Mohammad Ali Zahir

ID: 4007719

COMP 445: Data Communication & Network Protocols

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Presented to: Mme Sandra Cespedes

COMP 445 Theory Assignment 1

1. Circuit switching is a method for implementing a network of telecommunications through a single dedicated channel. While this method does have its advantages, such as increased connection quality due to being dedicated instead of shared, and we would have fixed bandwidth throughout the connection, it also has some major disadvantages. Firstly, if the router inside the connection for whatever reason fails, we would have a loss of connection, since there would be no other ways to communicate. This would lead to the link between connections active, even while no data is being transferred, which then would lead to a user manually coming and severing that link. Hence more time will be consumed for the user, and thus be more harmful to them.

2. As we know, DSL Isp's are dedicated, which would mean that the bandwidth received would be higher. However, while that is true, many factors can lead to the diminishing results to interference and loss of signals provided by the companies since sometimes the distance traveled by the signal to reach your residence would be very substantial. For Cable Isp's, since we are dealing with wires, the signals do not play a factor here, which would eliminate interference and signal loss. This is a way where cable isp's could be superior to DSL isp's. A way to speed up the connection provided would be install repeaters every certain amount of distance which would mitigate the signal loss from the DSL Isp's.

3. **For message switching:**

We assume that propagation delay (assume to be pd in calculations) is 0.

We then must determine the number of links present.

A → Node1 (Link 1)

Node1 → Node2 (Link 2)

Node2 → B (Link 3)

Hence, we would then have 3 links, which we will denote with N.

We then also have M, which is file size which 15Mb and then we finally have C which is data rate per link 1.5Mbps.

The formula for message switching would be:

$$N * \left(\frac{M}{C} + pd\right)$$

$$3 * \left(\frac{15Mb}{1.5Mbps}\right)$$

= 30 seconds

Hence, with message switching it would take 30 seconds for B to completely receive the message.

For packet switching:

We would once again assume the propagation delay to be 0 (pd = 0)

L = 1200 bits

The number of packets would be determined by M/L = 15Mbs/1200 bits = 0.0125 packets, denoted by P

Number of links as in message switching would still be 3, which will still be denoted with N

The formula for packet switching would be:

$$(P)(N)\left(\frac{L}{C} + \ pd\right)$$

$$(0.0125)(3)\left(\frac{1200}{1.5}\right)$$

= 30 seconds

Hence, with packet switching it would take 30 seconds for B to completely receive the message, and both switching methods would take the same time to completely deliver the message.

4. To find the end-to-end delay, we would have to find 3 types of delays.

i) **Processing delay**

Since in the question it is stated that we would not have congestion, hence processing delay would be 0 seconds.

ii) Transmission Delay

The formula for transmission delay (TD) would be:

$$TD \ = \frac{data\ size}{transmission\ rate}$$

Here data size is the 30 Mb Mp3 file that we have, and the transmission rate would be the 10 Mbps value that we have. Hence by replacing the values, we would have

$$TD = \frac{30Mb}{10Mbps}$$

$$TD = 3\ seconds$$

iii) Propagation Delay

The formula for propagation delay (PD) would be:

$$PD = \frac{size\ of\ link}{propagation\ speed}$$

Here we would have the size of the links be 5000km or 5 000 000 m, but twice hence 10 000 000m, and the propagation speed would 2 x 10^8 m/s. Hence by replacing the values, we would get.

$$PD = \frac{10\ 000\ 000\ m}{200\ 000\ 000 \frac{m}{s}}$$

$$PD = 0.05\ seconds$$

Hence, to find out end-to end delay, we would TD + PD, which is 3 + 0.05 = 3.05 seconds.

The answer would then be option c 3.05 seconds

5. As in Q4, the processing delay is still 0, we would not need to do that calculation.

i) **Transmission Delay:**

$$TD = \frac{data\ size}{transmission\ rate}$$

By replacing the values

$$TD = \frac{30\ Mb}{10\ Mbps}$$

= 3 seconds

ii) Propagation Delay:

$$PD = \frac{size\ of\ link}{propagation\ speed}$$

By replacing the values, we would get:

$$PD = \frac{10\ 000\ 000\ m}{200\ 000\ 000\ m/s}$$

$$= 0.05\ \text{seconds}$$

iii) Queuing Delay:

We have 3 number of packets, which we will denote by N.

We have the size of the packet, 10 Mbps, which we will be denote by L

We also would have the transmission rate, which would be 10 Mbps, which will be denoted by R.

The formula is:

$$QD = \frac{(N-1)(L)}{2R}$$

When we replace the values, we would get

$$QD = \frac{(3-1)(10\ Mbps)}{2*10Mbps}$$

= 1 second

Now if we add all the times, we will have PD + TD + QD = 0.05 + 3 + 1 = 4.05 seconds, hence we will choose option B.

6.

Since there are 10 FDM, we would have 10 times as much transmission delay that we had for the single in Q4, which would mean that the TD for this part would be 3 * 10 = 30 seconds, and the propagation delay, PD would still be the same, 0.05 seconds.

By adding the PD and the TD, we would get 30.05 seconds, which is option A

7. In a layered architecture, we would add an overhead layer. Since every layer adds more information to the network, we would a see a decrease in the internet quality and an increase in latency, which will make the overall communication go down. Another disadvantage that we could have been that the since adding a new layer would combine their functionalities as well, which would lead to problems of maintainability.

8. Data encapsulation is the process of adding new information in the network which will allow the network itself to add new features. Data de-encapsulation is the process, which is the opposite of data encapsulation, instead of adding information to the network, it removes it so that we could go back to the original data that we had. Both of these processes are very important in a layered architecture, since it would ensure that data is added and removed from its proper place and would eliminate the combination issue that is a main thing with layered networks.

9. We could find the application data size first

In total we have 1500 bytes, which is the maximum data size, TCP size is 20 bytes, IP size is 20 bytes and message size is 16 bytes.

$$Total\ Application\ data\ size\ =\ 1500 - (TP\ +\ IP\ +\ message)$$

$$Total\ Application\ data\ size\ =\ 1500 - (20 +\ 20 +\ 16)$$

$$Total\ Application\ data\ size\ =\ 1444\ bytes$$

We have the total application message size, which is 4096 bytes, which we will denote by M

We could find the number of frames by doing:

$$Number\ of\ frames\ =\ (\frac{M}{total\ application\ data\ size})$$

$$Number\ of\ frames\ =\ (\frac{4096\ bytes}{1444\ bytes})$$

$$Number\ of\ frames\ =\ 2.84, but\ we\ will\ assume\ 3$$

We can then find out the total overhead bytes by adding all the other components bytes multiplied by the number of frames, which we will denoted with O,

$$O\ =\ 3(TCP\ +\ IP\ +\ message\ +\ ethernet\ +\ trailer)$$

$$O\ =\ 3(20 + 20 + 16 + 14 + 4)$$

$$O\ =\ 222\ bytes$$

$$Overhead\ \%\ =\ \left(\frac{O}{M} x\ 100\right)$$

$$Overhead\ \%\ =\ \left(\frac{222\ bytes}{4096\ bytes} x\ 100\right)$$

$$Overhead\ \% = 5.42\ \%$$

Hence, the percentage overhead incurred in the transmission of the message is 5.42 %.