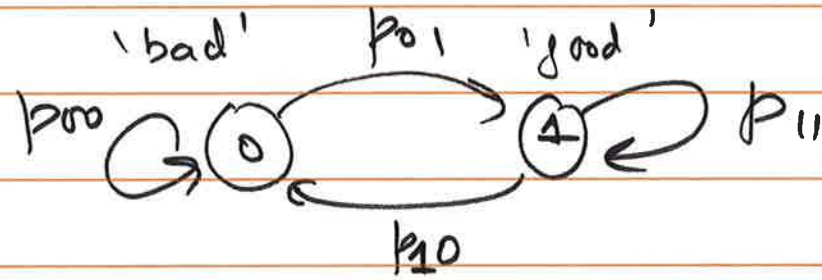
Feb 28, 2012 EE597

HW1 #10 Lecture 14

2-state Markov Chain



describing a channel

Transmission policy:
(ARQ mechanism)

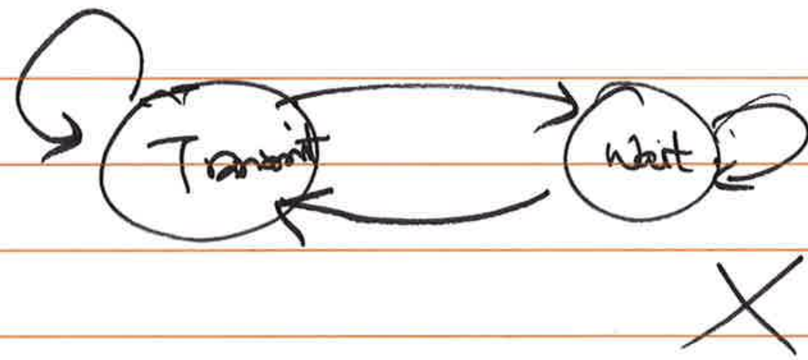
if good in the last try,
try the next transmission
right away.

if bad, i.e., transmission
fails, wait K time steps &
try again.

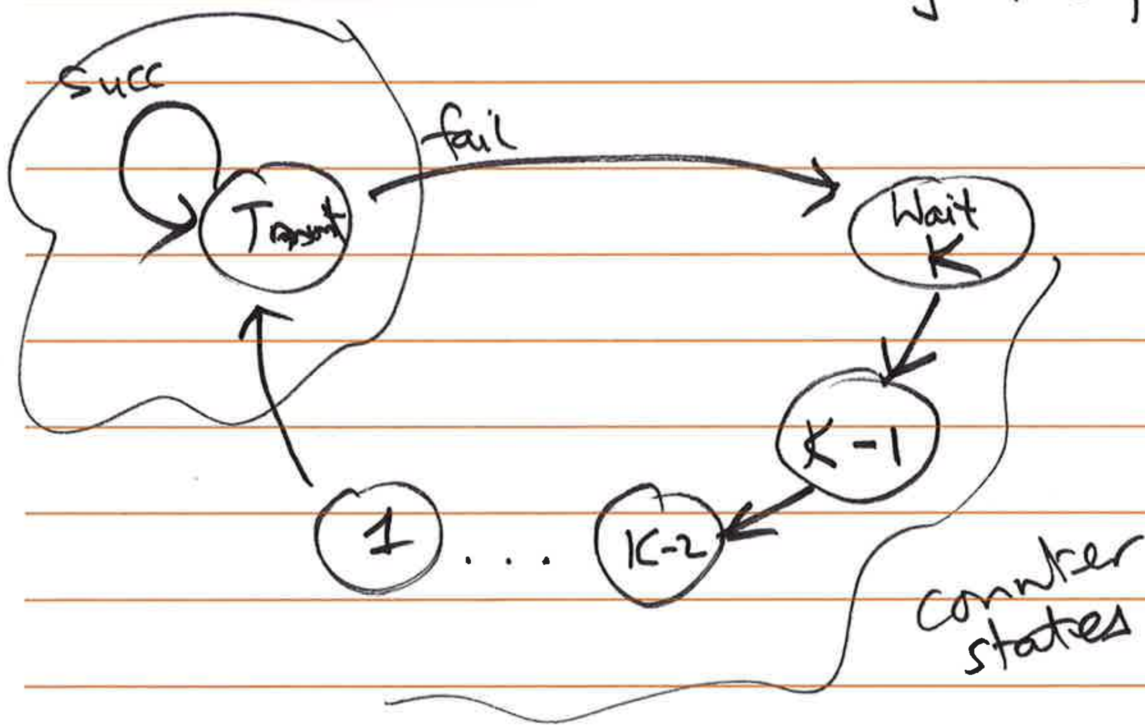
Parameter K constitutes a tradeoff:

- too many errors / wasted transmissions on bad links if too small
- low efficiency / throughput if K too large

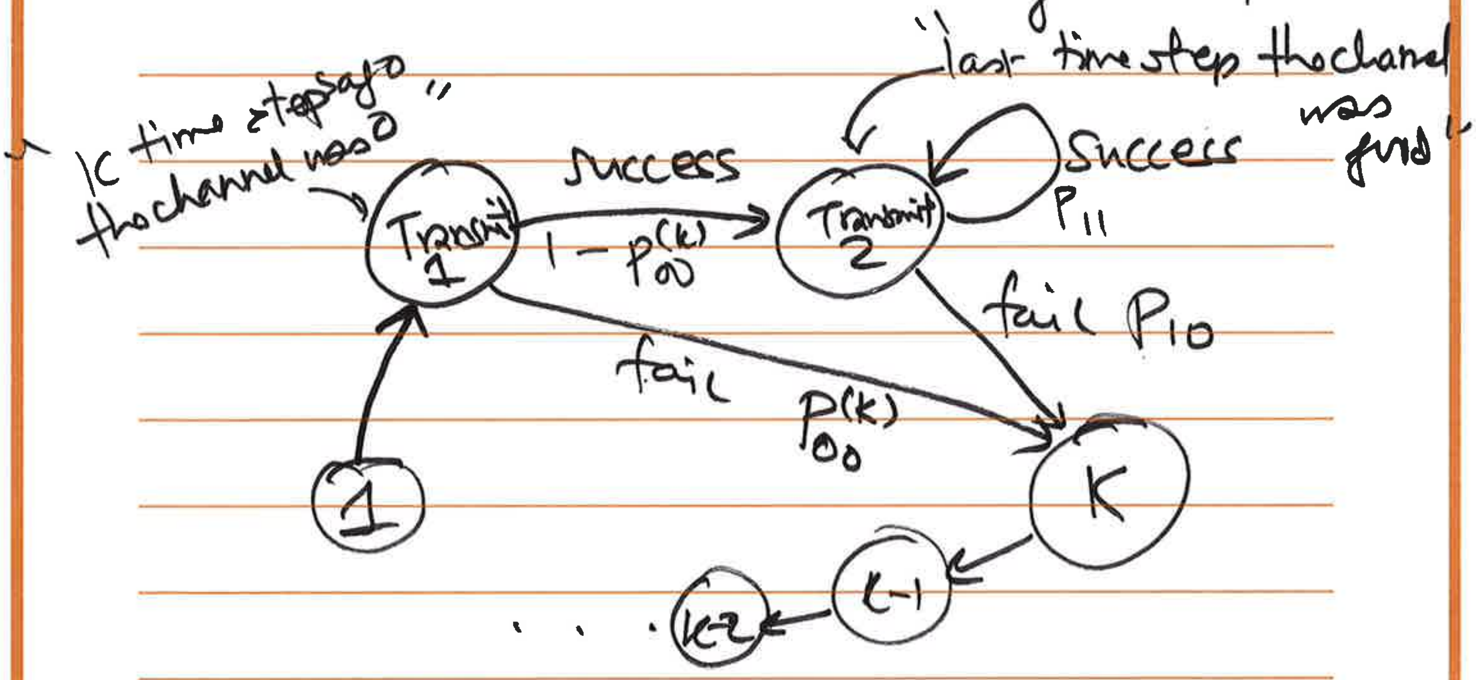
First cut at modelling the protocol.



Second cut at modeling the protocol.



Final cut at modelling the protocol



expected # transmission / success

Expected # slots / success = inverse of long-term fraction of success $= (\pi_{T_2})^{-1} = \frac{1}{\pi_{T_2}}$

$$= \frac{\pi_{T_1} + \pi_{T_2}}{\pi_{T_2}}$$

Giuseppe Bianchi (1998)

Analysis of the Saturation Throughput Regime of the IEEE 802.11 DCF

↗ Distributed Coordination Function

(CSMA mechanism of IEEE802.11)

(p-CSMA)

Unlike p-persistent CSMA, in 802.11, the ~~time between two~~ backoff time is a uniform random variable, not geometric.

The maximum contention window is originally chosen to be W_0

i.e. backoff is $\sim U[0, W_0-1]$

if transmission is unsuccessful, due to collision, double the contention window.

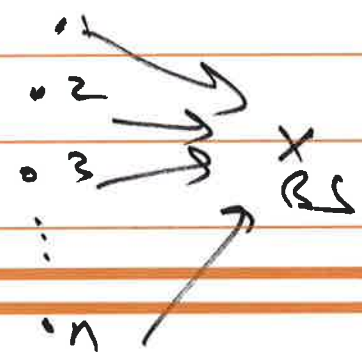
i.e pick from $\sim U[0, 2W_0-1]$

... so on upto <u>m stages</u>

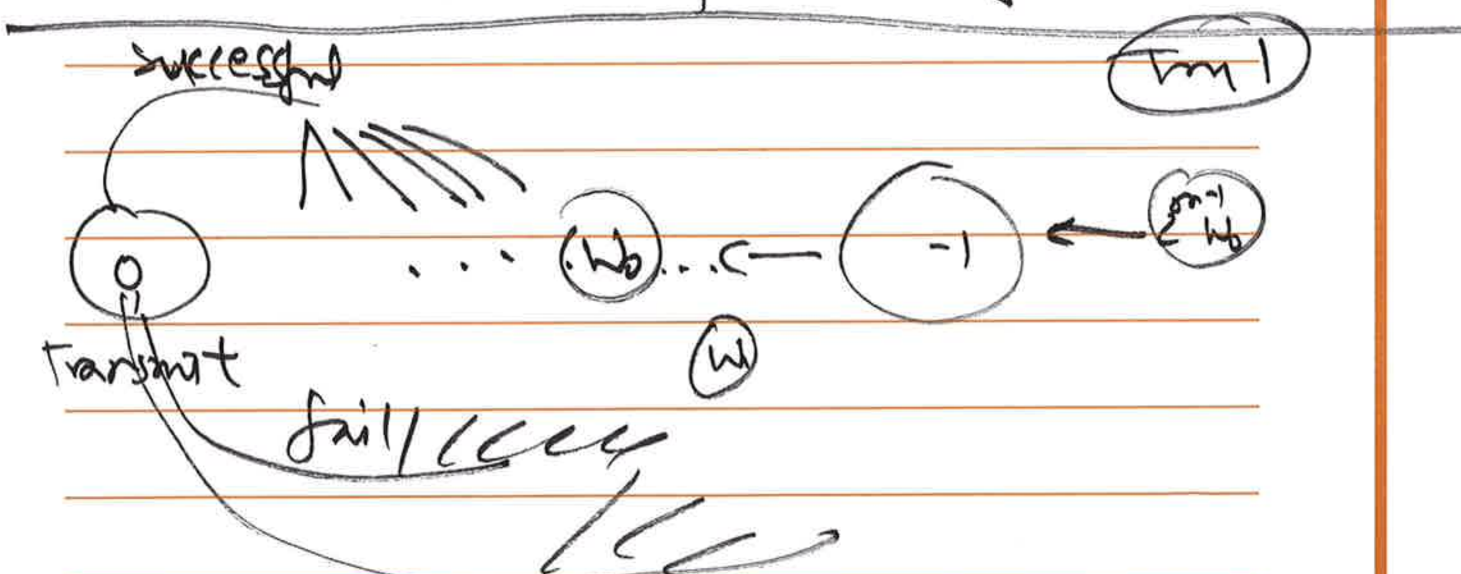
(Binary exponential backoff).

$W_0 \rightarrow 2W_0 \rightarrow 4W_0 \rightarrow \dots 2^{m-1}W_0$

after m-1 collisions, the contention window no longer increases.

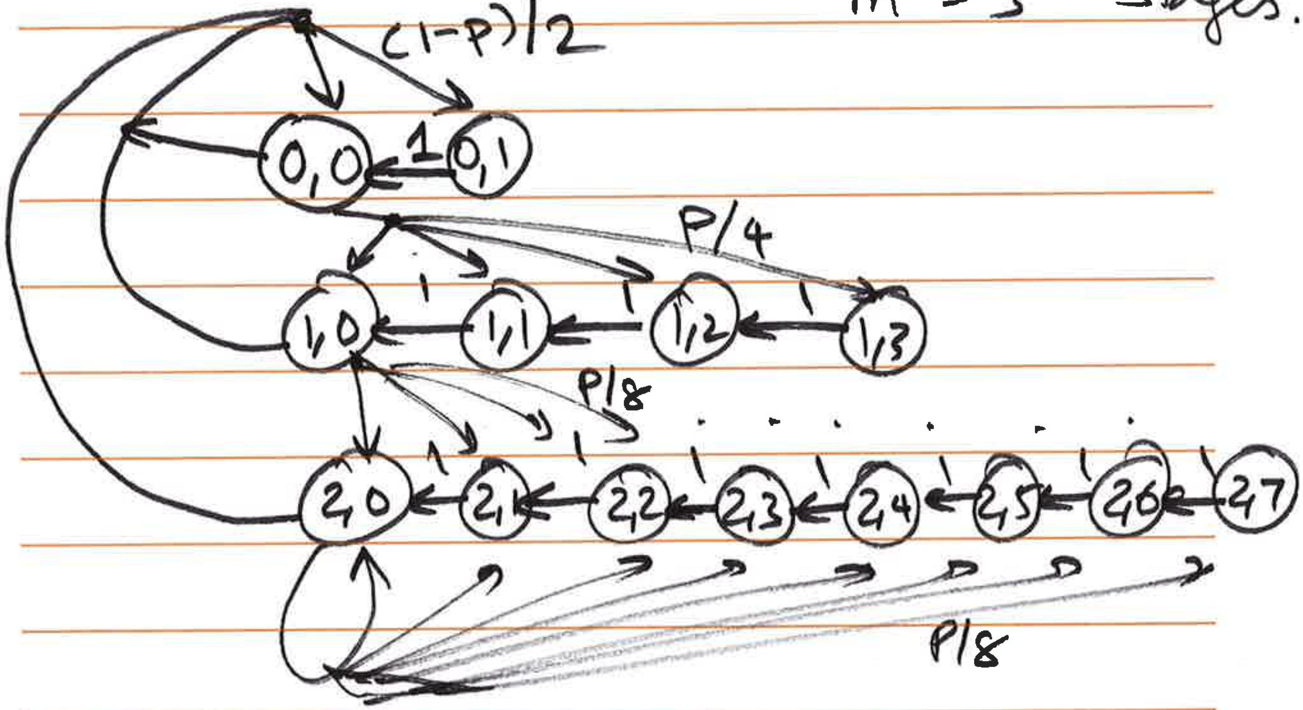


elements of the FSM / M.C description for a single transmitter



$W_0 = 2$

$m = 3$ stages.



~~In this example $\pi_{0,0} + \pi_{0,1}$ = long term fraction of successful slots~~

Note: We are not including times when the counter is frozen.

(2) — $\pi_{0,0} + \pi_{1,0} + \pi_{2,0}$ = long term fraction of transmission attempts = transmission prob. $= \tau$

Bianchi's model assumes that transmitter's states are independent of each other.

Prob. of successful transmission attempt = $(1-\tau)^{n-1} = 1-p$ —(1)

Can we solve for p now?

Yes, by numerically working out (1) & (2)

To estimate throughput, given p, pretend this is p-CSMA!
(another approximation)