SCHDF0018 - HIGHER DIPLOMA IN COMPUTER SCIENCE EXAMINATION
ARBDF0015 – THIRD YEAR ARTS EXAMINATION

COMPUTER SCIENCE

COMPP303: Networks and Internet Systems
COMP3616: Networks and Internet Systems

OUTLINE SOLUTIONS SUMMER 2004
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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 = (23)/(230,000) = 0.1 millisec, or 100 microsec
packet transmission time = (10,000)/(10,000,000) = 1 millisec, or 1,000 microsec
therefore number of packets in transit = (0.1)/(1) = (100)/(1000) = **0.1 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
= 50 + 2×(10+PROC) = 70 + 2×PROC microseconds;

$\textbf{throughput}_{\textbf{SW}}$ = (1 – 0.02)/((400 + 70 + 2×PROC) $\times 10^{-6}$) = (0.98)/((470 + 2×PROC) $\times 10^{-6}$) ≥ **2000**
therefore (470 + 2×PROC) $\times 10^{-6}$ ≤ (0.98)/(2000) = 490$\times 10^{-6}$
therefore 470 + 2×PROC ≤ 490
therefore 2×PROC ≤ 20, so max value is **PROC = 10 microsec**

$\textbf{throughput}_{\textbf{GBN}}$ = (1 – 0.02)/((400+(0.02×(70 + 2×PROC))) $\times 10^{-6}$) = (0.98)/((401.4+(0.04×PROC)) $\times 10^{-6}$) ≥ **2000**
therefore (401.4+(0.04×PROC)) $\times 10^{-6}$ ≤ (0.98)/(2000) = 490$\times 10^{-6}$
therefore 401.4+(0.04×PROC) ≤ 490
therefore 0.04×PROC ≤ 88.6, so max value is **PROC = 2215 microsec**

(2-b) in a CSMA/CD scheme, MMAT = ∞ since even with random waiting times, a node's transmission attempts may collide every time (see lecture notes, or any computer networks textbook, for details).

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 **decreases**.

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

Question 4

(4-a) ***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 flooded 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 (where converges = determines optimal routes, given a particular network topology).

(4-b) A Gateway (or Protocol Convertor) is usually a piece of software installed in a router. The Gateway software understands all the protocols used by networks to which the router is connected, so it can translate from one to another: it may have to operate in all 7 layers of the OSI Model (i.e. up to the Application layer). Adjustments to incoming packets could include changes to: values in header and/or trailer fields; data rate; size of packet; or even entire format of the packet. *(more details in lecture notes)*

Question 5

(5-a) First determine the sender's subnet number:

```
       10000000 01100000 00100010 00001100
       11111111 11111111 11111111 11000000
  AND ------------------------------------------------
       10000000 01100000 00100010 00000000
```

which (converting back into dotted-decimal notation) is a subnet number of **128.96.34.0**. Next, the bitwise AND of the destination address and the sender's subnet mask yields

```
       10000000 01100000 00100010 10001011
       11111111 11111111 11111111 11000000
  AND ------------------------------------------------
       10000000 01100000 00100010 10000000
```

which in dotted-decimal form is **128.96.34.128**. This does not match the sender's subnet number, so the destination is **not** on its subnet and the packet must be sent to a router.

(5-b) see lecture notes.