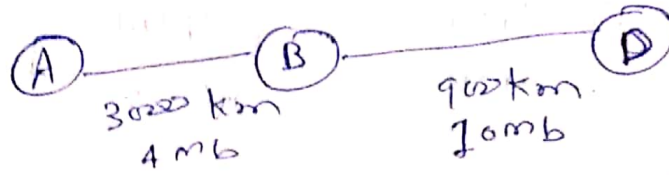


Ans (3)

(a.)



$$\text{End-to-end delay} = \text{delay}(A-B) + \text{delay}(B-D)$$

$$= \frac{500 \times 8}{4 \times 10^6} + \frac{3000 \times 10^3}{3 \times 10^8} + \frac{500 \times 8}{10 \times 10^6} + \frac{900 \times 10^3}{3 \times 10^8}$$

$$= \frac{4000}{4 \times 10^6} + \frac{1}{100} + \frac{4000}{10 \times 10^6} + \frac{3}{100}$$

$$= 10^{-3} + 10^{-2} + 4 \times 10^{-4} + 3 \times 10^{-3}$$

$$= 0.0144 \text{ sec} = 14.4 \text{ ms}$$

(b)

$$\text{Total file size} = 5 \text{ MB}$$

$$\text{chunk size} = 500 \text{ B}$$

$$\text{no of packets} = \frac{5 \text{ MB}}{500 \text{ B}} = 10000$$

$$\text{End-to-end delay for 500B packet} = 14.4 \text{ ms}$$

$$\text{End to end delay for 50B ACK packet} = \frac{50 \times 8}{10 \times 10^6} + \frac{900 \times 10^3}{3 \times 10^8} + \frac{50 \times 8}{4 \times 10^6} + \frac{3000 \times 10^3}{3 \times 10^8}$$

$$= 4 \times 10^{-5} + 3 \times 10^{-3} + 10^{-4} + 10^{-2}$$

$$= 13.14 \text{ ms}$$

$$\text{End to end delay} = \text{A-B} + \text{B-D} + \text{D-A (ACK)}$$

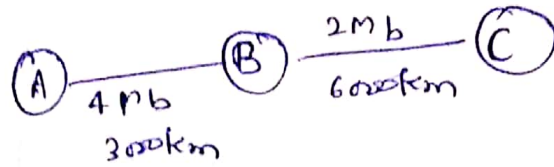
for one packet

$$= 14.4 + 13.14 = 27.54 \text{ ms}$$

$$\text{Total time for transfer} = (9999 \times 27.54 + 14.4) \text{ ms}$$

$$= 275.386 \text{ sec}$$

(C.1)



Queuing delay for packet 2 at B

$$= \frac{500 \times 8}{2 \times 10^6} - \frac{500 \times 8}{4 \times 10^6} = 1 \text{ ms}$$

Delay for packet 1 = delay(A-B) + delay(B-C)

$$= \frac{500 \times 8}{4 \times 10^6} + \frac{300 \times 10^3}{3 \times 10^8} + \frac{500 \times 8}{2 \times 10^6} + \frac{600 \times 10^3}{3 \times 10^8}$$

$$= 10^{-3} + 10^{-2} + 2 \times 10^{-3} + 2 \times 10^{-2}$$

$$= 33 \text{ ms}$$

$$\text{Delay for packet 2} = 33 \text{ ms} + 1 \text{ ms} = 34 \text{ ms.}$$