

1. 10 TB equals to  $8 \cdot 10^7$  Mb.

Using Internet will take  $8 \cdot 10^7 / 100 = 8 \cdot 10^5$  sec.

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Using hard disks will take  $8 \cdot 10^7 / 500 = 16 \cdot 10^4$  sec each time for copying the entire data. The round trip will take 2 hours = 7200 sec. So the total time will be  $2 \cdot 16 \cdot 10^4 + 7200 = 327200 < 8 \cdot 10^5$  sec.

As a result, plan b is faster.

2. BDP = bandwidth \* one-way delay

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a.  $57600(\text{b/s}) \cdot 100\text{ms} = 5760 \text{ b}$

b.  $1.54(\text{Mb/s}) \cdot 5\text{ms} = 7.7 \cdot 10^3 \text{ b}$

c. Propagation time =  $36000000 / (3 \cdot 10^8) = 0.12 \text{ s}$

BDP =  $5(\text{Mb/s}) \cdot 0.12 = 0.6 \text{ Mb}$

3. a.

The total propagation time will be  $3 \cdot 3 \cdot 10^{-6} \text{ s}$ .

The total store and forward time will be  $3 \cdot 8 \cdot 512 / 100000000 = 1.2288 \cdot 10^{-4} \text{ s}$

So the total time will be  $1.3188 \cdot 10^{-4} \text{ s}$ .

b.

Now the data throughput =  $512 - 50 = 462 \text{ B}$

So the effective bandwidth will be  $462 / 500 \cdot 100 = 92.4 \text{ Mbps}$

c.

Latency for receiving the acknowledgement is  $3 \cdot 3 \cdot 10^{-6} + 3 \cdot 8 \cdot 10 / 100000000 = 1.14 \cdot 10^{-5} \text{ s}$

Here total latency = original latency ( $1.3188 \cdot 10^{-4}$ ) +  $1.14 \cdot 10^{-5} = 1.4328 \cdot 10^{-4} \text{ s}$

Bandwidth = data\_size / latency =  $462 / 1.4328 \cdot 10^{-4} = 3.22 \cdot 10^6 \text{ Mbps}$

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4. a. 1 Because it is circuit switching

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b.  $f(n) = C_{10}^n \cdot 0.1^n \cdot 0.9^{10-n}$

c. It will overload if there are over 5 users.  $P(\text{overload}) = f(6) + f(7) + f(8) + f(9) + f(10) = 1.469 \cdot 10^{-4}$

5. a.  $2 \cdot 10^9 \cdot 5 \cdot 10^{-6} = 10^4 \text{ b}$

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b.  $2 \cdot 10^6 \cdot 40 \cdot 10^{-3} = 8 \cdot 10^4 \text{ b}$

c.  $20 \cdot 10^6 \cdot 5 \cdot 10^7 / (3 \cdot 10^8) = 3.333 \cdot 10^4 \text{ b}$

6. a.  $0.5^5 = 0.03125$

b. mean =  $\sum_i u(i) p(u(i))$

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| # of chips----u(i) | P(u(i)) |
|--------------------|---------|
| 0                  | 0.5     |
| 20                 | $0.5^2$ |
| 60                 | $0.5^3$ |
| 120                | $0.5^4$ |
| 200                | $0.5^5$ |


|     |         |
|-----|---------|
| 300 | $0.5^6$ |
| 420 | $0.5^6$ |

So, mean = 37.5

c. Use the same equation

For this case,

| # of Rounds | P       |
|-------------|---------|
| 1           | 1       |
| 2           | $0.5^1$ |
| 3           | $0.5^2$ |
| 4           | $0.5^3$ |
| 5           | $0.5^4$ |
| 6           | $0.5^5$ |

So, mean = 3.75 

d.  $m/n = 10$

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7. The following table contains the answer:

| Domain        | Registrant Name                            | Registrant Address   | Date        |
|---------------|--|--|-------------|
| Symbolics.com | Meystedt, Aron                             | 4146 Walnut Meadow, Dallas, TX, 75229 , US                             | 15-Mar-1985 |
| Facebook.com  | Domain Administrator                       | 1601 Willow Road, Menlo Park, CA, 94025, US                            | 28-Mar-1997 |
| Uiuc.edu      | University of Illinois at Urbana Champaign | 1304 West Springfield Avenue, Urbana, IL 61801-2910, US                | 18-Jul-1985 |
| Airbnb.com    | Domain Administrator                       | 888 Brannan Street, 4 <sup>th</sup> Floor, San Francisco, CA 94103, US | 05-Aug-2008 |