

Fundamentals of Communication Networks

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September, 23 2016

1. **Exercise (6 pts):**

Consider the TCP three-way handshake between two hosts A and B, where host A starts the connection. Compute the probability that the three-way handshake fails when:

- The link connecting A and B is symmetric and characterized by a packet error rate (PER) of 10^{-1} in both directions
- The link connecting A and B is asymmetric and characterized by a PER_{AB} of 10^{-1} from A to B and a PER_{BA} of 5×10^{-2} from B to A
- The link connecting A and B is symmetric and characterized by a bit error rate (BER) of 2×10^{-5} in both directions. Assume that all frames transmitted during the three way handshake have the same size $L = 1000$ bits, and that a frame is lost if at least 1 bit is lost.

2. **Exercise (8 pts)**

An ISP owns the following IP address space 165.124.76.0/23 Define an addressing plan to serve the following subnetworks:

- NET 1: 110 hosts
- NET 2,3,4 and 5: 60 hosts
- NET 6,7,8 and 9: 28 hosts

For each subnet indicate network address, broadcast address, netmask and maximum number of hosts.

3. **Exercise (8 pts)** In the network below, host A establishes a TCP connection with host B. Assuming

- Header and ACK lengths negligible
- Bidirectional links
- $MSS = 1000$ [byte]
- $RCWND = 8000$ [byte]
- $SSTHRESH = 4000$ [byte]

Compute the time needed to transfer a file of 100 kB from A to B (from TCP connection setup to reception of the last ACK packet) assuming $C_1 = 1$ Mbps, $C_2 = 10$ Mbps, $\tau_1 = 5$ ms, $\tau_2 = 3$ ms.



Figure 1: Network topology

4. **Exercise (8 pts)** A router has the following interface configuration and routing table:

Eth0: 180.12.144.254/26
Eth1: 180.12.144.25/26
Eth2: 180.12.144.180/26

Indicate how packets with the following destinations are handled by the router.

- 180.12.144.95

Table 1: Routing Table

Network	Mask	Next Hop
180.12.144.64	255.255.255.192	180.12.144.253
180.12.144.0	255.255.254.0	180.12.144.40
180.12.145.0	255.255.255.192	180.12.144.130
180.12.145.64	255.255.255.192	180.12.144.200
0.0.0.0	0.0.0.0	180.12.144.150

- (b) 180.12.144.222
- (c) 180.12.145.121
- (d) 180.12.145.203
- (e) 180.12.144.190
- (f) 180.12.146.34

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

In case the answer is FALSE, briefly explain why.

- T F In RIP, each router transmits its distance vectors to all routers in the network.
- T F In an IP network, two packets with the same source and destination addresses will always take the same route.
- T F Flow control in TCP is performed thanks to the RCWND.
- T F The codes $c1 = \{1,-1,-1,1\}$ and $c2 = \{-1,-1,1,1\}$ are orthogonal.