## Communication Networks
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Exercise 5 – Internet Protocol (IP) & Forwarding

Internet Protocol (IP)

5.1   NAT (Exam Question 2018)

Consider the network topology below. Alice has multiple PCs at home (10.0.0.11–13) which share a single public IP address (1.2.3.4) via a NAT device. Further, she operates a surveillance camera server which is directly connected to the Internet with a public IP address (5.6.7.8). The camera transmits the live video signal as a stream of UDP packets with source port 1000 to a configurable destination IP address and port.
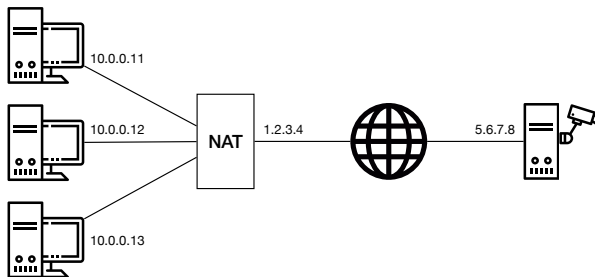

Alice operates three PCs and one camera server

a) Alice wants to receive the live video stream on one of her PCs and thus configures the camera to send the video signal to IP 10.0.0.11 and port 1234. However, she does not receive it on her PC. Why? Where is this traffic sent to?

b) Now Alice configures the camera to send the video signal to IP 1.2.3.4 and port 1234. But she still does not receive it on any of her PCs. Why? Where is this traffic sent to?

c) What can Alice do such that she receives the video signal at her PC with IP address 10.0.0.11 and at port 1234 assuming that she *cannot* modify the configuration of the NAT? Describe step-by-step what she can do if she has the following possibilities:

- send one single UDP packet with arbitrary source and destination addresses and ports from each of her PCs;

- observe the received packets at each of her PCs and the camera server;

- specify the destination IP address and port for the video signal.

Forwarding

5.2 The Art of Defaulting Properly (Exam Style Question)

Consider this simple network configuration between ETH and Swisscom. Assume that ETH owns a large IP prefix 13.1.0.0/17, but only uses 13.1.0.0/24 to address its internal hosts. For simplicity, we assume that ETH and Swisscom operators configure their forwarding table statically and rely on the use of a default route (0.0.0.0/0).
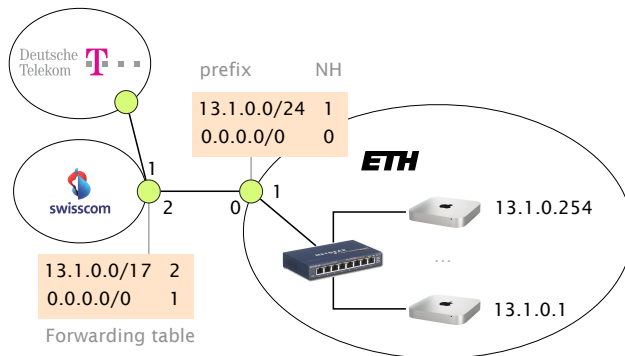
Where are my IP packets going?

a) How many IP addressable addresses does ETH "own" in total?

b) Give the first and last IP address that ETH can use for addressing a host.

c) Suppose Swisscom receives a packet for 13.1.0.66 from Deutsche Telekom. What is the path taken by this IP packet?

d) Suppose Swisscom receives a packet for 13.1.66.1 from Deutsche Telekom. What is the path taken by this IP packet?

e) What eventually happens to the packet for 13.1.66.1? As an attacker observing this, could you use this observation to congest the ETH-Swisscom link more easily? Explain why (or why not).

5.3   Summer Pruning (Exam Question 2018)

Consider an IP router with a forwarding table composed of the 9 entries depicted on the left. Write down (on the right) an equivalent forwarding table by combining entries together into shorter ones such that the resulting table has the least number of entries. Your reduced forwarding table should be such that the forwarding decision made by the router for any IP packet is equivalent to the initial one.

prefix	next-hop
82.130.32.0/20	1
82.130.64.0/20	1
82.130.80.0/20	2
82.130.96.0/20	1
82.130.112.0/21	1
82.130.120.0/21	1
82.130.122.0/24	1
82.130.123.0/24	1
82.130.124.0/24	2

prefix	next-hop

Answer to the same question as above considering the forwarding table below instead (left) in which an extra default route is defined.

prefix	next-hop
0.0.0.0/0	1
82.130.32.0/20	1
82.130.64.0/20	1
82.130.80.0/20	2
82.130.96.0/20	1
82.130.112.0/21	1
82.130.120.0/21	1
82.130.122.0/24	1
82.130.123.0/24	1
82.130.124.0/24	2

prefix	next-hop