Network 20q HW10

ZHANG Xiao Research Intern in IBM CRL

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1 Aloha

1.1 a

The probability of a successful transformation is $P_s = N * p * (1-p)^{N-1}$, only successful transmission could count throughput, so:

$$S = 1 * P_s = N * p * (1-p)^{N-1}(Mbps) \tag{1}$$

1.2 b

We need to calculate the differentiate of $S(p)$:

$$S(p)' = (N*p*(1-p)^{N-1})' = N*(1-p)^{N-1} - N*(1-p)^{N-1} = (1-N)*N*(1-p)^{N-2} \tag{2}$$

Set the equation to 0, we could get $p^* = \frac{1}{N}$

1.3 c

The maximum throughput is $S = N * \frac{1}{N} * (1-\frac{1}{N})^{N-1} = (1-\frac{1}{N})^{N-1}$, so $\lim_{N\to\infty}(1-\frac{1}{N})^{N-1}$ let $u = N-1$, we could get $\lim_{N\to\infty}(1-\frac{1}{N})^{N-1} = \lim_{u\to\infty}(1-\frac{1}{u+1})^u = \lim_{u\to\infty}(\frac{u}{u+1})^u = \lim_{u\to\infty}(\frac{1}{\frac{u+1}{u}})^u = \lim_{u\to\infty}(\frac{1}{1+\frac{1}{u}})^u = \frac{1}{e}(Mbps)$

2 Overhead

If we are going to seed 250 bytes data, the payload percentage is:

$$\frac{250}{8+6+6+2+40+20+4+12+250} = 0.718390804 = 71.8\% \tag{3}$$