Fundamentals of Communication Networks

Prof. Alessandro Redondi

February, 29 2016

1. **Exercise (5 pts)**:
   Two hosts A and B are connected to a host C. Let $P(A)$ be the packet error rate on the link from A to C and $P(B)$ the packet error rate on the link from B to C. Consider the following joint probability distribution:

	B	$\bar{B}$
A	0.05	0.05
$\bar{A}$	0.1	0.8

   Table 1: Joint probability distribution

   (a) Show that the distribution in Table 1 is a valid joint probability distribution.

   (b) Compute the packet error rate on the two links by computing the marginal probabilities $P(A)$ and $P(B)$.

   (c) Are the packet errors on the two links independent?

   (d) Compute the probability that a packet received from A is corrupted when a packet from B is corrupted.

2. **Exercise (7 pts)**
   A small enterprise purchases the IP address 175.203.80.0/20.
   (a) Define an addressing plan to serve the following requirements:

      - 2 subnets, 1000 hosts each
      - 2 subnets, 500 hosts each
      - 3 subnets, 200 hosts each
      - 5 subnets, 15 hosts each

   (b) How many point-to-point links can be addressed, in addition to the subnets specified at point (a)?

3. **Exercise (6 pts)**
   Host A is connected to host B through a router R and it establishes a TCP connection with host B. The capacities and propagation delays of the two links (A-R) and (R-B) are: $C_1 = 1$ Mbps, $\tau_1 = 0.5$ms and $C_2 = 5$ Mbps, $\tau_2 = 1$ms, respectively.
   Assuming:

   - MSS = 1000 byte
   - SSTHRESH = 4000 byte
   - RCWND = 8000 byte
   - ACK and headers are negligible
   - bidirectional links

   Compute the time needed to transfer a 300 kB file from A to B (from the connection setup to the reception of last ACK at A).

4. **Exercise (4 pts)**
   Two hosts A and B are connected through a switch S. Let MAC-A and IP-A be the layer 2 and 3 addresses of A and MAC-B, IP-B the addresses of B. Host A transmits an IP packet to B. Assuming that (i) the forwarding table of S is already stable and (ii) the ARP table of A is empty, indicate which packets are generated and transmitted in order to deliver the IP packet to B. For each packet indicate the addresses included in the layer 2 (MAC) and layer 3 (IP or ARP) headers.

5. **Question (6 pts)**

   Given the two networks:

   - eth0: 129.174.16.0/20

   - eth1: 129.174.128.0/20

   Indicate for each of the following addresses if it is a host or broadcast address and to which network it belongs (eth0, eth1 or none of the above).

   (a) 129.174.130.255

   (b) 129.174.28.66

   (c) 129.174.0.255

   (d) 129.174.31.255

   (e) 129.174.17.255

   (f) 129.174.143.255

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

   In case the answer is FALSE, briefly explain why.

   - $\boxed{\text{T}}$ $\boxed{\text{F}}$ Let η_{GBN} and η_{SR} denote the efficiency of go-back-N and selective repeat ARQ mechanisms, respectively. We always have: $\eta_{\text{GBN}} < \eta_{\text{SR}}$.

   - $\boxed{\text{T}}$ $\boxed{\text{F}}$ In an IP network, two packets with the same source and destination addresses will always take the same route.

   - $\boxed{\text{T}}$ $\boxed{\text{F}}$ Flow control avoids that the traffic on a link exceeds the link capacity.

   - $\boxed{\text{T}}$ $\boxed{\text{F}}$ IP could be used as an unreliable transport protocol if hosts executed only one application.