P8

a)

$$\begin{aligned} E(p) &= Np(1-p)^{N-1} \\ E'(p) &= N(1-p)^{N-1} - Np(N-1)(1-p)^{N-2} \\ &= N(1-p)^{N-2}((1-p) - p(N-1)) \end{aligned}$$

$$E'(p) = 0 => ((1-p) - p(N-1)) = 0; p = \frac{1}{N}$$

b)

$$E(p^*) = N\frac{1}{N}(1-\frac{1}{N})^{N-1} = (1-\frac{1}{N})^{N-1} = \frac{(1-\frac{1}{N})^N}{1-\frac{1}{N}}$$

$$\lim_{N\to\infty}(1-\frac{1}{N}) = 1 \qquad \lim_{N\to\infty}(1-\frac{1}{N})^N = \frac{1}{e}$$

Thus

$$\lim_{N\to\infty} E(p^*) = \frac{1}{e}$$

P9

See figure 6.11 and reasoning on pp. 486

$$\begin{aligned} &E(p) = Np(1-p)^{2(N-1)} \\ &E'(p) = N(1-p)^{2(N-2)} - Np2(N-1)(1-p)^{2(N-3)} \\ &= N(1-p)^{2(N-3)}((1-p) - p2(N-1)) \end{aligned}$$

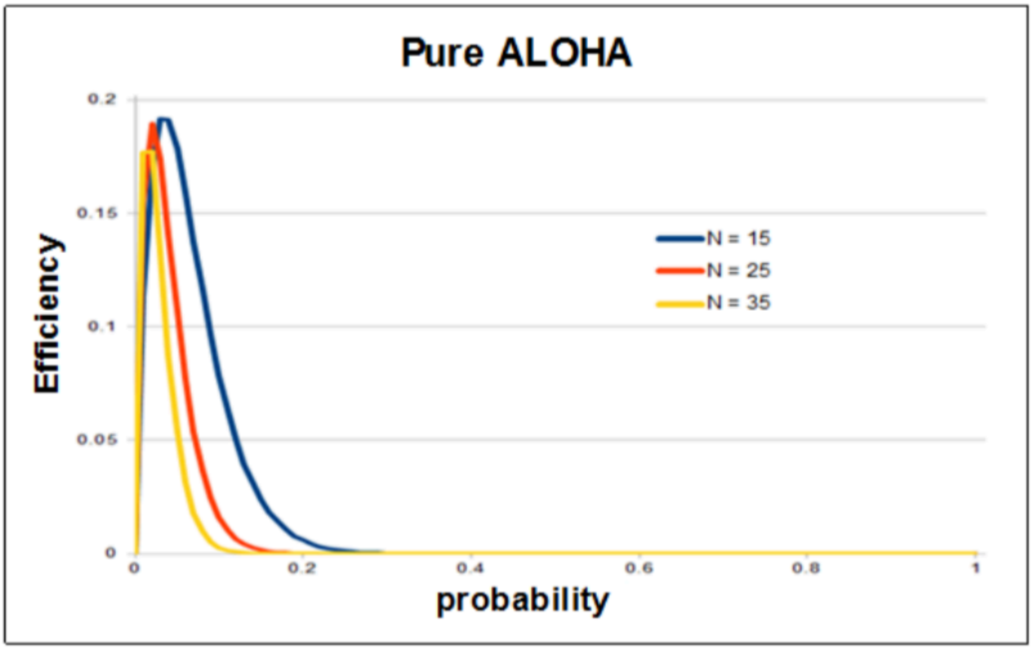
$$E'(p) = 0 \Rightarrow p^* = \frac{1}{2N-1}$$

$$E(p^*) = \frac{N}{2N-1}(1-\frac{1}{2N-1})^{2(N-1)}$$

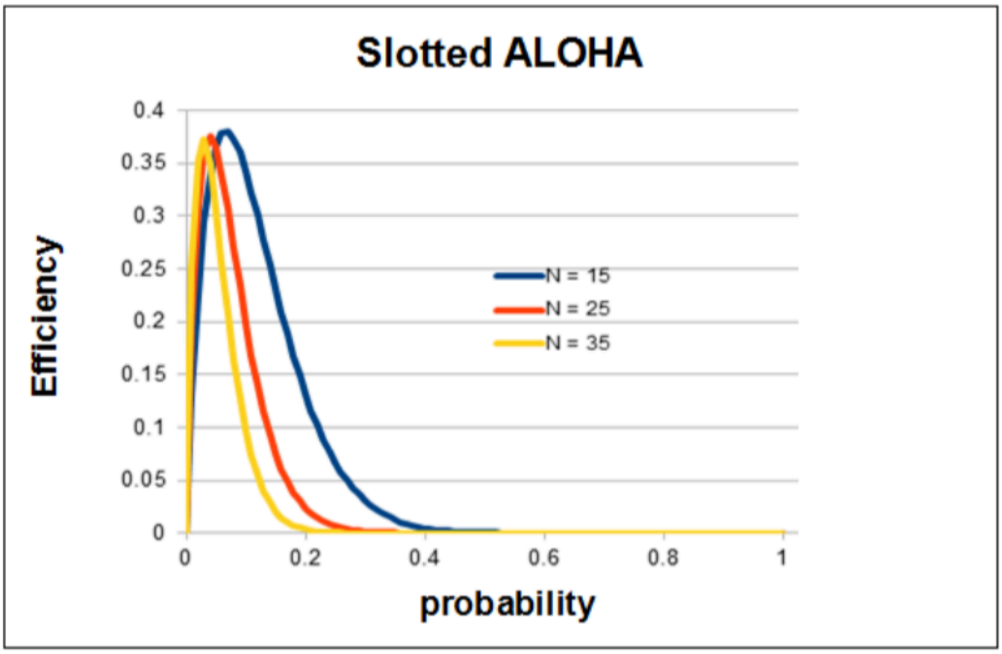
$$\lim_{N\to\infty} E(p^*) = \frac{1}{2}\cdot\frac{1}{e} = \frac{1}{2e}$$

P12

a)



b)



P13

Time to transmit a polling round is

$$N(Q/R + d_{poll})$$

The number of bits in a polling round is NQ and the maximum throughput therefore becomes:

$$\frac{NQ}{N(Q/R + d_{poll})} = \frac{R}{1 + \frac{d_{poll} R}{Q}}$$

Note, since all nodes have the same rate it is enough to look at an individual node and therefore remove N.