SCHDF0018 - HIGHER DIPLOMA IN COMPUTER SCIENCE EXAMINATION
ARBDF0015 – THIRD YEAR ARTS EXAMINATION
SCBDF003 / SCBDF0015 – THIRD YEAR SCIENCE & B.Sc. (GENERAL) DEGREE EXAMINATION

COMPUTER SCIENCE

COMPP303: Networks and Internet Systems
COMP3616: Networks and Internet Systems
COMP 3008: Networks and Internet Systems

OUTLINE SOLUTIONS WINTER 2005
Dr. J. Murphy

Question 1

(1-a) Distributed scripts: although actual communication is "vertical" (except in the physical medium), peer entities – at same layer, but in 2 different computers – are programmed as if data transmission were "horizontal". Together, these peer entities execute *distributed scripts.*

(1-b) TCP: retransmissions can lead to high delay and delay jitter; doesn't support multicast; slow start congestion control mechanism not suitable for continuous media.
UDP: traditionally, no retransmissions or congestion control; supports multicast.

(1-c) propagation delay = (500)/(250,000) = 2 millisec
packet transmission time = (10,000)/(10,000,000) = 1 millisec, or 1,000 microsec
therefore number of packets in transit = (2)/(1) = **2 packets**.

(1-d) least-cost routing: a value is assigned to each link in the network – this is the *cost* of using this link. The cost of a route is the combination (not necessarily additive) of the link costs. The best route is the one with the lowest cost, which therefore determines how to relay incoming packets. Possible link costs include:

- 1 for each link – finds route with the *fewest hops*
- (financial) cost of using the link – finds *cheapest* route
- packet delay on the link – finds *minimum-delay* route
- packet transmission time on the link – finds *maximum-bandwidth* route

Question 2

(2-a) TRANSF = 400 microseconds;
TIMEOUT = TRANSA + 2×(PROP+PROC), since TIMEOUT chosen optimally
= 40 + 2×(20+10) = 100 microseconds;

therefore $\textbf{throughput}_{SW} = (1 - 0.01)/((400+100)\times 10^{-6})$ = **1,980 packets/second** (*not* frames/second)

and $\textbf{throughput}_{GBN} = (1 - 0.01)/((400+(0.01\times 100))\times 10^{-6})$ = **2,468.83 packets/second**

(2-b) see lecture notes.

Question 3

(3-a)

1. In Ethernet, each node's physical address is guaranteed to be globally unique: TRUE.

2. The General Parity Check error-handling scheme, in which the receiver takes the closest valid codeword (in Hamming distance) to the received word to be the transmitted codeword, can detect any combination of bit errors: FALSE.

3. In any flow control scheme, if the receiver cannot handle the sender's current transmission rate it must send an explicit "slow down" signal to the sender: FALSE.

(3-b) Using the formula **`throughput = 1/(TRANSF + 5.4´PROP)`**,

1. If the length of the channel is increased, then PROP increases, therefore throughput **increases**.

2. If the average frame length is decreased, then TRANSF decreases, therefore throughput **decreases**.

Question 4

(4-a) desirable properties of a routing algorithm:

- correctness, simplicity, efficiency – obviously
- robustness – since usually the entire network can't be "re-booted" !!!
- stability – routing algorithm reaches equilibrium in a reasonable time
- fairness, optimality (often in conflict)
    - optimality – with respect to what ? What are we trying to optimise ?!
      -- average Packet delay ? total Packet throughput ?
      -- but these goals are also in conflict: operating any network near capacity implies long queueing delays in node buffers
      -- compromise – minimise number of relays (or hops) a Packet needs

(4-b) ***distance-vector:*** each router exchanges information about the entire network with neighbouring routers at regular intervals. Neighbouring routers = connected by a direct link (e.g. a LAN); regular intervals: e.g. every 30 seconds. Information exchanged = routing tables (details in lecture notes).

link-state: each router exchanges information about its neighbourhood with all routers in the network when there is a change. Neighbourhood of a router = set of neighbour routers for this router; each router's neighbourhood information is <u>flooded</u> through the network; change: e.g. if a neighbouring router does not reply to a status message. Information exchanged = link-state packets (details in lecture notes).

link-state converges faster in practice, so more widely used (converges = determines optimal routes, given a particular network topology).

Question 5

(5-a)

Transmission number	**Sender's Congestion Window (kB)**	Threshold (kB)
0	**2**	64
1	**4**	64
2	**8**	64
3	**16**	64
4	**32**	64

5	**2**	16
6	**4**	16
7	**8**	16
8	**16**	16
9	**18**	16
10	**20**	16
11	**2**	10

(5-b) see lecture notes.