

$$\eta = \frac{1}{1 + \frac{RTT}{\Delta}} \quad RTT \approx 2 \cdot \tau_{prop}$$

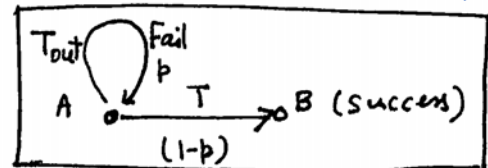
Stop & Wait Efficiency

Time to transmit & recv an Ack = $\tau_{trans} + \cancel{\tau_{trans}} + 2\tau_{prop} + 2\cancel{\tau_{proc}}$

$$\approx \tau_{trans} + 2\tau_{prop} \equiv T$$

• Efficiency $\eta = \frac{\tau_{trans}}{\tau_{trans} + 2\tau_{prop}}$ (no-noise) $= \frac{1}{1 + 2a}$; $a = \frac{\tau_{prop}}{\tau_{trans}}$
 \downarrow smallness param.

Let $p =$ prob. of pkt error



$\langle T \rangle =$ Expected time to send a pkt = $(1-p)T + p(T_{out} + \langle T \rangle)$

$$\eta_{(noisy)} = \frac{\tau_{trans}}{\langle T \rangle} ; \quad \langle T \rangle = T + \frac{p}{(1-p)} T_{out}$$

$T_{out} \approx T$ so Assume $T_{out} = T$

$$\langle T \rangle = \frac{T}{(1-p)} = (\tau_{trans} + 2\tau_{prop}) \cdot \frac{1}{(1-p)}$$

$$\eta_{noisy} = \frac{(1-p) \cdot 1}{(1+2a)}$$

$$\eta_{noisy} = (1-p) \eta_{ideal} \quad \frac{1}{1+2a} = \eta_{ideal}$$

Selective Repeat Efficiency

W = Window size. If $W \cdot T_{trans} > (T_{trans} + 2T_{prop})$
there is no waiting for ACK. $W = W_{opt}$
 $\Rightarrow W_{opt} = 1 + 2a$

(no noise) $\eta^{SR} = \text{Min}(1, \frac{W}{W_{opt}})$

As in stop & wait, noise-induced retransmissions lead to $(1-p)$ factor.

$$\eta_{noisy}^{SR} = (1-p) \cdot \text{Min}(1, \frac{W}{W_{opt}})$$



$$\eta^{SR} = \eta_{ideal}^{SR} \cdot (1-p)$$

* Work out efficiency of GBN in the noisy channel.
Timeout \rightarrow retrans. of whole window