Name: Rajal Rajesh Shetty Assignment 1 (TCP/IP)
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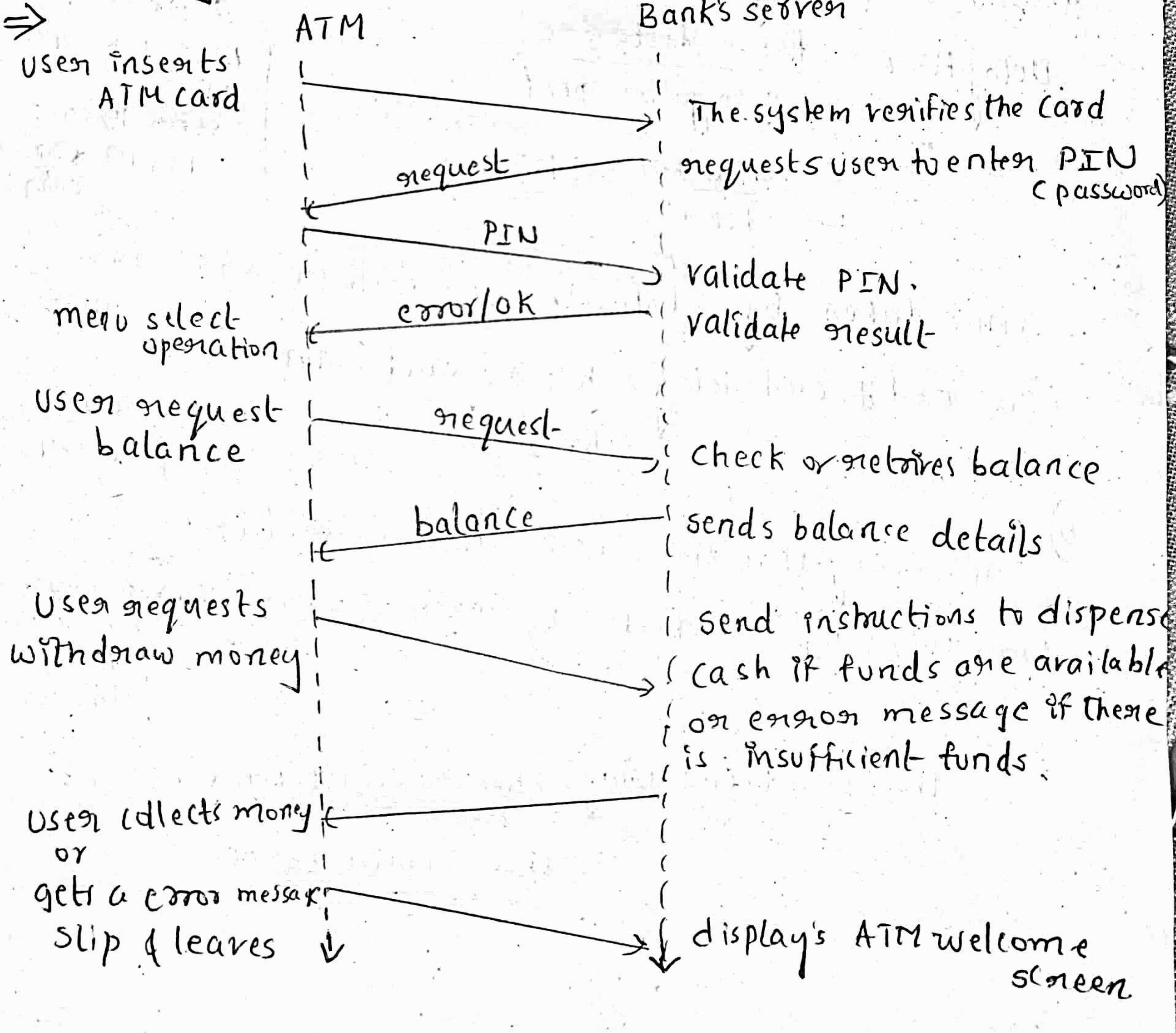
P1] Design & describe an applicatn level protocol to be used between an automatic teller machine & a bank centralized computr. Your protocol should allow a user's card & password to be verified, the account balance (which is maintained at the centralized computer) to be required or queried, & an account withdrawal to be made (that is, money disbursed to the users). Your protocol entities should be able to handle the all-too-common cases in which there is not enough money in the account to cover the withdrawal. Sketch the operatn of your protocol. Explicitly state assumption made by protocol about underlying end to end tranceport service.

⇒



P5] Review the car-caravan analog in section 1.4. Assume a propogation speed of 100 Km/hr.

a) suppose the caravan travels 150 kms, beginning in front of one tollbooth, passing through a second tollbooth, & finishing just after a third tollbooth. what is the end-to end delay?

b). Repeat (a), now assuming that there are eight cars in the caravan instead of 10.

⇒ a) suppose the caravan travels 150 km, begining in front of one tollbooth. passing through a second tollbooth, & finishing just after a third booth.

Assume a propogation speed of 100 km/hr.

$$\text{Delay time} = \frac{\text{total distance}}{\text{propogation speed}}$$

$$= \frac{150 \text{ km}}{100 \frac{\text{km}}{\text{hr}}} = \underline{\underline{1.5 \text{ hrs}}}$$

reason
12 sec to process 1 hr.
so for 10 cars
= 12 * 10 = 120 sec
= 2 min

Time taken by 3 tollbooths to reach 10 cars = 2*3
= 6 mins.

so, end to end delay : 1 hr 30 min + 6 min
= <u>1 hr 36 min</u>

reason
8x12=96

b) assuming that there are 8 cars instead of 10.

time taken by 3 tollbooths to reach 8 cars = 96*3 = 288 sec
in minutes
= 4 min
48 secs

so, the end to end delay: 1 hr 30 min + 4 min 48 secs.

⇒ <u>1 hr. 34 min 48 sec</u>

P6) This elementary problem begins to explore propagation delay & transmission delay, 2 central concepts in data networking. Consider 2 hosts, A & B, connected by a singe link of rate R bps. Suppose that 2 hosts are seperated by m meters & suppose the propogation speed along the link is s met/sec. Host A is to send a packet of size L bits to Host B.

a) Express the propogation delay, d_{prop} in terms of m & s.

b) Determine the transmission time of packet, d_{trans} in terms of L & R.

c) Ignoring processing & queuing delays, obtain an expression for end to end delay.

d) Suppose Host A begins to transmit the packet at time t=0, At time $t = d_{trans}$, where is the last bit of the packet.

e) Suppose d_{prop} is > than d_{trans}. At time $t = t_{trans}$, where is the first bit of the packet?

f) Suppose d_{prop} is < d_{trans}. At time $t = d_{trans}$. where is the first bit of the packet.

g) Suppose $s = 2.5 \cdot 108$, $L = 120$ bits, & $R = 56$ kbps. find the distance m so that $d_{prop} = d_{trans}$.

Ans
⇒ a) The propogation delay, $d_{prop} = \underline{m/s}$ sec → m → distance travelled, s → speed at which data travels in terms of m/s.

b) The transmission time of packet $d_{trans} = \underline{L/R}$ sec → L → bits R = bit/s

transmission delay is how long it takes to get all the data on network

c) end to end delay = $\underline{(L/R + m/s)}$ sec. or (Prop delay + trans delay)

d) The bit just left host A. since all bits need to be on link first before transmitting can start, the last bit of packet will have immediately just left the host.

e) The first bit is in the link & has not reached Host B (so basically its betn Host A & B).

f) The first bit is at Host B, its destination.

g) $m = (L/R) \times s$ ∴ $\frac{120}{56 \times 1000} \times 2.5 \times 10^8 = \underline{535714.28 \text{ meters}}$

P9] Consider the discussion 1.3 of packet switching verses circuit switching in which an example is provided with 1Mbps link. users are generating data at a rate of 100 kbps when busy, but are busy generating data only with probability $P = 0.1$. Suppose that the 1Mbps link is replaced by a 1Gbps link.

a. What is N, the max no of users that can be supported, under circuit switching?

b. Now consider packet switching & a user population of M users. Give Formula (in terms of p, M, N) for the probability that more than N users are sending data.

a)

$$\text{No of users (N)} = \frac{\text{total transmission}}{\text{Rate of data generate by ser when busy}}$$

$$= \frac{1\ \text{Gbps}}{100\ \text{Kbps}}$$

$$= \frac{1000 \times 10\cancel{0}\cancel{0} \times \cancel{1000}\ \text{bps}}{1\cancel{00} \times \cancel{1000}\ \text{bps}}$$

$$= \underline{10{,}000\ \text{users}}$$

$\therefore$ max no of users that can be supported under circuit switching is $\underline{\underline{10000}}$ users

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b) Consider packet switching & a user population of M users. Formula (in terms of p, M, N) for the probability that more than N users are sending data =

$$\boxed{M \sum n = N+1 \left(M p^{n} (1-p)^{M-n} \right)}$$

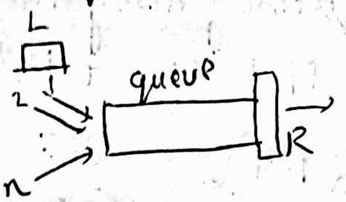
P13)

a) suppose N packets arrive simultaneously to a link at which no packets are currently being transmitted or queued. Each packet is of length L & the link has transmission rate R. what is the average queuing delay of N packets?

b) Now suppose that N such packets arrives to a link every LN/R seconds. what is the average queuing delay of a packet?

=)

a)



since the packet in this problem arrives simultaneously, all the packets are going to want to proceed at once.

∴ The first packet queuing delay = 0.

second packet queing delay = L/R.

3rd packets waits for = $2(L/R)$ sec

⋮

The Nth packet queuing delay = $(N-1)\, L/R$.

∴ The average queuing delay of Nth packet =

$$= \frac{\left(L/R + 2\, L/R + 3\, L/R + \cdots + (N-1)\, L/R \right)}{N}$$

$$= \frac{L}{(RN)} \sum_{i=1}^{N-1} i$$

$$= \left(L/RN \right) \frac{N\,(N-1)}{2} \Rightarrow \boxed{(N-1)\frac{L}{2R}}$$

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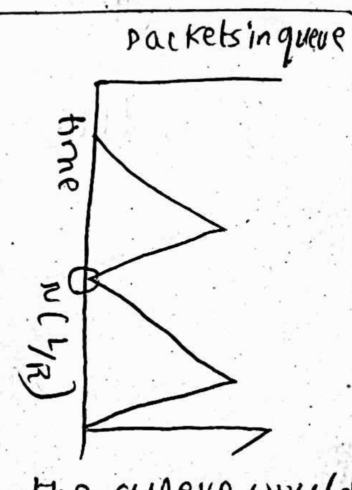
b)

To transmit N such batches, it takes LN/R sec.

∴ a new batch arrives then the queue is empty each time. Thus, the avg. delay of a packet across all batches is the avg delay within one batch,

Hence, the avg queuing delay of packet $= \underline{\underline{(N-1)\frac{L}{2R}}}$



if there was even 1 remaining packet, eventually the queue would go towards infinity & would cause issue to router/network.