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 2003
Dr. L. Murphy

Question 1

(1-a) the minimum Hamming distance (or "minimum distance") of the scheme is the smallest number of bit errors that changes one valid codeword into another. If the way of computing the check bits is known, a list of all the valid codewords can be compiled and stored at the receiver. When a word W is received, the receiver finds the closest valid codeword to W (in Hamming distance) and takes this codeword as the transmitted codeword.
Limitations: if the minimum distance of an error-handling scheme is D, this scheme can detect any combination of less than or equal to D-1 bit errors and correct any combination of strictly less than D/2 bit errors (alternatively: if you want to detect B bit errors, use a scheme with minimum distance at least B+1; if you want to correct B bit errors, use a scheme with minimum distance at least 2B+1).

(1-b) packet transmission time pkt_trans = (1000)/(1000000) = 1 millisecond. Therefore total travel time for a packet = (pkt_trans) + 4×(3×pkt_trans) = 13 milliseconds.

(1-c) in the Lecture Notes (or any computer networks textbook).

(1-d) A port is a conduit into a computer through which data flows. Can have **multiple application processes on a single host**, each with their own port number. A process is uniquely addressed by a <port, host> pair. Common applications are available at well-known (and reserved) ports on each host; user applications must choose from the set of non-reserved ports (generally, above 1023).

Question 2

(2-a) **X = 3, Y = 0, Z = 3, W = 3**

(2-b) 1. TRANSF = 200 microseconds;
TIMEOUT = TRANSA + 2×(PROP+PROC), since TIMEOUT chosen optimally
= 40 + 2×(10+10) = 80 microseconds;
therefore throughput = $(1 - 0.02)/((200+(0.02\times 80))\times 10^{-6})$ = **4,861.11 packets/second** (*not* frames/second)

2. If Stop-and-wait ARQ scheme used instead of Go-back-n, throughput will be lower (in this case, $\text{throughput}_{SW} = (1 - 0.02)/((200 + 80)\times 10^{-6})$ = 3,500 packets/second). But this comes with the benefits of lower complexity and (slightly) lower overhead to indicate packet sequence numbers. Also, Stop-and-wait throughput may be sufficient for the purposes of the application(s) being supported.

Question 3

(3-a) Using the formula **`throughput = 1/(TRANSF + 5.4´ PROP)`**, to increase the throughput:

1. decrease TRANSF – either by **decreasing the average frame length**, or by **increasing the node transmission rate**.
2. decrease PROP – either by using a **shorter channel**, or by **replacing the channel with a material which has higher signal propagation speed** (may be feasible e.g. replace fibre with co-ax).

(3-b) 1. divide the channel into **independent sub-channels**, one for each transmission (e.g. using TDM or FDM) – turns the channel into a set of point-to-point links.

2. **reservations**: a node must obtain the token (giving permission to transmit) before transmitting; when finished, node releases the token to its neighbour. Modification – token doesn't have to be passed from neighbour to neighbour, as long as all nodes get (maybe unequal) chances to transmit.

Question 4

(4-a) **A:**

Network ID	**Cost**	**Next Hop**
12	**1**	**–**
10	**1**	**–**

B:

Network ID	**Cost**	**Next Hop**
12	**1**	**–**
90	**1**	**–**
7	**1**	**–**

C:

Network ID	**Cost**	**Next Hop**
10	**1**	**–**
90	**1**	**–**
6	**1**	**–**

D:

Network ID	**Cost**	**Next Hop**
7	**1**	**–**

When C receives B's initial routing table, since B is 1 hop from C, C modifies B's table as follows:

Modified B:

Network ID	Cost	Next Hop
12	2	B
90	2	B
7	2	B

The only entry in common is for Network 90, and C's original entry is lower-cost, so C's new table is

C:

Network ID	**Cost**	**Next Hop**
10	**1**	**–**
12	**2**	**B**
90	**1**	**–**
6	**1**	**–**
7	**2**	**B**

If C then receives A's initial table, since A is 1 hop from C, C modifies A's table as follows:

Modified A:	Network ID	Cost	Next Hop
	12	2	A
	10	2	A

The entries in common are for Networks 12 and 10. In both cases the information from A is not lower-cost, so C's new table is unchanged:

C:	**Network ID**	**Cost**	**Next Hop**
	10	**1**	**–**
	12	**2**	**B**
	90	**1**	**–**
	6	**1**	**–**
	7	**2**	**B**

(4-b)

A:	**Advertiser**	**Network**	**Cost**	**Neighbour**
	A	**12**	**1**	**B**
	A	**10**	**4**	**C**

B:	**Advertiser**	**Network**	**Cost**	**Neighbour**
	B	**12**	**3**	**A**
	B	**90**	**1**	**C**
	B	**7**	**1**	**D**

C:	**Advertiser**	**Network**	**Cost**	**Neighbour**
	C	**10**	**2**	**A**
	C	**90**	**3**	**B**
	C	**6**	**1**	**–**

D:	**Advertiser**	**Network**	**Cost**	**Neighbour**
	D	**7**	**3**	**B**

C uses Dijkstra's shortest-path algorithm to determine its shortest-path spanning tree, as in Lecture Notes (or any standard textbook). Result of first five steps is shown in attached Figure (alternative sequences of steps exist due to details of how ties are broken).

<u>Question 5</u>

(5-a) in the Lecture Notes (or any computer networks textbook).

(5-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: no retransmissions; supports multicast; no congestion control (traditionally).