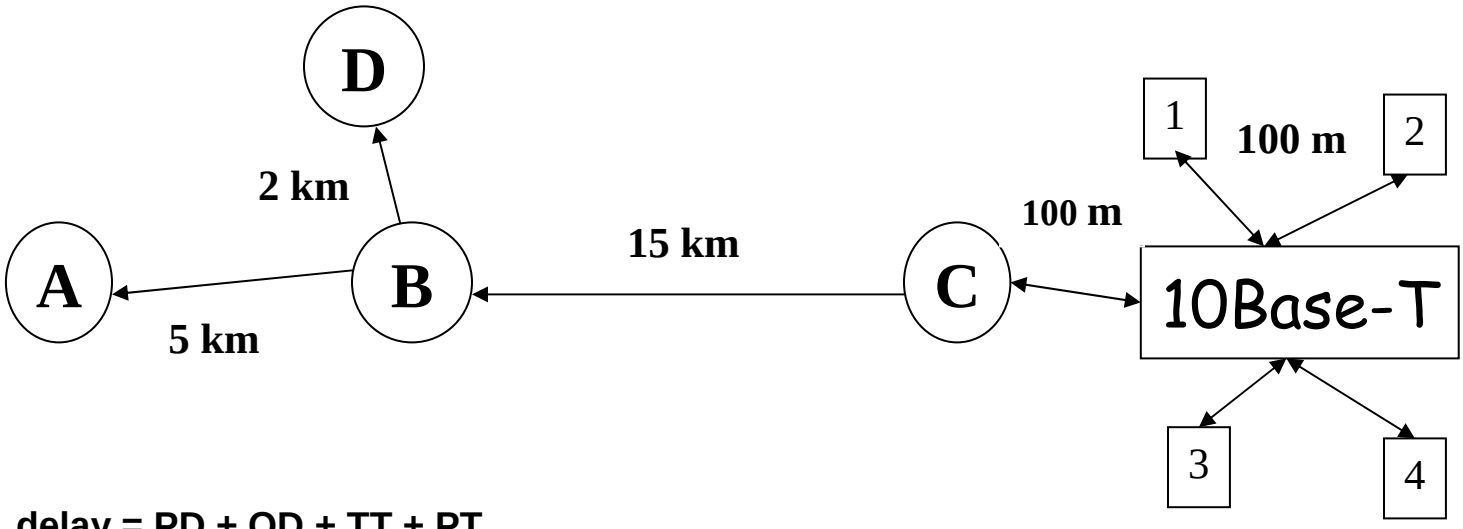
13. Given the internet pictured below with a propagation speed of 200 m/microsec on the packet-switched WAN and 150 m/microsec through the 10BASE-T LAN and:

nodes **A-D** are spaced on the WAN as shown with 1 Gbps links between nodes. Assume processing time for nodes **A, B and D** is **0** and that processing time for node **C** is 20 ms.

Nodes **C, 1- 4** are all 100 m from the 10BASE-T hub.

Assume a packet = frame = 1250 bytes on this internet.

How long will it take to send a packet from node 4 to node A in the situation that when the packet arrives at node B there are 2 packets in front of it waiting in a queue to go to node A and 2 packets waiting in a queue to go to node D . Assume there is no other traffic on the LAN and the WAN. List ANY assumptions you make and show ALL work to get some partial credit.



delay = PD + QD + TT + PT
one packet = 1250 bytes x 8 = 10000 bits = 10^4 bits

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packet from 4 to C:

PD = QD = 0

$$TT = \frac{10^4 \text{ bits}}{10^7 \text{ bits/ sec.}} = 10^{-3} \text{ sec.} = 0.001 \text{ sec} = 1000 \text{ microsec.}$$

$$PT = \frac{200 \text{ m}}{150 \text{ m/microsec.}} = 0.000001 \frac{1}{3} \text{ --sec} = 1 \frac{1}{3} \text{ -- microsec.}$$

$$= 1001\ \frac{1}{3}\ \text{microsec.}$$

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packet from C to B:

QD = 0

PD = 0.020 sec = **20000 microsec.**

$$TT = \frac{10^4 \text{ bits}}{10^9 \text{ bits/ sec.}} = 10^{-5} \text{ sec.} = 0.00001 \text{ sec} = \textbf{10 microsec.}$$

$$PT = \frac{15000 \text{ m}}{200 \text{ m/microsec.}} = 0.000075 \text{ sec} = \textbf{75 microsec.}$$

$$= \textbf{20085 microsec.}$$

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packet from B to A:

PD = 0

$$TT = \frac{10^4 \text{ bits}}{10^9 \text{ bits/ sec.}} = 10^{-5} \text{ sec.} = 0.00001 \text{ sec} = \textbf{10 microsec.}$$

QD = 2 x TT = **20 microsec.**

$$PT = \frac{5000 \text{ m}}{200 \text{ m/microsec.}} = 0.000025 \text{ sec} = \textbf{25 microsec.}$$

$$= \textbf{55 microsec.}$$

Total Delay

packet from 4 to C: **1001 1/3 -- microsec.**

packet from C to B: **20085 microsec.**

packet from B to A: **55 microsec.**

Total = 21141 1/3 -- microsec = 0.021141 1/3 —seconds