1: a. A picks $(0,1)$

$$\Pr[A_k=0] = \Pr[A_k=1] = \frac{1}{2}$$

B picks $(0,1,2,3)$

$$\Pr[B_k=0] = \Pr[B_k=1] = \dots = \Pr[B_k=3] = \frac{1}{4}.$$

$$\begin{aligned}
\Pr^{(2)}[A_k < B_k] &= \Pr[A_k=0]\Pr[B_k>0] \\
&\quad + \Pr[A_k=1]\Pr[B_k>1] \\
&= \frac{1}{2}\left[\left(1-\frac{1}{4}\right) + \left(\frac{1}{4}+\frac{1}{4}\right)\right] \\
&= \frac{1}{2}\left(\frac{3}{4}+\frac{1}{2}\right) \\
&= \frac{5}{8}.
\end{aligned}$$

b. A picks $(0,1)$

B picks $(0,1,\dots,7)$.

$$\begin{aligned}
\Pr^{(3)}[A_k < B_k] &= \Pr[A_k=0]\Pr[B_k>0] \\
&\quad + \Pr[A_k=1]\Pr[B_k>1] \\
&= \frac{1}{2}\left[\left(1-\frac{1}{8}\right) + \left(1-\frac{1}{4}\right)\right]. \\
&= \frac{1}{2}\left(\frac{7}{8}+\frac{3}{4}\right) \\
&= \frac{13}{16}.
\end{aligned}$$

c. $P_r^{(4)}[A_c < B_c] = \frac{1}{2}\left[\left(1-\frac{1}{2^4}\right)+\left(1-\frac{2}{2^4}\right)\right].$

$$P_r^{(i)}[A_c < B_c] = \frac{1}{2}\left[\frac{2^i - 1 + 2^i - 2}{2^i}\right].$$

$$= \left(\frac{2^{i+1} - 3}{2^{i+1}}\right)$$

$$= 1 - \frac{3}{2^{i+1}}$$

when $i \geq 10$, B always picks $(0, 1, \ldots, 1023)$, and B gives up after 16 tries.

$$P_r[A \text{ wins the rest}] = \prod_{i=4}^{9}\left(1-\frac{3}{2^{i+1}}\right)\prod_{i=10}^{16}\frac{2045}{2048}$$

d. B discards B_1 and tries w/ B_2

(2.) MAC addr. are 48 bits

$\Rightarrow$ # of possible addrs 2^{48}

a. $P_r[2 \text{ host w/ same addr}] = \boxed{1-\left(\frac{2^{48}-1}{2^{48}}\right)\left(\frac{2^{48}-2}{2^{48}}\right)\cdots\left(\frac{2^{48}-2+1}{2^{48}}\right)}$

P Z

$$\approx \frac{1+2+\ldots+1023}{2^{48}} \qquad = \sum_{i=1}^{1023} i = \frac{i(i+1)}{2}.$$

$$= \frac{1023 \times 1024}{2 \times 2^{48}}$$

$$= 1.86 \times 10^{-9}$$

b. $Pr[\text{none of } 2^{20} \text{ nets}] = (1-p)^{2^{20}}$; $p = 1.86 \times 10^{-9}$

$Pr[\text{at least 1 net}] = 1 - (1-p)^{2^{20}}$

c. $Pr[\text{all nets}] = p^{2^{20}}$

(3.) It doesn't depend on infrastructure that could've been impacted by the disaster.

(4.) $Pr[\text{frag. loss}] = .01$

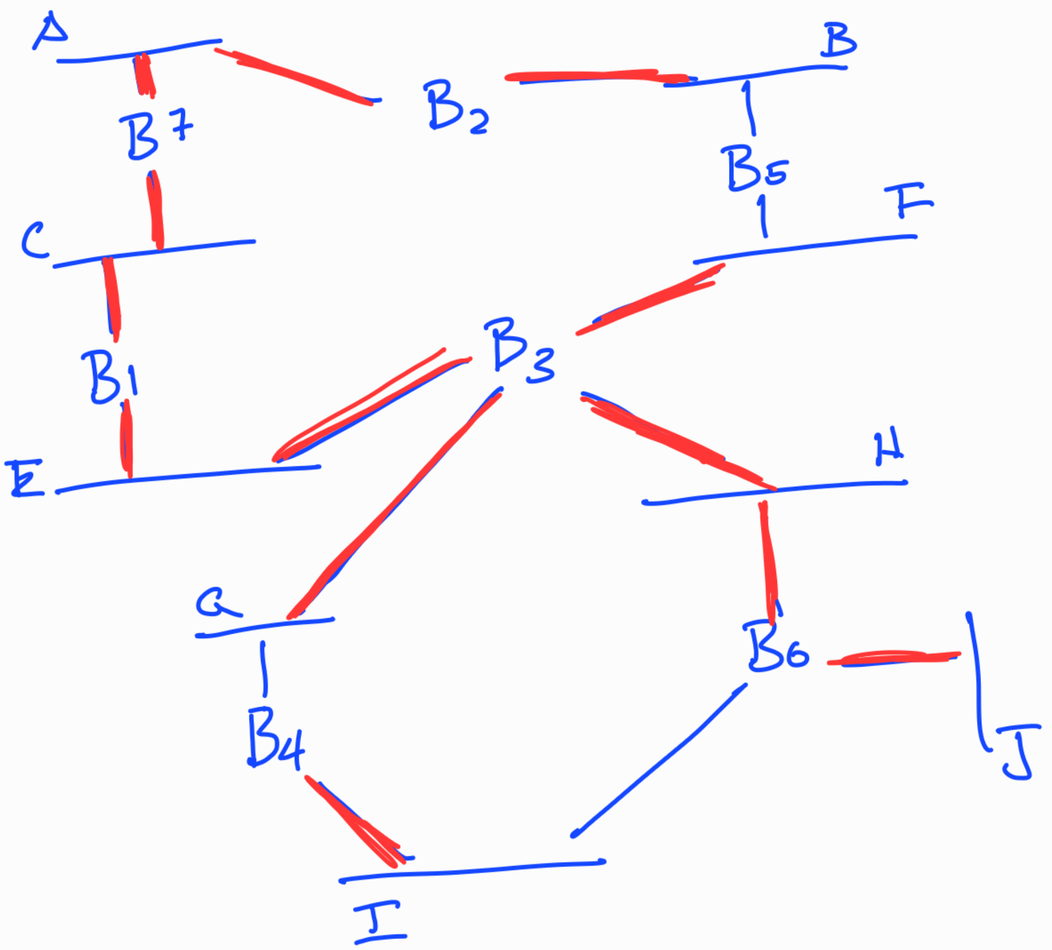
$Pr[\text{packet loss}] = .1$

a. $Pr[\text{loss}] = .01$

b. $Pr[\text{loss}] = 1 - (1 - .0001)^{10} \approx .001$

c. ident field helps identify the fragment loss so we only retx. that one.

6.



Pick B_1 as root.

B_2 gets to B_1 via B_7

B_3 via B_1

B_4 via B_3

B_5 via B_3

B_6 via B_3

B_7 via B_1

A uses B_7 to get to the root.

B uses B_2

C uses B_1

E uses B_1

F uses B_3

G uses B_3

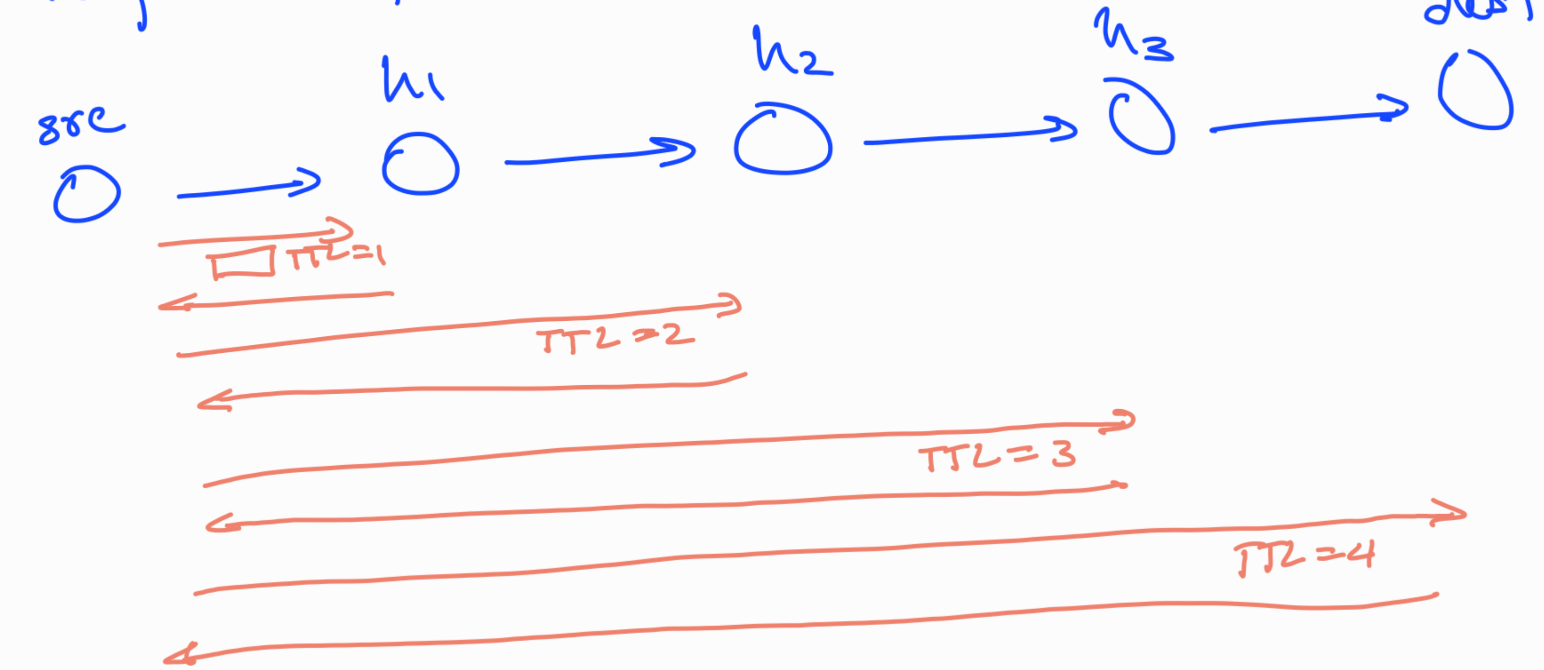
H uses B_3

I uses B_4

J uses B_6.

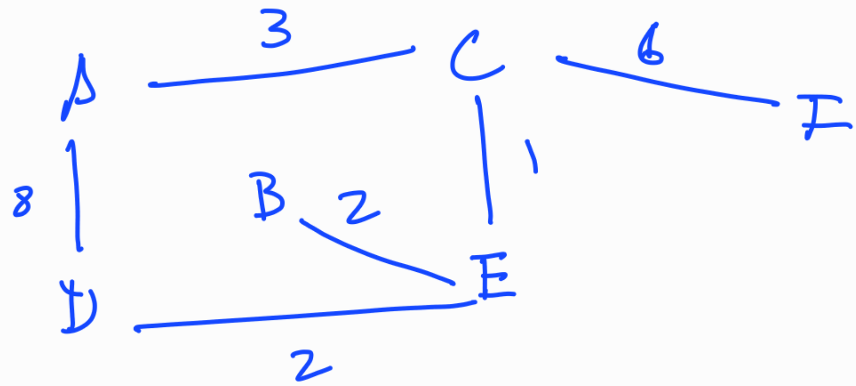
The chosen ports are marked using red.

7. Traceroute uses the ICMP protocol. It uses different TTL values to get the response of the intermediate hops.



In the example, the traceroute from src to dest uses 4 ICMP packets, each w/ TTL=1, 2, 3, 4 respectively.

5.



	A	B	C	D	E	F
A	–	6, C	3, C	6, C	4, C	9, C
B	6, E	—	3, E	4, E	2, E	9, E
C	3, A	3, E	—	3, E	1, E	6, F
D	6, E	4, E	3, E	—	2, E	9, E
E	4, C	2, B	1, C	2, D	—	7, C
F	9, C	9, C	6, F	9, C	7, C	—

8 Mktg: 16 machines

Eng: 5 machines + 1/week.

Sales: 1 machine / 2 clients.

year 1: 0

year 2: 6 clients.

$$\left.\begin{array}{l} Pr[+1 \text{ client}] = .6 \\ Pr[-1 \text{ client}] = .2 \\ Pr[0 \text{ client}] = .2. \end{array}\right\} \text{per week}$$

a. 1 year = 52 weeks.

After 7 years:

Eng: $5 + 7 \times 52 = 369$.

Mkt: 16

Sales: $E[c/\text{week}] = 1(.6) - 1(.2) = 0.4$

Each week we expect to have 0.4 clients more.

$$\Rightarrow \frac{6 + 6 \times 52 \times 0.4}{2} \approx 66$$

total $= 16 + 66 + 369 = \underline{451}$ machines.

b. total $= 16 + 5 + 52y + 3 + 0.2(52)(y-1)$

$= 62.4y + 13.6$

$62.4y + 13.6 = 65534$

$y \approx 1050$ years.

mkt: 16 addrs.

eng : $5 + 1050(52) \approx 54605$

sales : $3 + 1049(52)0.2 \approx 10913$

c. For 454 machines, 2 class C is enough.