

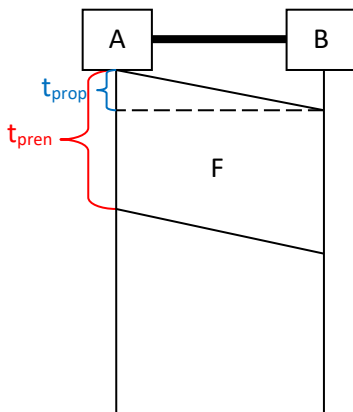
1. Između hosta A i B prenosi se fajl veličine 5kB. Link je dužine 250m dok je brzina prostiranja signala linkom  $2,5 \cdot 10^8$  m/s.

Gdje se nalaze prvi i poslednji bit fajla u trenucima  $t=t_{\text{pren}}$  i  $t=t_{\text{prop}}$  ako je:

- a) kapacitet linka 10 Mb/s
- b) kapacitet linka 100 Gb/s

Rešenje:

a)



$$t_{\text{prop}} = \frac{l}{v} = \frac{250m}{2,5 \cdot 10^8 m/s} = 1\mu s$$

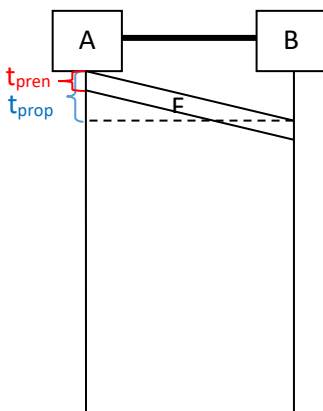
$$t_{\text{pren}} = \frac{F}{R} = \frac{5 \cdot 1024 \cdot 8b}{10Mb/s} = \frac{40960b}{10^7 b/s} = 4.096ms$$

$$t_{\text{pren}} > t_{\text{prop}}$$

U trenutku  $t=t_{\text{pren}}$  prvi bit se nalazi na hostu B, a poslednji bit na početku linka.

U trenutku  $t=t_{\text{prop}}$  prvi bit se nalazi na hostu B, a poslednji bit na hostu A.

b)



$$t_{\text{prop}} = \frac{l}{v} = \frac{250m}{2,5 \cdot 10^8 m/s} = 1\mu s$$

$$t_{\text{pren}} = \frac{F}{R} = \frac{5 \cdot 1024 \cdot 8b}{100Gb/s} = \frac{40960b}{10^{11} b/s} = 0.4096\mu s$$

$$t_{\text{pren}} < t_{\text{prop}}$$

U trenutku  $t=t_{\text{pren}}$  prvi bit se nalazi na linku, a poslednji bit na početku linka.

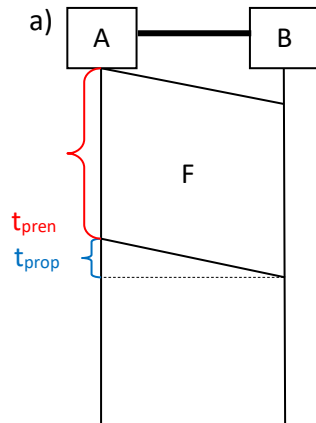
U trenutku  $t=t_{\text{prop}}$  prvi bit se nalazi na hostu B, a poslednji bit na linku.

2. Između hostova A i B prenosi se fajl veličine 100 kB. Uz pretpostavku da je vrijeme obrade u mrežnim čvorištima i kašnjenje u redovima čekanja zanemarljivo malo, odrediti koliko iznosi ukupno kašnjenje i efektivna propusnost ukoliko:

- a) Između hostova A i B postoji direktni link kapaciteta 10Mb/s, pri čemu je dužina linka 25m, a brzina prostiranja signala linkom  $2,5 \cdot 10^8$  m/s.
- b) Između hostova A i B postoji jedno mrežno čvorište, dok su linkovi kapaciteta 10Mb/s, dužine linkova su po 25m, a brzina prostiranja signala linkovima  $2,5 \cdot 10^8$  m/s.
- c) Između hostova A i B postoje dva mrežna čvorišta, dok su linkovi kapaciteta 10Mb/s, dužine linkova su po 25m, a brzina prostiranja signala linkovima  $2,5 \cdot 10^8$  m/s.
- d) Ponoviti a), b) i c) za slučaj kada se fajl segmentira na 100 segmenata pri čemu se svakom segmentu dodaje zaglavlje veličine 20B.

e) Ponoviti c) za slučaj kada se fajl segmentira na 100 segmenata, pri čemu se svakom segmentu dodaje zaglavlje veličine 20B, a vrijeme obrade u čvorištu je  $1\mu s$ .

Rešenje:



$$F = 100KB$$

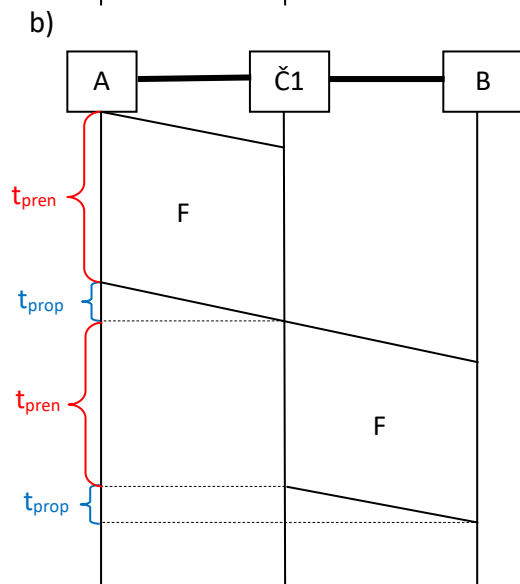
$$t_{prop} = \frac{l}{v} = \frac{25m}{2.5 \cdot 10^8 m/s} = 0.1\mu s$$

$$t_{pren} = \frac{F}{R} = \frac{100KB}{10Mb/s} = \frac{100 \cdot 1024 \cdot 8b}{10^7 b/s} = 81920\mu s$$

$$t_{pren} \gg t_{prop}$$

$$t_{uk} = t_{prop} + t_{pren} = 81920.1\mu s \approx 81ms$$

$$R_{eff} = \frac{F}{t_{uk}} = \frac{100KB}{81920.1\mu s} = 9.99Mb/s$$



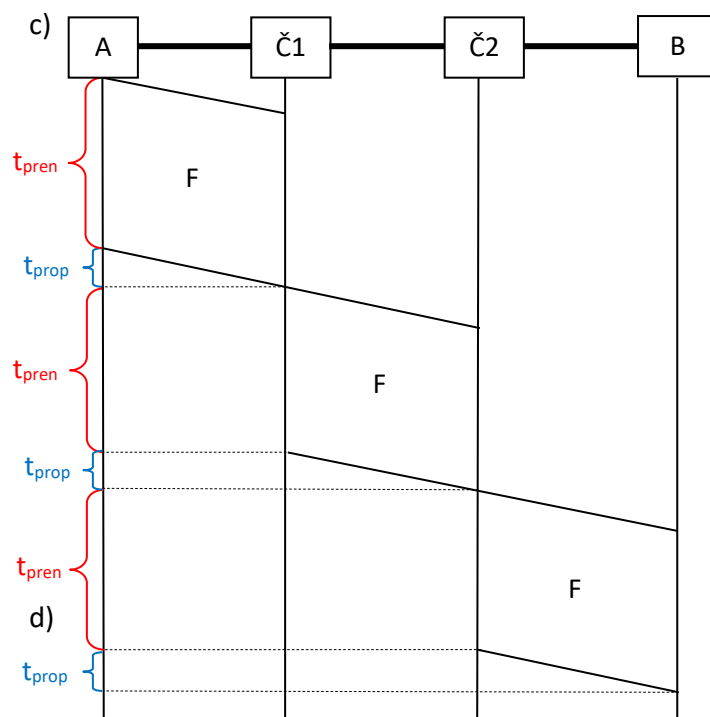
$$t_{prop1} = t_{prop2} = \frac{l}{v} = \frac{25m}{2.5 \cdot 10^8 m/s} = 0.1\mu s$$

$$t_{pren1} = t_{pren2} = \frac{F}{R} = \frac{100KB}{10Mb/s} = \frac{100 \cdot 1024 \cdot 8b}{10^7 b/s} = 81920\mu s$$

$$t_{pren} \gg t_{prop}$$

$$t_{uk} = 2t_{prop} + 2t_{pren} = 163840.2\mu s$$

$$R_{eff} = \frac{F}{t_{uk}} = \frac{100KB}{163840.2\mu s} = 4.99Mb/s$$



$$t_{prop1} = t_{prop2} = t_{prop3} = \frac{l}{v} = 0.1\mu s$$

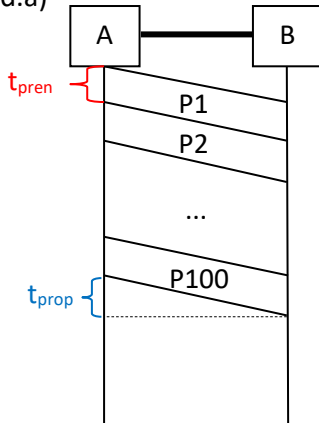
$$t_{pren1} = t_{pren2} = t_{pren3} = \frac{F}{R} = 81920\mu s$$

$$t_{pren} \gg t_{prop}$$

$$t_{uk} = 3t_{prop} + 3t_{pren} = 245760.3\mu s$$

$$R_{eff} = \frac{F}{t_{uk}} = \frac{100KB}{245760.3\mu s} = 3.33Mb/s$$

d.a)



$$S = \frac{F}{N} = 1KB$$

$$h = 20B$$

$$N = 100$$

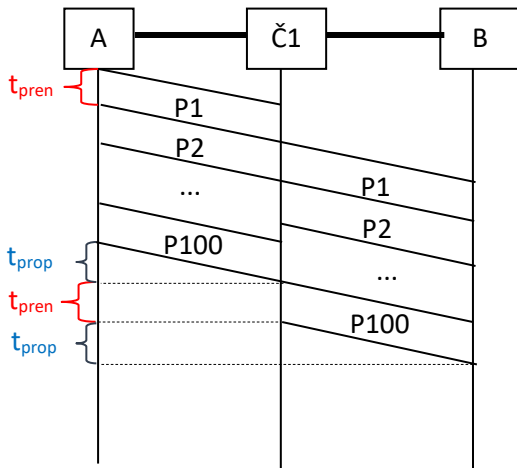
$$t_{prop} = \frac{l}{v} = \frac{25m}{2.5 \cdot 10^8 m/s} = 0.1\mu s$$

$$t_{pren} = \frac{S+h}{R} = \frac{1KB+20B}{10Mb/s} = \frac{(1024+20) \cdot 8b}{10^7 b/s} = 835.2\mu s$$

$$t_{uk} = t_{prop} + N \cdot t_{pren} = 0.1\mu s + 83520\mu s = 83520.1\mu s$$

$$R_{eff} = \frac{F}{t_{uk}} = \frac{100KB}{83520.1\mu s} = 9.808Mb/s$$

d.b)



$$S = \frac{F}{N} = 1KB$$

$$h = 20B$$

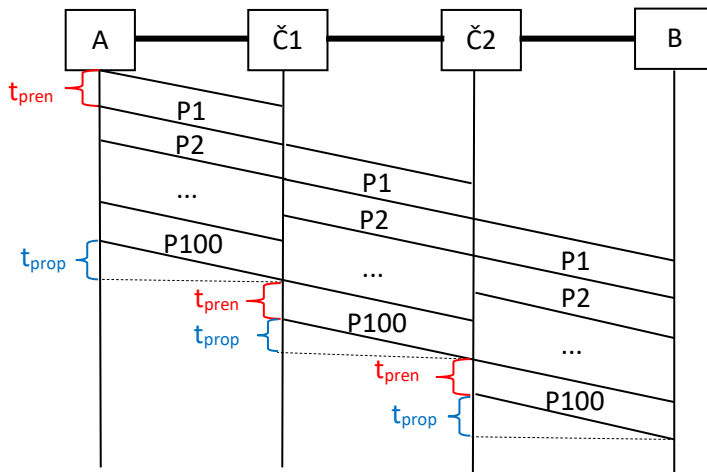
$$t_{prop} = \frac{l}{v} = \frac{25m}{2.5 \cdot 10^8 m/s} = 0.1\mu s$$

$$t_{pren} = \frac{S+h}{R} = \frac{1KB+20B}{10Mb/s} = \frac{(1024+20) \cdot 8b}{10^7 b/s} = 835.2\mu s$$

$$t_{uk} = 2t_{prop} + 101 \cdot t_{pren} = 0.2\mu s + 84355\mu s = 84355.2\mu s$$

$$R_{eff} = \frac{F}{t_{uk}} = \frac{100KB}{84355.2\mu s} = 9.711Mb/s$$

d.c)



$$S = \frac{F}{N} = 1KB$$

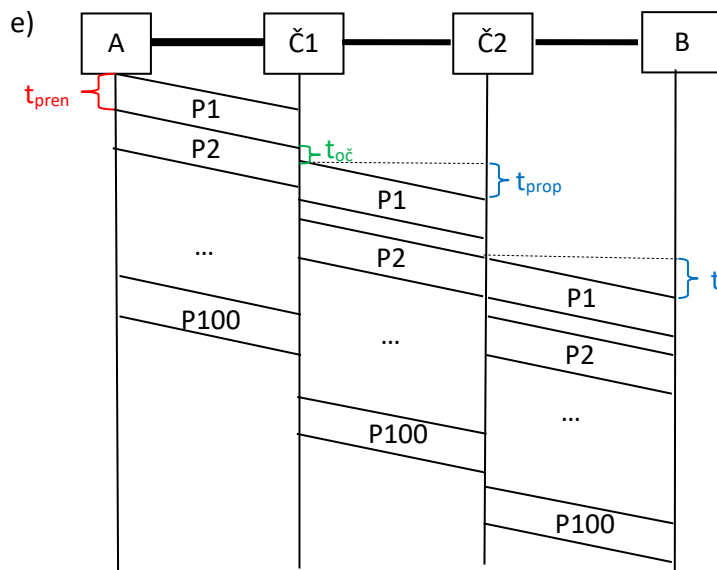
$$h = 20B$$

$$t_{prop} = \frac{l}{v} = \frac{25m}{2.5 \cdot 10^8 m/s} = 0.1\mu s$$

$$t_{pren} = \frac{S+h}{R} = \frac{1KB+20B}{10Mb/s} = \frac{(1024+20) \cdot 8b}{10^7 b/s} = 835.2\mu s$$

$$t_{uk} = 3t_{prop} + 102 \cdot t_{pren} = 0.3\mu s + 85190.4\mu s = 85190.7\mu s$$

$$R_{eff} = \frac{F}{t_{uk}} = \frac{100KB}{85190.7\mu s} = 9.616Mb/s$$



$$S = \frac{F}{N} = 1KB$$

$$h = 20B$$

$$t_{prop} = \frac{l}{v} = \frac{25m}{2.5 \cdot 10^8 m/s} = 0.1 \mu s$$

$$t_{pren} = \frac{S+h}{R} = \frac{1KB+20B}{10Mb/s} = \frac{(1024+20) \cdot 8b}{10^7 b/s} = 835.2 \mu s$$

$$t_{uk} = 3t_{prop} + 102 \cdot t_{pren} + 101t_{oč} = 0.3 \mu s + 85190.4 \mu s + 101 \mu s = 85291.7 \mu s$$

$$R_{eff} = \frac{F}{t_{uk}} = \frac{100KB}{85291.7 \mu s} = 9.604 Mb/s$$