

**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 AUTUMN 2003
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Question 1

- (1-a) Ethernet CSMA/CD – try to reduce the *likelihood* and *effects* of a collision:
- CSMA: a node wishing to transmit must first listen to the channel (e.g. by measuring the channel's voltage level). If the channel is busy, some other node is transmitting and our node must wait until it detects that the channel is idle. When the channel is determined to be idle, our node can transmit.
 - CD: during transmission, our node listens to the channel and if another transmission is detected (e.g. higher voltage level than expected for one transmission), all nodes involved in the collision stop transmitting immediately. Each node then computes a randomly sized time interval, waits for that amount of time, and begins the transmission attempt again.
 - Problem: even with Carrier Sensing before transmission, collisions can still occur because it takes non-zero time for signal to propagate along the channel. If the propagation time along the length of the channel is denoted by τ , can show that the *worst-case collision detection time* is (approximately) 2τ
- (1-b) in the Lecture Notes (or any computer networks textbook).
- (1-c) Details of IPv4 addressing – in the Lecture Notes (or any computer networks textbook). Can determine which class a given IPv4 address belongs to by examining 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).
- (1-d) node throughput = 50 frames/sec, or $(50 \times 2,000) = 100,000$ bits/sec
system throughput = $50 \times (\text{node throughput}) = 2,500$ frames/sec, or 5,000,000 bits/sec
maximum system rate = $(10,000,000 / 2,000) = 5,000$ frames/sec, or 10,000,000 bits/sec
efficiency = $(2,500 / 5,000)$ or $(5,000,000 / 10,000,000) = \mathbf{0.5}$, or **50%**

Question 2

- (2-a) TRANSF = 400 microseconds;
TIMEOUT = TRANSA + $2 \times (\text{PROP} + \text{PROC})$, since TIMEOUT chosen optimally
= $40 + 2 \times (20 + 10) = 100$ microseconds;

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

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

- (2-b) see lecture notes.

Question 3

(3-a)

1. In Ethernet, if the node transmission rate is increased while all other parameters are held constant, the throughput increases: TRUE.
2. The IEEE 802.2 Logical Link Control protocol is specific to the technology being used in a particular broadcast Local Area Network, and therefore must be defined separately for Ethernet, Token Ring, Token Bus, etc: FALSE.
3. The Single Parity Check can correct a single bit error in a transmitted codeword: FALSE.

(3-b) **Circuit-switching:** a path is set up in the network between the sender and the receiver, by making the appropriate connections in network switches.

- the necessary network resources are reserved for the connection prior to any data transfer; if this is not possible, the connection request is blocked.
- these reserved resources are held for the duration of the connection, regardless of actual usage.

Virtual circuit packet switching: a route is set up in the network between sender and receiver, by making appropriate entries in network routers' routing tables.

- resources may or may not be reserved for this route. If resources need to be reserved and are not available, the connection request is blocked.

Principal differences:

- Circuit switching creates a path in the network; virtual circuit p.s. creates a route which exists only in software.
- In circuit switching, the links in the path cannot be shared during the connection; in virtual circuit p.s. they can.
- Also, c-s is ideal for "smooth" network traffic, whereas v-c is ideal for bursty traffic (especially if it's long-lived &/or interactive).

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 **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 (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.