CS 3873: Net-Centric Computing

Assignment 4: IP and Network Routing

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[Mandatory] Declaration: “I warrant that this is my own work.”

Signed by Mahmoud Moustafa

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1. (2 points) IPv6 uses 128-bit addresses. If a block of 1 million addresses is allocated every picosecond, how long will the addresses last? Compare that with the age of our universe ($\approx 10^{10}$ years).

   With 128 bits, there will be 3.4×10^{38} addresses. Allocating 3.4×10^{38} addresses every picosecond 10^{18}, they will last for 10^{13} years which is 1000 times the age of the universe.

2. (5 points) Consider the network setup in the following figure. Suppose that the ISP assigns the router the address 24.34.136.211 and that the network prefix of the home network is 192.168.1.0/24.

2) 192.168.1.0 /24

11000000 10101000 00000001 $\underbrace{00000000}_{\text{Changable}}$

a. Assign addresses to all 3 interfaces in the home network and the network interface of the router connected to the home network.

a) 1 → 11000000 10101000 00000001 00100000

192.168.1.16

2 → 11000000 10101000 00000001 00001100

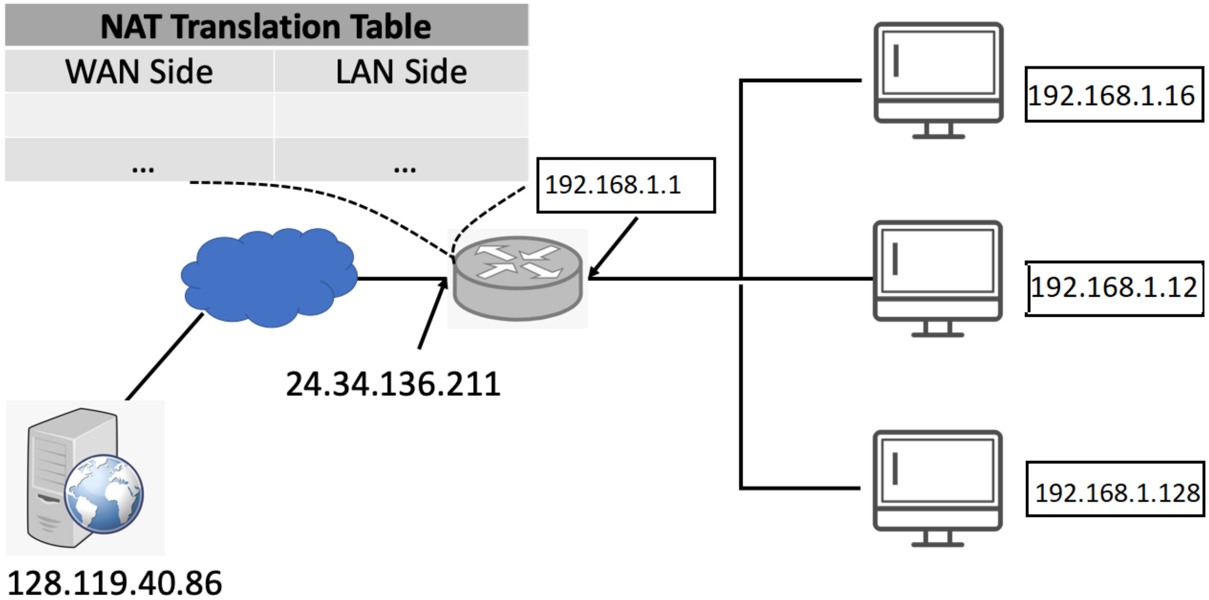
192.168.1.12

3 → 11000000 10101000 00000001 10000000

192.168.1.128

4 → 11000000 10101000 00000001 00000001

192.168.1.1



b. Suppose each host has 2 ongoing TCP connections, all to port 80 at host 128.119.40.86. Provide the 6 corresponding entries in the NAT translation table.

NAT Translation table	
WAN Side	LAN Side
24.34.136.211, 5050	192.168.1.16, 3873
24.34.136.211, 5051	192.168.1.16, 3863
24.34.136.211, 6074	192.168.1.12, 3383
24.34.136.211, 6073	192.168.1.12, 3382
24.34.136.211, 5007	192.168.1.128, 3362
24.34.136.211, 5008	192.168.1.128, 3365

3. (1 point) We made a distinction between the forwarding function and the routing function performed in the network layer. What are the key differences between routing and forwarding?

   Routing: network-wide process, route datagrams among routers along and end-to-end path from source host to destination host.

   Forwarding: router-local action, forward datagrams (packets) arriving on one of a router's input links to one of its output links.

4. (4 points) Consider a datagram network using 32-bit host addresses. Suppose a router has four links, numbered 0 through 3, and packets are to be forwarded to the link interfaces as follows:

Destination Address Range	**Link Interface**
11100000 00000000 00000000 00000000 through 11100000 00111111 11111111 11111111	0
11100000 01000000 00000000 00000000 through 11100000 01000000 11111111 11111111	1
11100000 01110000 00000000 00000000 through 11100000 01111111 11111111 11111111	2
11100001 10110000 00000000 00000000 through 11100001 10111111 11111111 11111111	3
11100010 10000000 00000000 00000000 through 11100010 11111111 11111111 11111111	4

   a. Complete the following forwarding table according to the above setting, assuming longest prefix matching is used to decide where to forward a packet to the correct link interface. Note that the column of network prefix should be presented in the decimal form of a.b.c.d/x. You need to decide how many entries that this table requires.

Network Prefix (Decimal)		Output Link Interface
From	To	
224.0.0.0/10	224.63.255.255/10	0
224.64.0.0/16	224.64.255.255/16	1
224.112.0.0/12	224.127.255.255/12	2
225.176.0.0/12	225.191.255.255/12	3
226.128.0.0/9	226.255.255.255/9	4

b. According to the above forwarding table, give the output link interface for each datagram with the following destination addresses:
225.180.128.1, 224.135.1.2, 224.111.0.1

225.180.128.1 → 3
224.135.1.2 → 2 (NS)
224.111.0.1 → 2

5. (3 points) Consider a router that interconnects three subnets: Subnet 1, Subnet 2, and Subnet 3. Suppose all of the interfaces in each of these three subnets should use addresses in a large block defined by prefix 128.16.0.0/12. You need to further divide this large address block into three smaller **non-overlapping** address blocks for these three subnets. They need to further meet the following conditions:
    a. Subnet 1 is required to support at least 300 interfaces, and the last address for this subnet is 128.31.255.255
    b. Subnet 2 is to support at least 120 interfaces, and the last address for this subnet is 128.16.1.127
    c. Subnet 3 is to support at least 400 interfaces, and the last address for this subnet is 128.17.7.255.

5) $128.16.0.0/12 = 10000000\ 0001\,0000\ 00000000\ 00000000$

$2^{32} - 2^{12} = 2^{20}$ addresses in total

a) $2^8 < 300 < 2^9$

$256 < 300 < 512$

Last address: 128.31.255.255

$= 10000000\ 00011111\ 11111111\ 11111111$

We'll use 2^9

$128.31.255.255 \quad - 512$

: start address $= 128.31.254.0$

$= 10000000\ 00011111\ 11111110\ 00000000$

128.31.254.0 / 23

b) 120 interface. Therefore, we'll use $2^9 = 128$

Last address: 128.16.1.127

$= 10000000\ 00010000\ 00000001\ 01111111$

$128.16.1.127 \ - 128$

= Start address: 128.16.1.0

$= 10000000\ 00010000\ 00000001\ 00000000$

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c) 400 interfaces → we'll use $2^9 = 512$

Last address : 128.17.7.255

= 10000000 00010001 00000111 11111111

128.17.7.255 − 512

: start address : 128.17.6.0

= 10000000 00010001 00000110 00000000

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