**T03: Data Link Layer I**

**Q1:** Consider the case of transmitting 1250 Bytes frame over on a link with a delay of 200ms (millisecond) when the length of the link is 200km. Assume that acknowledgment packets are of negligible size, processing time at a node is negligible, and the link is error-free.

Calculate the transmission efficiency of following ARQ methods if the bandwidths and the lengths of the link are 1Kbps, 1Mbps, 1Gbps and 20Km, 200Km, 2000Km, 20000Km respectively.

a. Stop-and-wait ARQ?

Frame size = L = 1250 \* 8 bits = 10,000 bits

Prop rate = 200km/(200\*10-3s) = 1000km/s

Tframe = L/(Transmission rate) (in seconds)

Tprop = Distance/(prop rate) (in seconds)

Graphical user interface, text, application, chat or text message

Description automatically generated

1. 1Kbps and 20Km

Tframe = 10,000/1,000 = 10s

Tprop = 20/1,000 = 0.02s

A = 0.02/10 = 0.002

S = 1/1.004 = 0.996 (99.6%)

1. 1Mbps and 2,000Km

Tframe = 10,000/1,000,000 = 0.01s

Tprop = 2,000/1,000 = 2s

A= 2/0.01 = 200

S= 1/401 = 0.0025 (0.25%)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 20Km | 200Km | 2,000Km | 200,000Km |
| 1Kbps | 99.6% |  |  |  |
| 1Mbps |  |  | 0.25% |  |
| 1Gbps |  |  |  |  |

1. Go-Back-N ARQ where W is large enough to keep the channel fully busy?

W >= 2a+1

1. Selective-Repeat ARQ where W is 7?
2. A = Tprop / Tframe = 0.02/10 = 0.002, W > 2a+1 s=1 (100%)
3. 2/0.01 = 200, W < 2a+1 s= w/(1+2a)=7/401=0.0175 (1.75%)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 20Km | 200Km | 2,000Km | 200,000Km |
| 1Kbps | 100% |  |  |  |
| 1Mbps |  |  | (1.75%) |  |
| 1Gbps |  |  |  |  |

**Q2:** Consider a sliding window protocol (Go-Back-N ARQ) used for flow control on a given data link where the data rate is 8,000 bits/second, the propagation delay is 0.25 second, and the frame size is 1600 bits. Assume that acknowledgment packets are of negligible size, processing time at a node is negligible, and the link is error-free.

What is the minimum window size which will allow full utilization (efficiency) of the link?

Tprop = 0.25

L= 1600 bits

Tframe = 1,600/8,000 = 0.2s

A = Tprop / Tframe = 0.25/0.2 = 1.25

1 + 2a = 3.5

For s =1, W must be >= 1+2a. Wmin round must be 4.

**Q3:** Assume data in 8-bit words as shown below: 10011001 11100010 00100100 10000100

CNCO2000

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Tutorial 03



1. Calculate the checksum at the sender’s end and the receiver’s end

10011001

11100010

101111011

1

01111100

1. State an example of an error that checksum fails to detect?

If the strings are the same but in different order it is wrong but will be accepted

**Q4:** Given the data word (1011011), or data polynomial D(x) = x6 + x4 + x3 + x[[1]](#footnote-1) + 1 and given the generator polynomial G (x) = x + 1?

1. Find the codeword C(x)
2. Assume the received message H (x) is

**H(x) = C(x) + E(x)**, where E(x) is the error polynomial

* 1. When H(x) contains no errors show that H(x) is divisible by G(x)
  2. Determine whether the error is detectable when:
     + E(x) = 1
     + E(x) = x + 1
     + E(x) = x3 + x

1. | P a g e [↑](#footnote-ref-1)