Fundamentals of Communication Networks

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1. **Exercise (6 pts)**:
   A host receives 300 packets (100 TCP segments and 200 UDP datagrams). The cumulative density functions (CDF) of the size of the two types of packets are reported in Figure 1.

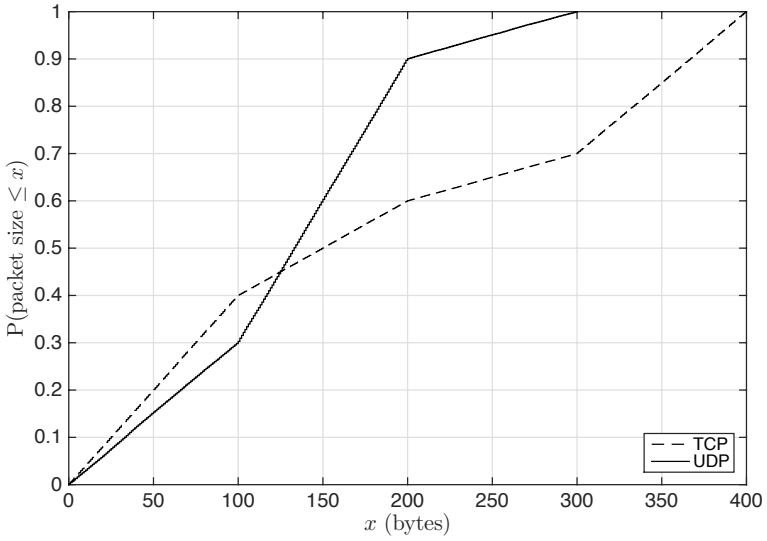

Figure 1: CDF of TCP and UDP packet sizes

   (a) Compute the joint probability distribution function indicated in Table 1 (hint: the first cell of the table should contain the probability that a received packet is a TCP segment AND its size is lower than 100 bytes).

Table 1: Joint PDF

	size ≤ 100	$100 <$ size ≤ 200	$200 <$ size ≤ 300	$300 <$ size ≤ 400
TCP				
UDP				

   (b) Compute the probability that a packet greater than 200 bytes is a TCP segment

2. **Exercise (8 pts)**
   A small enterprise purchases the IP address 15.128.224.0/20. Define an addressing plan (clearly indicating network address, network mask and broadcast address) to serve the following requirements:

   - 1 subnet, 1000 host
   - 3 subnets, 500 hosts each
   - 4 subnets, 230 hosts each

- 1 subnets, 100 hosts

How many host addresses are available after this assignment? How many point to point links can be accommodated?

3. **Exercise (6 pts)**
   Hosts A and B are interconnected through a router R. The link A-R has a capacity of 1Mbps and the link R-B of 5 Mbps. The propagation delay of both links is equal to 5 ms. Host A needs to transfer a 15 kB file to host B.
   (a) Compute the time needed to transfer the file from A to B using TCP (including the connection setup time). Assume MSS = 600 byte, SYN and ACK packets = 20 byte, RCVWND = 2400 byte, SSTHRESH = 3000 byte. Indicate the value of the transmission window as time goes by.
   (b) Repeat the computation assuming that a simple Stop-and-Wait protocol is used in place of TCP. Assume 600 bytes packets, 20 bytes ACKs and timeout = 25 ms (ignore all headers).

4. **Exercise (6 pts)**
   A router has two interfaces with the following configuration:
   - eth0: 131.79.1.1/23
   - eth1: 131.168.72.1/21

   The routing table of the router is the following:

Table 2: Routing table

Network	Netmask	Next Hop
131.168.44.0	255.255.252.0	131.168.72.3
131.175.0.0	255.255.0.0	131.168.72.3
131.175.18.0	255.255.255.0	131.79.1.3
0.0.0.0	0.0.0.0	131.79.1.3

   Indicate how the packets with the following destinations are handled by the router:
   1. 131.79.0.12 coming from eth1
   2. 131.79.1.255 coming from eth0
   3. 131.168.47.12 coming from eth0
   4. 131.0.0.6 coming from eth1
   5. 131.175.19.12 coming from eth1

5. **Question (4 pts)**
   (a) Compute the efficiency of a stop-and-wait protocol implemented over a 2Km channel characterised by a capacity of 10 Mbps and a propagation delay of 2ms/Km. Assume that packets are 1500 bit long, ACKs are negligible and the stop-and-wait timeout is 20ms.
   (b) Repeat the computation assuming a go-back-n protocol with window size equal to 4.
   (c) What is the optimal go-back-n window?

6. **Questions (4 pts - each answer can be either TRUE or FALSE)**
   In case the answer is FALSE, briefly explain why.
   - [T] [F] The Spanning Tree Protocol is implemented through the exchange of BPDU packets.
   - [T] [F] Two different VLANS connected through a switch can communicate with each other.
   - [T] [F] RIP response messages are transmitted periodically and contain distance vectors.
   - [T] [F] HTTP persistent mode is less efficient than non-persistent mode.