Q1: Solution

a) There are 2 things are needed to be modified: The frame header and transmitter operation.

• The frame header needs to be changed to recieve the list of frames, when the reciever show that which frames are needed to be sent.

• Transmitter operation. It can be used to skip retransmission of frames that have already been received, if the recieved list includes oldest frames that aren’t received.

b)

There will be an signifiant increase of performance if the error rate or delay is high. A single frame can ask for the retransmission of several frames. The complexity of the protocol will improve to the unchanged Selective repeat ARQ

Q2: Solution

D (Distance) = 375,000 km = 375 x 10^6   m

c (Speed of Light) = 3 x 10^8  m

R = 1,5 Mbps = 1,5 x 10^6 bps.

We have:

Maximum Send Window:

For Default HDLC Frame:

Go Back N : 7

Selective Repeat : 4

For Extended HDLC Frame:

Go Back N : 127

Selective Repeat : 64

Round Trip Propagation Delay: RTT

                       RTT = 2 x Propagation delay = 2 \*D /c = 2 \* 375\*10^6/(3\*10^8) = 2.5 s

Possible Frame Size (bits): Nf

                       N x Nf / R = RTT => Nf = 2.5 \* 1.5 \* 10 ^6 / N ( N is maximum send window size)

* Minimum frame size => Maximum send window size

For Go-Back-N:

With N = 7 : Nf = 535 715 bits

With N = 127: Nf = 29 528 bits

For Selective Repeat:

With N = 4: Nf = 973 500 bits

With N = 64: Nf =  58 594 bits

Q3: Solution

a.

For sending a single real-time telephone speech signal across a packet network with a maximum delay of 20 ms, there are four adaptation functions are necessary:

1. Reliability and sequencing: To prevent lossing or misordering. When the receiver end, packets must be sequenced and arranged as well as detected and corrected for errors.
2. Time: To keep the required time gaps between packets, the network must synchronize its clock with the sender and reciever.
3. Pacing and flow control: To prevent packet loss due to congestion, it control the rate at which packets are transmitted and received to meet the required the capacity of the network.
4. Addressing: To identify the source and destination of each voice sample, also enables routing of packets through the network.

b.

|  |  |
| --- | --- |
| The hop-by-hop strategy | In the end-to-end strategy |
| * Putting the necessary adaption functions at each intermediate packet network node. * Each node processes the ones it has received before sending the packets to the sub node. * May cause more delays and costs. If one node fails, the security may be affected. * Are better because of reducing overhead and delays | * Where the necessary adaption functions are implemented. * The packets are sent unchanged through the network, and the endpoints carry out any necessary processing. * Reduces delays and overhead, but it could not handle well in networks with high packet loss rates delays. * Are prefered when additional processing is required at intermediary nodes |

Q4: Solution

a.

Base on topology, there are 5 subnets which are S1,S2, S3, S4, S0/0/0

b.

Because we have 4 subnet S1, S2, S3, S4, doesn’t include S0/0/0/0

N is the number of bits

* N = 3.

c.

Because the number of bits N = 3, then the number of subnets does this create is

d.

Usable hosts does this create per subnet:

28-n – 2 = 28-3 – 2 = 30

Q5: Solution

Using Dijkstra algorithm to find the set of shortest paths, we have this table:

a.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Iteration | N | D1 | D2 | D3 | D5 | D6 |
| Initial | {4} |  |  |  |  |  |
| 1 | {4,2} | (5,4) | (1, 4) | (2,4) | (3,4) |  |
| 2 | {4,2,3} | (4,2) |  | (2,4) | (3,4) |  |
| 3 | {4,2,3, 5} | (4,2) |  |  | (3,4) | (3,3) |
| 5 | {4,2,3,5,6} | (4,2) |  |  |  | (3,3) |
| 6 | {4,2,3,5,6,1} | (4,2) |  |  |  |  |

From D4 to D1 , the path is D4 -> D2 -> D1 : 4

From D4 to D2 , the path is D4 -> D2: 1

From D4 to D3, the path is D4 -> D3: 2

From D4 to D5, the path is D4 -> D5 : 3

From D4 to D6, the path is D4 -> D3 -> D6: 3

b.

|  |  |  |
| --- | --- | --- |
| Destination | Cost | Next Hop |
| D1 | 4 | 2 |
| D2 | 1 | 2 |
| D3 | 2 | 3 |
| D5 | 3 | 5 |
| D6 | 3 | 3 |