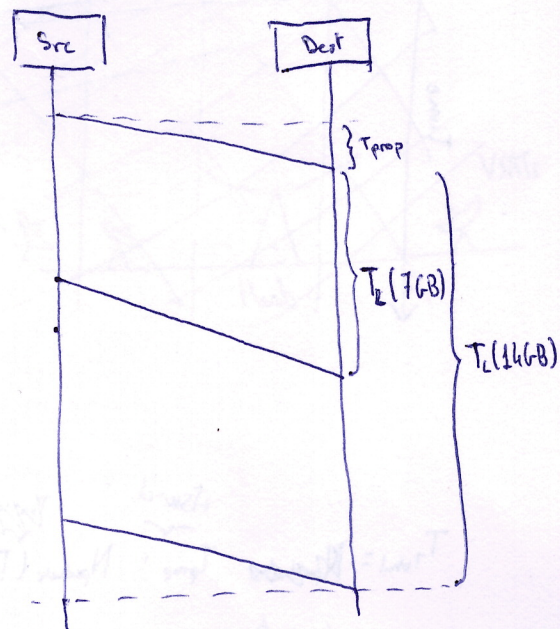
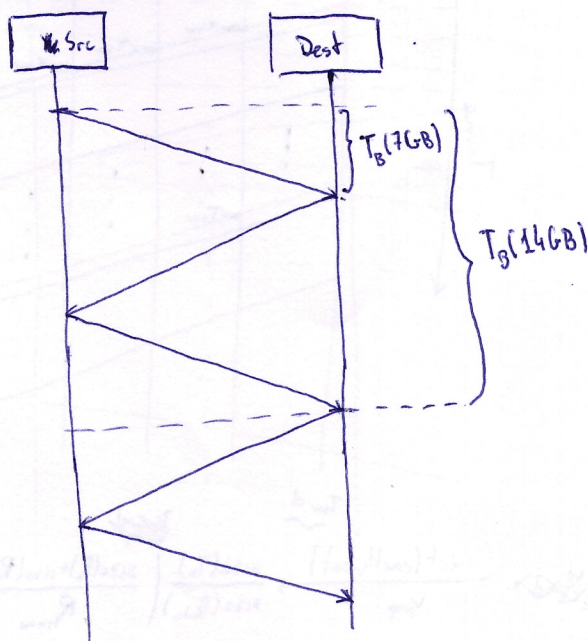


~~1.2.3~~

1.2.4. Imagine you trained your St. Bernard, Bernie, to carry three 7-GB 8-mm tapes. The dog can travel to your side at 18 km/h. For what range of distances does Bernie have a higher data rate than a transmission line of data rate (without overhead) is 150 Mbps?



$$T_B(N_{Tx}) = \frac{(2 \frac{N_{Tx}}{N_{PB}} - 1)d}{V_B}$$

$$R_B = \lim_{N_{Tx} \rightarrow \infty} \frac{N_{Tx}}{T_B(N_{Tx})} = \lim_{N_{Tx} \rightarrow \infty} \frac{N_{Tx} \cdot V_B}{(2 \frac{N_{Tx}}{N_{PB}} - 1)d} = \lim_{N_{Tx} \rightarrow \infty} \frac{N_{Tx} \cdot V_B}{2d \frac{N_{Tx}}{N_{PB}} - N_{PB}d} = \lim_{N_{Tx} \rightarrow \infty} \frac{N_{Tx} \cdot V_B \cdot N_{PB}}{(2N_{Tx} - N_{PB})d} = \lim_{N_{Tx} \rightarrow \infty} \frac{V_B \cdot V_{PB}}{2d - \frac{N_{PB} \cdot d}{N_{Tx}}} = \frac{V_B \cdot V_{PB}}{2d}$$

$$R_L = 150 \frac{\text{Mb}}{\text{s}}$$

$$R_B = R_L \Rightarrow \frac{V_B \cdot V_{PB}}{2d} = 150 \frac{\text{Mb}}{\text{s}} \Leftrightarrow \frac{18 \frac{\text{km}}{\text{h}} \cdot \frac{1 \text{h}}{3600 \text{s}} \cdot 3 \cdot 7 \cdot 2^{30} \cdot 8 \text{b}}{2d} = 150 \cdot 2^{20} \frac{\text{b}}{\text{s}} \Leftrightarrow d = \frac{3 \cdot 18 \cdot 7 \cdot 2^{30} \cdot 8 \text{ km}}{2 \cdot 150 \cdot 2^{20}} = 2.867 \text{ km}$$

How does the answer change if

a) Bernie's speed is doubled?

$$d = \frac{V_B \cdot V_{PB}}{2R_L} = \frac{2 \cdot 18 \frac{\text{km}}{\text{h}} \cdot \frac{1 \text{h}}{3600 \text{s}} \cdot 3 \cdot 7 \cdot 2^{30} \cdot 8 \text{b}}{2 \cdot 150 \cdot 2^{20} \frac{\text{b}}{\text{s}}} = 5.734 \text{ km}$$

b) Each tape's capacity is doubled

$$d = \frac{18 \frac{\text{km}}{3600 \text{s}} \cdot 3 \cdot 2 \cdot 7 \cdot 2^{30} \cdot 8 \text{b}}{2 \cdot 150 \cdot 2^{20} \frac{\text{b}}{\text{s}}} = 5.734 \text{ km}$$

c) The data rate of the transmission line is doubled

$$d = \frac{18 \frac{\text{km}}{3600 \text{s}} \cdot 3 \cdot 7 \cdot 2^{30} \cdot 8 \text{b}}{2 \cdot 2 \cdot 150 \cdot 2^{20} \frac{\text{b}}{\text{s}}} = 1.434 \text{ km}$$