EE 4004 '05
KOMC 1/3

EE4004 Summer 2005

2 (b)

(i) Different Switching Procedures in WAN

1. Circuit Switching
2. Packet Switching
   → Datagram mode
   → Virtual circuit mode

[4 marks]

(ii) X.25 Packet

Flag 01111110
Address (1-3 bytes)
Control (1-2 bytes)
Header (3 bytes)
Data (≤ 4096 bytes)
Frame Check Sequence (high)
Frame Check Sequence (low)
Flag 01111110

X.25 packet: Header (3 bytes), Data (≤ 4096 bytes)

Total X25 encapsulation: Flag to Flag

The Flag is used to mark the beginning and end of the packet
The Address is used for network routing
Control contains flow and set-up information
The X.25 packet itself has header information and the data to be carried.
The FCS is used for error detection/correction.

[6 marks]

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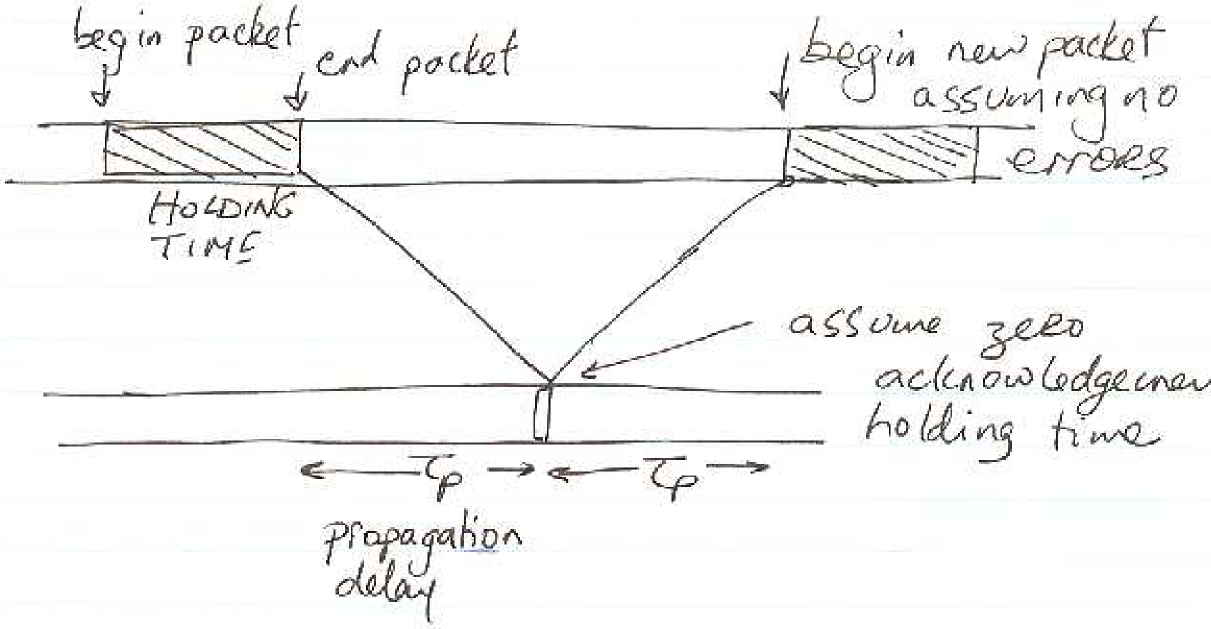
3(a)



Total Time to Transmit one Packet & Receive Acknowledgement

$$TT = H + 2\tau_p$$

Utilisation $\quad u = \dfrac{H}{TT} = \dfrac{H}{H + 2\tau_p} = \dfrac{1}{1 + \frac{2\tau_p}{H}}$

$H = \dfrac{n}{r}$, n = no of bits in packet, r = channel data rate

If there are errors, the probability that a packet with n bits will arrive with no errors is

$$(1-p)^n$$

If M packets are sent only

$M(1-p)^n$ will be correct

to guarantee one correct we need

$$1 = M(1-p)^n \Rightarrow M = \frac{1}{(1-p)^n}.$$

The total time used is thus increased by the factor M i.e.

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$$U = \frac{H}{M \cdot TT} = \frac{(1-p)^n H}{H + 2\tau_p}$$

$$= \frac{(1-p)^n}{1 + \frac{2\tau_p}{H}} = \frac{(1-p)^n}{1 + \frac{2\tau_p r}{n}}$$

[10 marks]

3(b) For given p, τ_p, r, U is a maximum when

$$\frac{dU}{dn} = 0$$

[Aside: if $y = (1-p)^x$, $\ln y = x \ln(1-p)$

$\frac{d}{dx}(\ln y) = \frac{1}{y}\frac{dy}{dx} = \ln(1-p)$

$\Rightarrow \frac{dy}{dx} = y \ln(1-p) = (1-p)^x \ln(1-p)$]

$$\frac{du}{dn} = \frac{\left(1 + \frac{2\tau_p r}{n}\right)(1-p)^n \ln(1-p) - (1-p)^n \left[-\frac{2\tau_p r}{n^2}\right]}{\left(1 + \frac{2\tau_p r}{n}\right)^2}$$

Setting this to zero:

$$\ln(1-p)\, n^2 + 2\tau_p r \ln(1-p)\, n + 2\tau_p r = 0$$

$$\Rightarrow n = \frac{-2\tau_p r \ln(1-p) - \sqrt{[2\tau_p r \ln(1-p)]^2 - 4\ln(1-p)(2\tau_p r)}}{2\ln(1-p)}$$

[8 marks]

3(c) Putting $r = 10$ kbps, $\tau_p = 10$ms, $p = 0.001$ in the formula gives

$$n = 358$$

[2 marks]