Fundamentals of Communication Networks

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1. **Exercise (5 pts)**:

   Two hosts A and C are connected to a host B, which acts as a relay for packets traveling from A to C. Let $P(E_{\text{AB}}) = 10^{-2}$ be the packet error rate on the link from A to B and $P(E_{\text{BC}}) = 10^{-3}$ the packet error rate on the link from B to C.

   Host B suffers from periodic malfunctionings due to over-heating: during the hottest hours of day (1PM - 6PM), host B is down 75% of the times. During the rest of the day, host B works fine.

   (a) Compute the average daily packet error rate from A to C.

   (b) Compute the packet error rate from A to C during a working day (8 AM - 6 PM)

   (c) Compute the packet error rate from A to C during the afternoon (1 PM - 6 PM)

2. **Exercise (8 pts)**

   An ISP owns the following IP address space 29.88.192.0/22 Define an addressing plan to serve the following subnetworks:

   - NET 1: 500 hosts
   - NET 2: 100 hosts
   - NET 3: 100 hosts
   - NET 4: 50 hosts
   - NET 5: 50 hosts
   - NET 6: 50 hosts
   - NET 7: 25 hosts
   - 5 point-to-point links

   For each subnet indicate network address, broadcast address and netmask.

3. **Exercise (7 pts)**

   Consider the network in Fig 1. At time $t = 0$ the output queue of R1 has five packets with destinations A,A,B,B,C. Assuming packet length of 1024 bits, compute the time each packet is completely received by its destination.

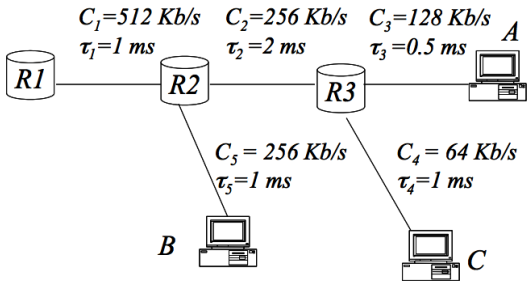

Figure 1: Network

Table 1: Routing table

Network	Next-hop	Cost
Net1	R1	1
Net2	R2	4
Net3	R3	3
Net4	R3	3
Net5	R1	2
Net6	R2	1

Table 2: distance vector

Net1	2
Net2	3
Net3	4
Net4	1
Net5	16
Net6	2

4. **Exercise (4 pts)**

   A router R runs the RIP protocol (link cost equal to 1) on all its interfaces. The neighbouring routers are R1, R2 and R3 and R has the routing table illustrated in Table 1:

   Assuming that R receives from R1 the distance vector reported in Table 2, write the new routing table on R after updating. What happens if R receives a packet with destination Net5?

5. **Question (6 pts)** Host A has to transmit a 76KByte file to Host B using UDP. The link from A to B has a capacity of 1Mbps and a propagation delay of 2ms. The maximum length of a UDP packet (including all headers) on the link from A to B is 1.5 KBytes. Considering that the layer 2 header is 36 bytes, the IP header is 160 bytes and the UDP header is 64 bytes, and assuming no errors, compute:
   (a) How many UDP datagrams will be transmitted
   (b) How much overhead information is transmitted in percentage
   (c) The transfer time of the file (assume a stop-and-wait transmission scheme with ACKs of negligible length)

6. **Questions (4 pts - each answer can be either TRUE or FALSE)**

   In case the answer is FALSE, briefly explain why.

   - [T] [F] HTTP in non-persistent mode requires to open one TCP connection for each request-response cycle.
   - [T] [F] FTP requires a single TCP connection between the client and the server for each file exchanged.
   - [T] [F] Store-and-Forward is always less efficient than Cut-Through
   - [T] [F] The TTL field of an IP packet can be used to count the number of routers from the source of the destination