Übung 3

Montag, 15. November 2010
11:49

1) Stop-and-Wait ARQ: Packet 1,0

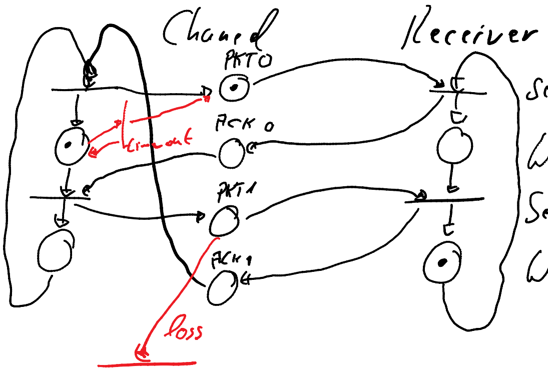
Sender | Channel | Receiver

Send Pkt 0 — Send ACK for pkt 0

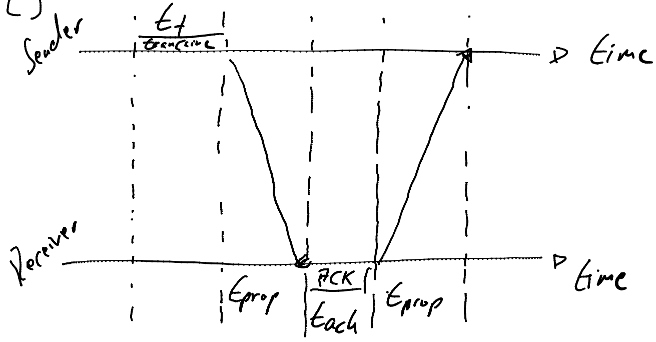
Wait ack 0 — Waits PKT 1

Send Pkt 1 — Sends ACK 1

Wait ack 1 — Waits PKT 0



2)



$P = 0$ (no errors)

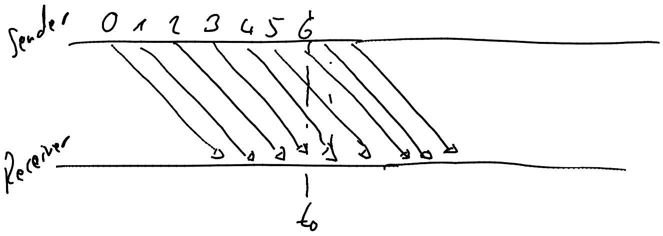
$$U_{P=0} = \frac{t_f}{t_f + t_{prop} + \underbrace{\cancel{t_{ack}}}_{\approx 0} + t_{prop}} = \frac{t_f}{t_f + 2 \cdot t_{prop}} = \frac{1}{1+2a} \quad \left(\text{with } a = \frac{t_{prop}}{t_f}\right)$$

with $P \neq 0$, a pkt is transmitted on average N times $\left(\frac{1}{1-P}\right)$ (see ex. 1.6)

$$U = \frac{t_f}{(N-1)\underbrace{(t_f + t_{ack\_timeout})}_{=2t_{prop}} + (t_f + 2 \cdot t_{prop})} = \frac{t_f}{N(t_f + 2 \cdot t_{prop})} = \frac{1-P}{1+2a}$$

time cost on package loss

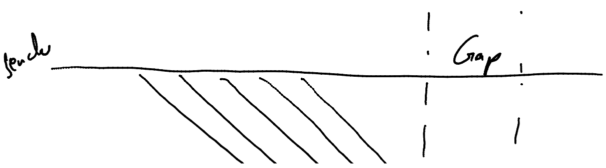
3) $P = 0$ (no errors)



Case 1

→ the ACK for frame 0 is received before t_0

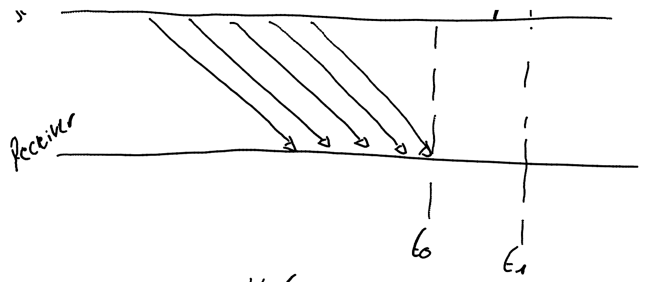
$U_{P=0} = 1$



Case 2

→ the ACK for frame 0 is received at $t_1 > t_0$

$U_{..} < 1$



→ the ACK for frame 0 is received at $t_1 > t_0$

$U_{p=0} < 1$

$$U_{p=0} = \frac{K \cdot t_f}{t_1} = \frac{\text{time for transmis. } K \text{ frames}}{\text{time until ACK for frame 0 is received}}$$

- $t_1 = t_f + t_{prop} + t_{ack} + t_{prop} \approx t_f + 2 \cdot t_{prop}$

$$\rightarrow U_{p=0} = \frac{K \cdot t_f}{t_f + 2 t_{prop}} \Rightarrow t_f = \frac{2 \cdot U \cdot t_{prop}}{K - U} \Rightarrow t_f = 1{,}36 \cdot 10^{-6} \text{ sec}, \text{ with } t_{prop} = \frac{1500}{3 \cdot 10^8}$$

$= 5\,\mu s$

$$t_f = \frac{L}{R} \Rightarrow L = (1{,}36 \cdot 10^{-6})(10 \cdot 10^6) = 13{,}63 \text{ bits} \approx 14 \text{ bits}$$

4) Selective-Repeat Protocol, $t_f = \frac{1000}{R} = 0{,}015625 \text{ sec}$, $t_{prop} = \frac{90000 \cdot 10^3}{3 \cdot 10^8} = 0{,}3 \text{ sec}$

$K \cdot t_f$ > time needed for the ACK of first frame to be received + processed, T

time needed for transmitting K frames ↓ = window

$$T = t_f + t_{prop} + t_{proc} + t_f + t_{prop} + t_{proc} = 0{,}64125 \text{ s}$$

$$a) \Rightarrow K \cdot t_f > T \Rightarrow K > \frac{T}{t_f} \Rightarrow K > 41{,}04 \approx 42$$

b) $P_f = 0{,}01$

Avg # transmis. to send each frame: $N = \frac{1}{1-p}$

→ time to deliver a frame $t_f \left(\frac{1}{1-p}\right)$

$$U = \frac{U_{p=0}}{\left(\frac{1}{1-p}\right)} = 1\,(0{,}99) = 0{,}99$$

pkt. Rate for successful and not — transmissions

$$R = 64000 \frac{\text{bit}}{\text{sec}} = 64 \frac{\text{pkts}}{\text{sec}} \Rightarrow \text{pkt. transmission rate for succes delivery} \Big\} = 64 \cdot 0{,}99 = 63{,}36 \frac{\text{pkts}}{\text{sec}}$$

c) with GO-BACK-N

If success at first time $(1-p)$

→ time to transmit frame t_f

If failure at first time (p)

knowing that we need $\frac{1}{1-p}$ transmission attempts on average time to delivere frame

$$t_f + \underbrace{N_f \cdot t_f}\left(\frac{1}{1-p}\right) = t_f + T\left(\frac{1}{1-p}\right)$$

number of frames transmitted after the last one and until timeout → $N_f = \frac{T}{t_f}$ → timeout

$\Rightarrow$ Total time for frame: $(1-p)\, t_f + p\left(t_f + T\left(\frac{1}{1-p}\right)\right) = t_f + p\,\frac{T}{1-p}$

$\Rightarrow$ Utilisation: $\dfrac{t_f}{t_f + p \cdot \frac{T}{1-p}} = 0{,}7074$, pkt delivery rate $= 64 \cdot 0{,}7 = 42{,}5\ \frac{\text{pkts}}{\text{sec}}$