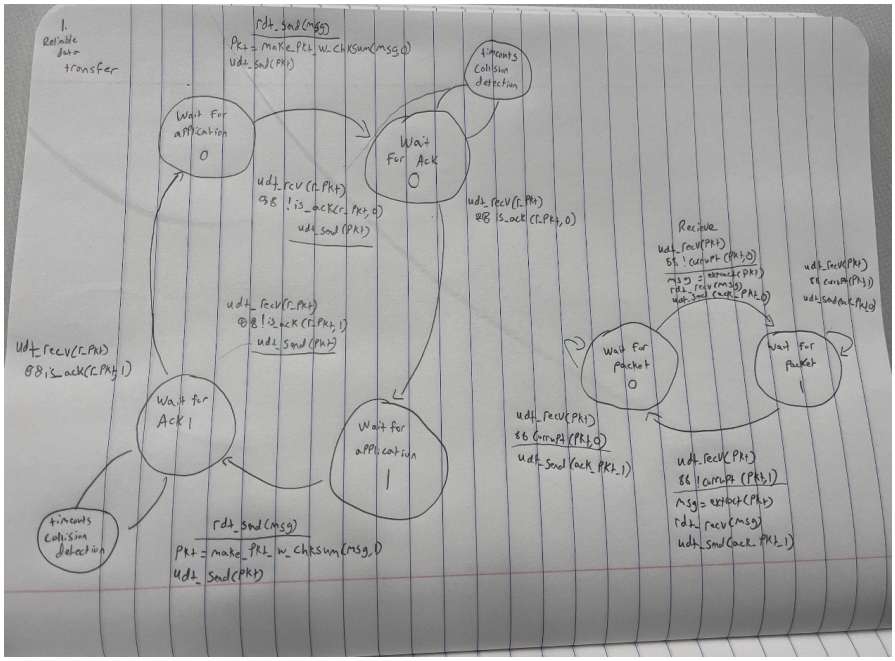
Aiden Pratt
CS-6014 Lower Network Layers

question 1: Reliable Data Transfer

include timeouts and checksums and collision detection



question 2: Throttling

What is the difference between flow control and congestion control? Describe the way TCP implements each of these features.

Flow control ensures that one host does not overwhelm the other, focusing on regulating the data flow rate between sender and receiver. However, it disregards the network's state, which can lead to issues in congested conditions, resulting in packet loss or drops. The delay may escalate rapidly. Flow control relies on the receiver's window size (rwnd), representing the allowable amount of unacknowledged data. It primarily operates at the receiver's end.

In the congestion control protocol, a lost packet is identified through either receiving three duplicate acknowledgment packets or encountering a timeout. Congestion control adapts between three states based on the acknowledgment and loss status of packets.

TCP adopts an "end-to-end" congestion control approach, abstaining from seeking assistance from intermediate routers. If TCP detects lost packets, indicating congestion, it initiates a slowdown in transmission. Conversely, consistent packet acknowledgments signal a healthy network, prompting TCP to accelerate transmission.

This dynamic adjustment ensures efficient data transfer without relying on intermediary support.

question 3: NAT

Two hosts (IPs A: 10.0.0.1 and B: 10.0.0.2) sit behind a NAT enabled router (public IP 5.6.7.8). They're both communicating with a remote host X, 1.2.3.4 on port 80. What are *possible* values for the source and destination addresses and ports for packets:

- from A to X behind the NAT
    - source IP of A:10.0.0.1
    - source port: 7777
    - Destination IP: 1.2.3.4
    - destination port: 80
- from B to X behind the NAT
    - source IP of B: 10.0.0.2
    - source port: 8888
    - Destination IP: 1.2.3.4
    - destination port: 80
- from A to X between the NAT and X
    - source IP: 5.6.7.8
    - source port: 9999
    - destination ip: 1.2.4
    - destination port: 80
- from B to X between the NAT and X
    - source IP: 5.6.7.8
    - source port: 9999
    - destination ip: 1.2.3.4
    - destination port: 80
- from X to A between X and the NAT
    - source address: 1.2.3.4
    - source port: 80
    - destination address 5.6.7.8
    - destination port 9999
- from X to A between the NAT and A
    - source address: 1.2.3.4
    - source port: 80
    - destination address 10.0.0.1
    - destination port 7777

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What are the corresponding contents of the router's NAT translation table?

NAT TRANSLATION TABLE

WAN SIDE	LAN SIDE
public ip 5.6.7.8, public port 1111	local ip is 10.0.0.1, local port 2222

port changes when out

question 4: routers
A company has 3 groups that each have a subnet on the corporate network. Group A uses subnet 1.1.1.0/24. Group B uses 1.1.2.0/24. Group C uses subnet 1.1.3.0/24. Each group has a router. There is a link between each pair of routers.
A and B have a link: 1.1.4.0 (on A) to 1.1.4.1 (on B) A and C have a link: 1.1.5.0 (on A) to 1.1.5.1 (on C) B and C have a link: 1.1.6.0 (on B) to 1.1.6.1 (on C)

- How many subnets are a part of this network, and what is the smallest IP prefix (i.e. most fixed bits) that can be used to describe each one?
    - 6 total subnets
    - the smallest IP prefix is 31
- If this network is somehow connected to the internet, what is the cheapest (i.e. smallest number of address) IP prefix the company could have purchased (without using NAT)?
    - A 1.1.1.0/24 - 00000001.00000001.00000001.00000000 - 4 bytes
    - B 1.1.2.0/24 - 000000001.000000001.000000010.00000000
    - C 1.1.3.0/24 - 00000001.00000001.00000011.0000000000
    - 1.1.1 – 1.1.6.1
    - 21, all the subnets in the company share the same starting 21 bits
- Assume the router for group A has 4 ports: port 1 is connected to the group subnet, port 2 is connected to router B, port 3 is connected to router C, and port D is connected to the ISP. Write out router A's forwarding table.
    - router A forwarding table

ip address	port number
1.1.1.0/24	1
1.1.4.0/24	2
1.1.5.1	3
0.0.0.0	D

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question 5: routing