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1.      Define the following parameters for a switching network:

* N = number of hops between two given end systems
* L = message length in bits
* B = data rate, in bits per second (bps), on all links
* P = fixed packet size, in bits
* H = overhead (header), bits per packet
* S = call setup time (circuits switching or virtual circuit) in seconds
* D = propagation delay per hop in seconds

1. For N=4, L=3200, B=9600, P=1024, H=16, S=0.2, D=0.001, compute the end-to-end delay for circuit switching, virtual circuit packet switching, and datagram packet switching. Assume that there are no acknowledgments. Ignore processing delay at nodes.

Circuit switching:

- There is a connection set up delay

- Whole message is transferred at one time

Tc = S + (L / B) + N \* D

= 0.2 + 3200/9600 + 4 \* 0.001 =

= 0.2 + 0.33 + 0.004 = 534ms

Datagram packet switching:

- Breaks the message into packets of size P (where H is header info). The end-to-end delay is the time it takes to deliver the complete message through a first hop plus the time it takes to deliver the last packet through to the last hop.

Td = (Np + N - 1) \* (P / B) + N \* D

= (4 + 3 - 1) \* (1024 9600) + 3 \* 0.001

= 0.634(sec)

Np = 3200 / (1024 - 16) = 3.17 therefore, we need 4 packets

Virtual circuit packet switching:

- It is assumed that packets are pipelined on the virtual circuit. Thus one packet comes out of the pipeline every P/B seconds after the first packet comes out the pipeline. The time to deliver the first of the L/P packets to the destination is N(P/B). Every P/B seconds a new packet from the remaining [(L/P)-1] packet arrive at the destination

Tv = S + Td

= 0.2 + 0.643 = 0.843(sec)

b.    Derive general expressions for the three techniques of part(a), taken two at a time (three expressions in all), showing the conditions under which the delays are equal.

Circuit switching Vs Diagram packet switching:

Tc = S + (L / B) + N \* D, Td = (Np + N - 1) \* (P / B) + N \* D ≡ Td = (Np \* P/ B) + D + (N – 1) ((P / B) + D)

S + N \* D + L / B = ((Np + N - 1)P / B) + N \* D

S + L / B = ((Np + N - 1)P / B)

Circuit switching Vs Virtual circuit packet switching:

Tv = S + Td, Tc = Tv

L / B = (Np + N – 1) P / B

Diagram packet switching Vs. Virtual circuit packet switching

Td = Tv - S

2.    What value of P, as a function of N, L and H, results in a minimum end-to-end delay on a datagram network? Assume that L is much larger than P, and D is zero.

 Suppose NP = (L / P – H) is an integer and D = 0, we have

Td = ( (L / P – H) + N + 1) P / B

To minimize Td, we view Td as a function of P, take the derivative:

*d*Td / *d*P = 0 = 1 / B ((L / P – H) + N – 1) – (P / B) (L / (P – H)2

0 = L (P – H) + (N – 1) (P – H)2 – LP, 0 = -LH + (N – 1)(P – H)2

(P – H)2 = LH / N – 1, therefore we have P = H + √(LH / N – 1)

3.    Explain the flaw in the following reasoning: Packet switching requires control and address bits to be added to each packet. This introduces considerable overhead in packet switching. In circuit switching, a transparent circuit is established. No extra bits are needed. Therefore, there is no overhead in circuit switching. Because there is no overhead in circuit switching, line utilization must be more efficient than in packet switching.

Due to the fact that a Transparent Static circuit is established, Circuit Switching is in face less efficient as there can be instances where nodes can be idle and hence inefficient. If there is an issue with any in-between nodes in Circuit Switching then the whole connection is lost. When traffic is heavy a Circuit Switching network can be blocked while in Packet Switching packets are only delayed. And there is no concept of priorities that can be assigned in Circuit switching.