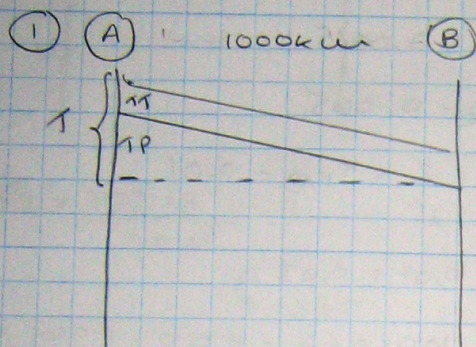


Ficha 1

Ficheiro: 10^6 bits

$$V_t = 1 \text{ Mbps} = 10^6 \text{ bps}$$

$$V_p = 2 \times 10^5 \text{ km/s}$$



Só um canal

$$\text{Tempo total} = T_t + T_p$$

$$T_t = \frac{F}{V_t} = \frac{10^6 \text{ bits}}{1 \times 10^6 \text{ bps}} = 1 \text{ seg}$$

$$T_p = \frac{D}{V_p} = \frac{1000}{2 \times 10^5} = \frac{1}{2 \times 10^2} = 0,005 \text{ s}$$

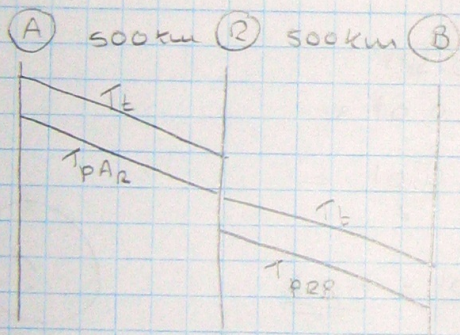
$$1 + 0,005 = 1,005 \text{ s} = \underline{\underline{1005 \text{ ms}}}$$

(2) VOLUME = $V_t \times T_p$

↳ quantos bits transmite o computador A quando o 1º bit chega a B.

$$V = 10^6 \text{ bps} \times 0,005 = 5000 \text{ bits}$$

(3)



$$T_t = 1 \text{ s} \times 2$$

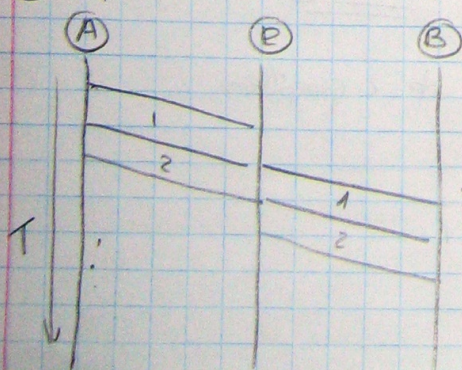
$$T_{PAR} = \frac{500}{2 \times 10^5} = 0,0025$$

$$T_{PRB} = 0,0025$$

$$T_{\text{total}} = \underline{\underline{2,005 \text{ segundos}}}$$

(4) pacotes de 10 000 bits

$$\frac{10^6}{10^4} = 10^2 = \underline{\underline{100 \text{ pacotes}}}$$



$$T_{\text{pacote}} = \frac{10^4}{10^6} = 10^{-2} \text{ s}$$

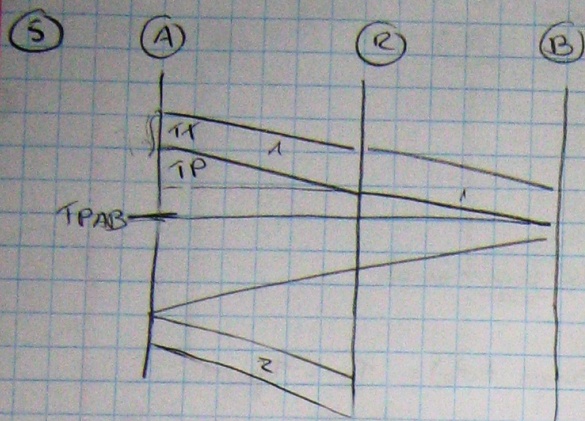
Fila espera

$$T = 100 \times T_{\text{pacote}} + T_{PAR} + T_{\text{pacote}} + T_{PRB}$$

independente do tamanho

$$= 100 \times 10^{-2} + (0,005) + 10^{-2}$$

$$= 1,015 \text{ s}$$



$$F = 10^6 \quad P = 10^4$$

100 pacotes

$$T_{\text{pacote}} = 10^{-2} \text{ s}$$

$$T_{PAR} = 0,0025$$

$$T_{PAB} = 0,005$$

$$RTT = 2 \times T_{PAB} = 0,01$$

$$T' = 2 \times T_{\text{pacote}} + RTT = 0,02 + 0,01 = 0,03 \text{ s}$$

$$T = 100 \times T' - \underbrace{1 \times T_{PAB}}_{\text{ultimo pacote}} = 100 \times 0,03 - 0,05 = \underline{\underline{2,995 \text{ s}}}$$

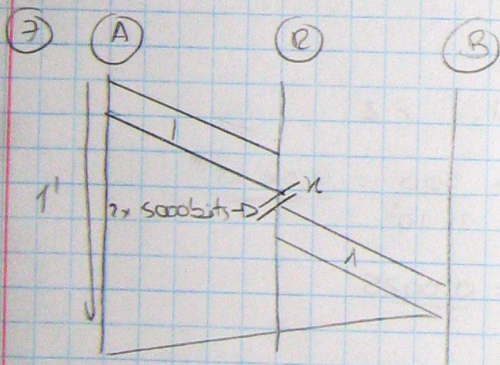
(C) THROUGHPUT

$$V_{\text{media}} = \frac{F}{T}$$

$$V_S = \frac{10^6}{2,995}$$

$$V_H = \frac{10^6}{1,015}$$

$$\frac{V_S}{V_H} \times 100\% \approx 33\%$$



$$T_{\text{pacote}} = 0,01 \text{ s}$$

$$T_{\text{pacotes}} = \frac{0,01}{2}$$

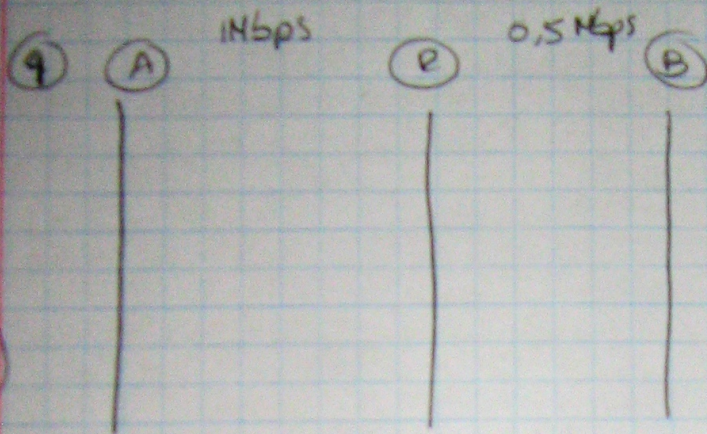
$$X = \frac{2 \times 0,01}{2} = \underline{\underline{0,01}}$$

$$T' = T_{\text{pacote}} \times 2 + \underbrace{T_{PAB}}_{0,01} + 0,01 + \frac{RTT}{2,01} = 0,045$$

$$T = 100 T' - \frac{RTT}{2} = \underline{\underline{3,995 \text{ s}}}$$

(8) A variação da latência é o tempo de 2 pacotes

$$T_{2 \text{ pacotes}} = 0,01 = 10 \text{ ms}$$



$$F = 100 \cdot 10^6 \text{ bits}$$

$$T_E = \frac{100 \cdot 10^6}{1 \times 10^6} = 100$$

$$T_L = \frac{100 \cdot 10^6}{0.5 \times 10^6} = 200$$

$$T = 300$$

$$V_m = \frac{100 \cdot 10^6}{300} = 333333 - 0,3 \text{ Mbps}$$