

ARBDF0015 – THIRD YEAR ARTS EXAMINATION

COMPUTER SCIENCE

COMP3616: Networks and Internet Systems

OUTLINE SOLUTIONS FOR AUTUMN EXAM 2002

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Question 1

(1-a) Hierarchical modularity: computer network software is structured as a hierarchy of layers. Each layer offers certain *services* to the higher layers, while hiding from the higher layers the *details* of how those services are implemented – this is hierarchical modularity.

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) UDP: connectionless transport protocol ; TCP: connection-oriented transport protocol.
UDP: 8 byte header; TCP: 20-60 byte header.
UDP: no flow/congestion control; TCP: supports flow/congestion control (sliding window).
UDP: unreliable delivery; TCP: reliable (using ACKs and Timeouts).
UDP: transports IP packets; TCP: byte-oriented, doesn't preserve message boundaries end-to-end.

(1-c) token = special frame that is passed from one node to the next. A node may only transmit Frame(s) when it has the token. When a node receives the token, it removes it from the ring (“removing the token” means changing it into the start of a data Frame) and transmits one Frame, then puts the token back on the ring (i.e. transmits it to next node). Since only one node can hold the token at any given moment, no collisions can occur.

(1-d) node throughput = 50 frames/sec, or $(50 \times 2,500) = 125,000$ bits/sec
system throughput = $100 \times (\text{node throughput}) = 5,000$ frames/sec, or 12,500,000 bits/sec
maximum system rate = $(100,000,000 / 2,500) = 40,000$ frames/sec, or 100,000,000 bits/sec
efficiency = $(5,000 / 40,000)$ or $(12,500,000 / 100,000,000) = \mathbf{0.125, \text{ or } 12.5\%}$

Question 2

(2-a) TRANSF = 200 microseconds;
TIMEOUT = TRANSF + 2×PROP, since TIMEOUT chosen optimally and PROC=0
= 40 + 2×20 = 80 microseconds;

there fore $\text{throughput}_{\text{sw}} = (1 - 0.02) / ((200 + 80) \times 10^{-6}) = \mathbf{3,500 \text{ packets/second}}$ (not frames/second)

and $\text{throughput}_{\text{GBN}} = (1 - 0.02) / ((200 + (0.02 \times 80)) \times 10^{-6}) = \mathbf{4,861.11 \text{ packets/second}}$

Since we wanted a throughput of at least 4,500 packets/sec, Go -back-n can be used but Stop-and-wait can't.

(2-b) see lecture notes.

Question 3

(3-a) Using the formula $\text{throughput} = 1 / (\text{TRANSF} + 5.4 \cdot \text{PROP})$,

1. If the node transmission rate is increased, TRANSF decreases, therefore throughput **increases**.
2. If the average frame length is decreased, TRANSF decreases, therefore throughput **increases**.

(3-b)

1. In Ethernet, a node wishing to transmit might never be allowed to access the channel: **TRUE**.
2. The reason for a minimum Ethernet frame length is to ensure a minimum level of efficiency: **FALSE**
3. Token Ring efficiency cannot approach 100% under any conditions: **FALSE**
4. In a Token Bus, each node connected to the bus (whether it is in the logical ring or not) receives each frame transmitted on the bus: **TRUE**.

Question 4

(4-a) 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 of the values of its links. The best route is the one with the lowest cost, therefore know 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

(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 **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).

Question 5

(5-a)	Transmission no.	Sender's Congestion Window (kB)	Threshold (kB)	Rcvr. Window (kB)
	0	4	64	24
	1	8	64	24
	2	16	64	24
	3	24	64	24
	4	24	64	24
	5	4	12	24
	6	8	12	24
	7	12	12	24
	8	16	12	24
	9	20	12	24
	10	20	12	20
	11	20	12	20

(5-b) Details of IPv4 addressing – in lecture notes. Can determine which class a given IPv4 address belongs to by the first few bits (A: starts with 0; B: starts with 10; C: starts with 110), or equivalently, by the numerical value of the first byte (A: 1-126; B: 128-191; C: 192-223).