.1
39 14.141262 Inventec_59:55:43 Broadcast ARP Who has 172.20.255.254? Tell 172.20.1.5
164 48.177144 Dell_e7:c5:a6 SamsungE_2e:0d:57 ARP Who has 172.23.100.2? Tell 172.23.0.9
165 48.177351 SamsungE_2e:0d:57 Dell_e7:c5:a6 ARP 172.23.100.2 is at 00:15:99:2e:0d:57
Frame 21 (60 bytes on wire, 60 bytes captured)
Ethernet II, Src: Fuji-Xer_3f:b9:d4 (08:00:37:3f:b9:d4), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
Address Resolution Protocol (request)
0000 ff ff ff ff ff ff 08 00 37 3f b9 d4 08 06 00 01 .... 7?......
0010 08 00 06 04 00 01 08 00 37 3f b9 d4 ac 17 64 01 .... 7?....d.
0020 00 00 00 00 00 00 ac 17 ff fe ff ff ff ff ff ff ....
0030 ff ff ff ff ff ff ff ff ff ff ff ff ....
Intel(R) 82566DM-2 Gigabit Network Connec...
Packets: 166 Displayed: 20 Marked: 0
Profile: Default