

Question 1.

$$10 \text{ Gbps} = 10^{10} \text{ bit/s}$$

$$1 \text{ TB} = 2^{40} \text{ byte} * 8 \text{ bit/byte} = 2^{43} \text{ bit}$$

$$280 \text{ km} / 40 \text{ kmph} = 7 \text{ hour} = 25200 \text{ s}$$

$$2^{43} \text{ bit} / 25200 \text{ s} * \text{num} > 10^{10} \text{ bits/s}$$

$$\Rightarrow \text{num} > 28.6 \text{ Thus, at least 29 pigeons}$$

----- total data per pigeon carries

----- total sec per pigeon travels

----- speed per pigeon * num > 10Gbps

Question 2.

$$(a) 1024 \text{B} = 2^{10} \text{ byte} * 8 \text{ bit/byte} = 2^{13} \text{ bit}$$

$$(4 \mu\text{s} + 2^{13} \text{ bit} / 10^3 \text{ bit}/\mu\text{s}) * 4 = 48.768 \mu\text{s}$$

----- (delay + data length / speed) * 4

$$(b) ((1024 \text{ B} - 150 \text{ B}) / 1024 \text{ B}) * 1 \text{ Gbps} = 0.854 \text{ Gbps}$$

----- (actual data / packet size)*bandwidth

$$(c) 80 \text{ byte} * 8 \text{ bit/byte} = 640 \text{ bit}$$

$$((1024 \text{B} - 150 \text{B}) * 8 \text{ bit/byte}) / (4 * (4 \mu\text{s} + 80 \text{B} * 8 \text{ bit/byte} / 10^3) + 48.768 \mu\text{s}) * 10^6 \text{ bps} = 0.1 \text{ Gbps}$$

Question 3.

$$(a) 10 \text{ Gbps} = 10240 \text{ Mbps} \quad 10^4 \text{ Mbps} / 200 \text{ Mbps} = 50$$

----- total / per person

$$(b) P = \binom{800}{n} * (0.04^n) * (0.96^{800-n})$$

$$(c) \sum_{i=51}^{800} P_i = \binom{800}{i} * (0.04^i) * (0.96^{800-i})$$

Question 4.

$$(a) 1 \text{ Gbps} = 10^9 \text{ bit/s} \quad 80 \mu\text{s} = 8 * 10^{-5} \text{ s}$$

$$10^9 \text{ bit/s} * 8 * 10^{-5} \text{ s} = 8 * 10^4 \text{ bit}$$

-----bandwidth *delay product

$$(b) 54 \text{ Mbps} = 54 * 10^6 \text{ bit/s} \quad 0.2 \mu\text{s} = 2 * 10^{-7} \text{ s}$$

$$54 * 10^6 \text{ bit/s} * 2 * 10^{-7} \text{ s} = 10.8 \text{ bit}$$

-----bandwidth *delay product

$$(c) 35,786 \text{ km} / 3 * 10^5 \text{ km/s}$$

----- delay

$$100 * 10^6 \text{ bit/s} * 35,786 \text{ km} / 3 * 10^5 \text{ km/s} = 1.2 * 10^7 \text{ bit}$$

-----bandwidth *delay product

Question 5. (correction: OK, I created an off by one mistake. they score 6 points in round 1, 5 points in round 2, etc. so it should really read 6-n+1.)

$$(a) 0.7^5 = 16.8\%$$

----- win first five rounds

$$(b) 0.3 * 6 \quad \text{----l}$$

$$0.7 * 0.3 * 11 \quad \text{----wl}$$

$$0.7^2 * 0.3 * 15 \quad \text{----wwl}$$

$$0.7^3 * 0.3 * 18 \quad \text{----wwwl}$$

$$0.7^4 * 0.3 * 20 \quad \text{----wwwwl}$$

$$0.7^5 * 0.3 * 21 \quad \text{----wwwwwl}$$

$$0.7^6 * 21 \quad \text{----wwwwww}$$

$$= 13.137$$

$$(c) 0.3 * 1 + 0.7 * 0.3 * 2 + 0.7^2 * 0.3 * 3 + 0.7^3 * 0.3 * 4 + 0.7^4 * 0.3 * 5 + 0.7^5 * 6 = 2.94$$

$$(d) m/n = 13.137 / 2.94 = 4.467$$

2
2
2
2
2

Question 6.

domains	registar	Date
uiuc.edu	University of Illinois at Urbana Champaign	18-Jul-1985
google.com	MARKMONITOR INC.	1997-09-15
gooooooogle.com	ENOM, INC.	02-aug-2001
kravets.org	Proxy Protection LLC	1999-09-01
acmilan.it	Milan A.C. S.p.a.	2007-03-01