3)

Frames are generated at node A and sent to node C through node B. Determine the minimum data rate on the link connecting nodes B and C so that the buffer at node B does not overflow. The following is given

- Data Rate on link A-B is 100 Kbps
- Propagation delay is 5 μsec/km on both links
- Links are FDX
- Data Frames are 1000 bits long. ACK frames are of negligible length
- Link A-B is 4000 Km, Link B-C is 1000 Km
- "A" can transmit 3 frames to "B" before it has to stop and wait for ACK from "B". While "B" can transmit ONLY one frame to "C" before it has to stop and wait for ACK from "C".
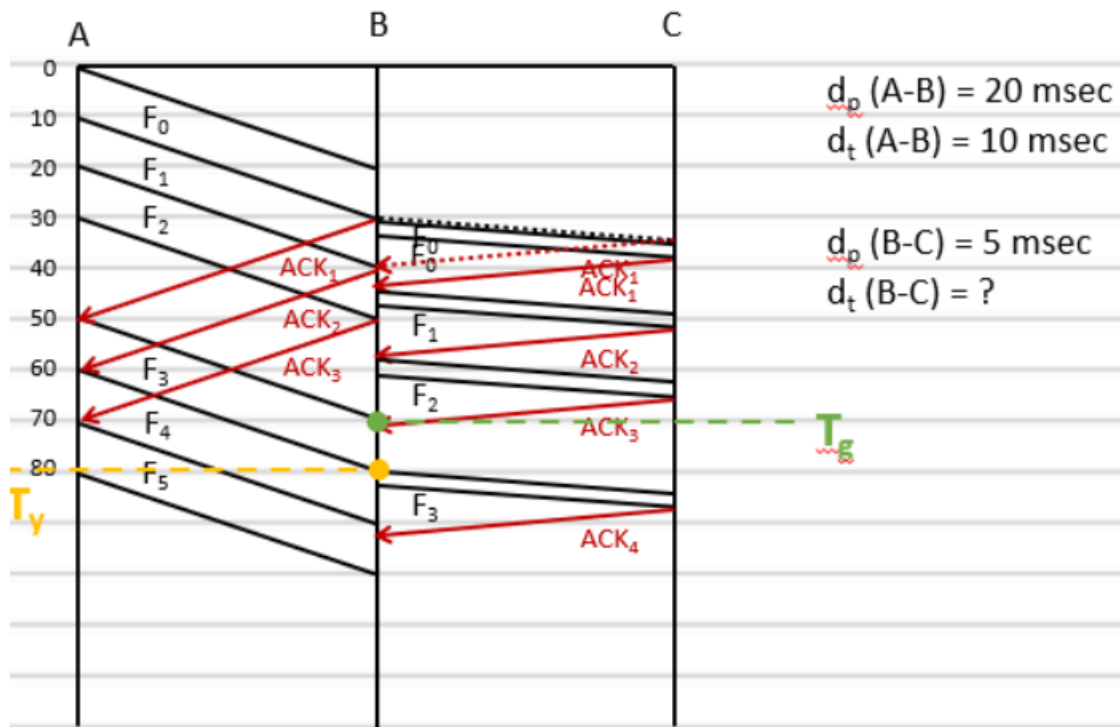
- A -> B:

  Propagation time = 4000 x 5 μsec = 20 msec

  Transmission time per frame = $\dfrac{1000}{100\times10^{3}} = 10\,\text{msec}$

- B -> C:

  Propagation time = 1000 x 5 μsec = 5 msec

  Transmission time per frame = x = 1000/R

  R = data rate between B and C (unknown)

$$T_g <= T_y$$

$$30 + 3 \times (10 + d_t) <= 80$$

$$d_t = 1000 / R <= 20 / 3$$

$$R >= 3000 / 20 = 150 \text{ Kbps}$$