HW: Lower Network Layers
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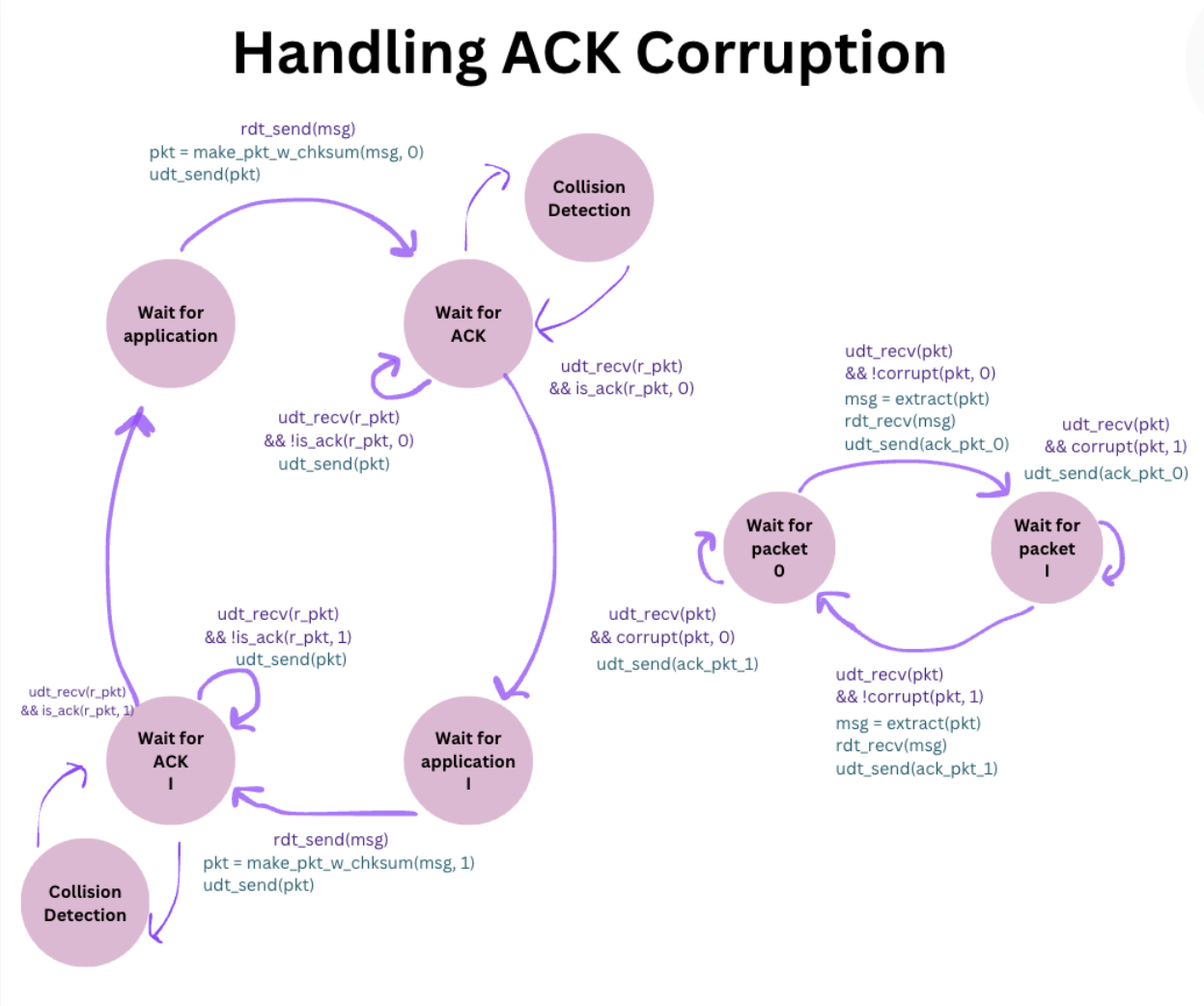
Question 1: Reliable Data Transfer



Question 2: Throttling

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

Flow control is a mechanism used to prevent the sender from overwhelming the receiver. It ensures that the sender does not transmit data faster than the receiver can process and accept it. For TCP, the nodes will send the size of its receive window, which indicates how much free space is in its receive buffer. The sender can then send only as much data as the receiver's buffer can handle, waiting for an acknowledgment and any updates on the window size before sending more.

The goal of congestion control is to prevent too much data from being sent to the network too quickly, which can lead to congestion, packet loss, etc. It is more concerned with

the overall health of the network. TCP doesn't ask for information/assistance from intermediate routers, instead, all decisions are based on messages between the endpoints.

Question 3: NAT

1. From A to X behind the NAT
    a. Source:
        i. Address: 10.0.0.1
        ii. Port A: 10
    b. Destination:
        i. Address: 1.2.3.4
        ii. Port: 80
2. From B to X behind the NAT
    a. Source:
        i. Address: 10.0.0.2
        ii. Port B: 30
    b. Destination:
        i. Address: 1.2.3.4
        ii. Port: 80
3. From A to X between the NAT and X
    a. Source:
        i. Address: 5.6.7.8
        ii. NAT Port A: 50
    b. Destination:
        i. Address: 1.2.3.4
        ii. Port: 80
4. From B to X between the NAT and X
    a. Source:
        i. Address: 5.6.7.8
        ii. NAT Port B: 40
    b. Destination:
        i. Address: 1.2.3.4
        ii. Port: 80
5. From X to A between X and the NAT
    a. Source:
        i. Address: 1.2.3.4
        ii. Port: 80
    b. Destination:
        i. 5.6.7.8
        ii. NAT Port A: 50
6. From X to A between the NAT and A
    a. Source:
        i. Address: 1.2.3.4
        ii. Port A: 80
    b. Destination:
        i. Address: 10.0.0.1
        ii. Port A: 10

From A and B to X:

Internal Source	**External Source**	**Destination**
10.0.01: 10	5.6.7.8: 50	1.2.3.4: 80
10.0.02: 30	5.6.7.8: 40	1.2.3.4: 80

From X back to A or B:

External Source	**External Source**	**Destination**
1.2.3.4: 80	10.0.01: 10	5.6.7.8: 50
1.2.3.4: 80	10.0.02: 30	5.6.7.8: 40

Question 4

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? In this example, there are a total of 6 subnets. The smallest IP prefix is 24. The links between the subnets 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)? 1.1.0.0/21 is the cheapest IP prefix, 2^11 (2,040) total of available addresses.

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.

Port	Destination	Subnet Mask	Interface
1	1.1.1.0/24 (Group A's subnet)	255.255.255.0	Port 1
2	1.1.2.0/24 (Group B's subnet)	255.255.255.0	Port 2
3	1.1.3.0/24 (Group C's subnet)	255.255.255.0	Port 3
D	0.0.0.0/0 (Default route to internet)	0.0.0.0	Port D

Question 5

Table 1

Size	Total Messages
5	19
10	152
15	299
20	733
25	1385
30	2078
35	3127
40	4290
45	5030
50	6145
55	10618
60	25054
65	18361
70	24990
75	40911
80	36557
85	26505
90	30832