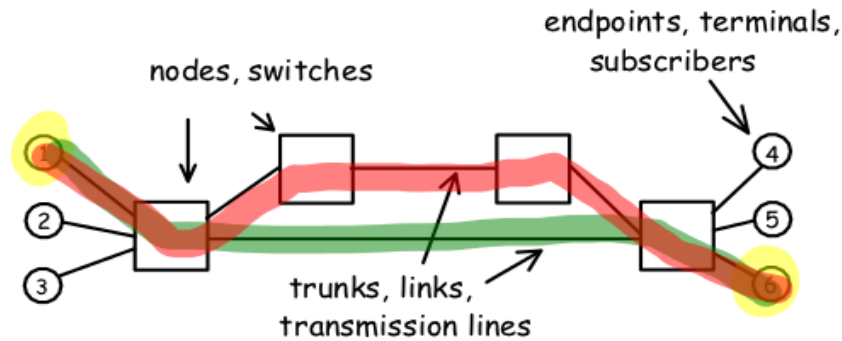


Lecture 14

Exercise 1: What links and switches would have to be used for node 1 to communicate with node 6?



Exercise 2: Find examples of communication networks other than the PSTN or the Internet. Identify the endpoints, switching nodes and communication links.

	<u>endpoints</u>	<u>links</u>	<u>switching nodes</u>
bluetooth PAN:	cell phone, mouse, etc.	wireless	none (point-to-point)
"cable" TV: cable network studios	subscriber sets,	co-ax, fibre, satellite	headend, optical node

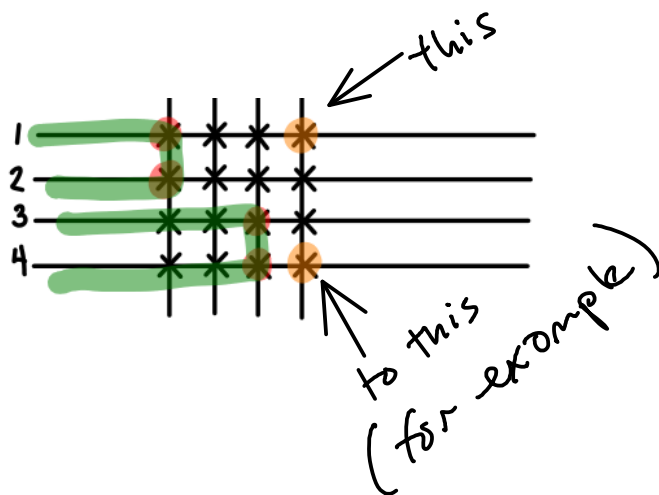
Exercise 3: Assuming each CO has 10,000 directly-connected subscribers, how many CO's are required to service 3 million subscribers? What is the aggregate data rate at each CO if 10% of users are active with a data rate of 128kb/s each? What SONET rate (OC-*n*) would handle this data rate?

$$\frac{3 \times 10^6 \text{ subscribers}}{10^4 \text{ subscribers/CO}} = 300 \text{ end offices.}$$

$$10\% \times 10,000 \times 128 \text{ kb/s} = 128 \text{ Mb/s}$$

1 OC-3 would handle \approx 150 Mb/s

Exercise 4: What connections could be made to connect line 1 to line 4?



Exercise 5: What are the values of N , n and k in the diagram above?

$$N = 10$$

$$n = 5$$

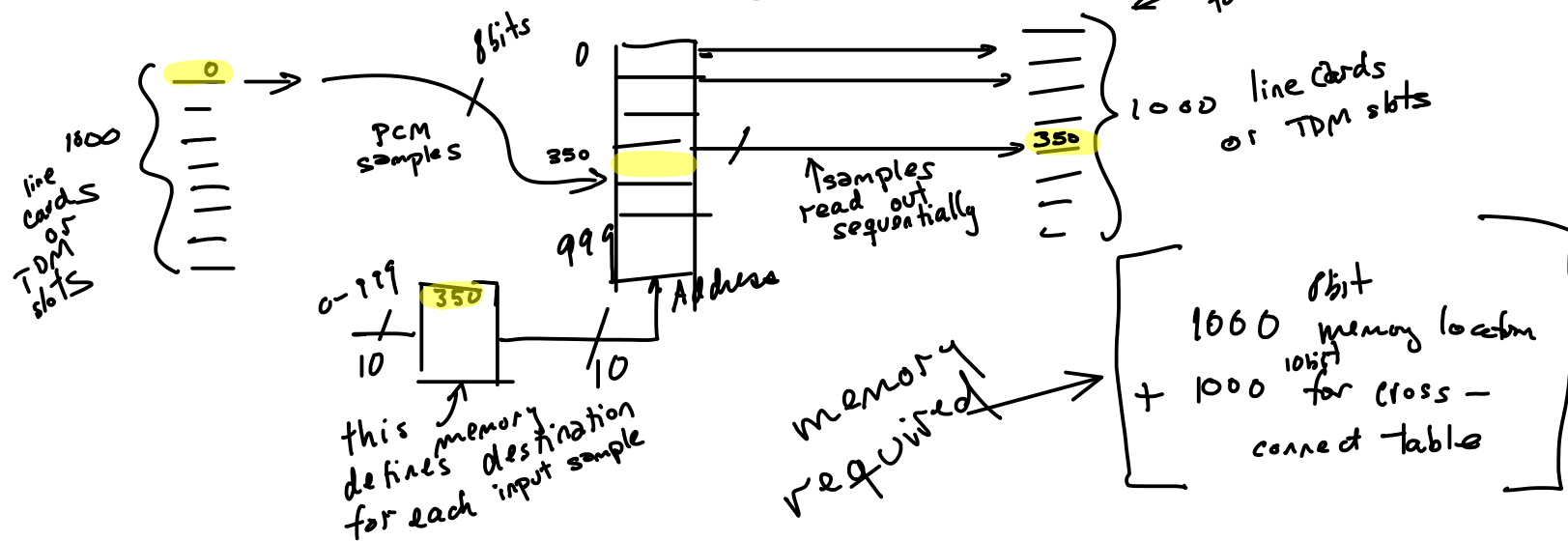
$$k = 2$$

Exercise 6: You want to design a 1000×1000 digital switch. How fast must you write and read samples from memory assuming a sample rate of 8 kHz? How much buffer memory is required?

samples/second $1000 \text{ reads} = 8 \text{ M reads/second}$
 $8,000 \times 1000 \text{ writes} = 8 \times 10^6 \text{ writes/second}$

RAM bandwidths are 100's MHz
 so this is easily done

example:
 connect time slot 0
 to time slot 350



memory required

1000 8bit memory locations
 + 1000 for cross-connect table

Exercise 7: What is the average call arrival rate?

$$a \approx \underline{\underline{0.075}} \quad \text{Erlangs} \quad \underline{\underline{0.05 \rightarrow 0.10}}$$
$$H = \frac{3.5 \text{ minutes}}{60} = 210 \text{ seconds}$$
$$\textcircled{a} = \lambda H$$
$$\lambda = \frac{a}{H} = \frac{0.075}{210} = 36 \times 10^{-3} \text{ calls/second per subscriber.}$$

Exercise 8: A switch has 20 outgoing trunks available for 1200 users. Each user attempts to make one call every two hours and the average call time is 1.2 minutes. What is the probability that a call will be blocked? What if there were 2 trunks for 100

$$1200 \text{ users}$$
$$\lambda = \frac{1}{2 \times 60 \times 60} \text{ calls/seconds}$$

$$H = 1.2 \text{ minutes} = 1.2 \times 60 = 72$$

$$a_0 = \lambda H = \frac{1}{2 \times 60 \times 60} \cdot 72 \quad (\text{offered load per user})$$

$$a = \lambda \cdot H \cdot (\# \text{ users}) = \frac{72 \times 1200}{2 \times 60 \times 60} = 12$$

20 trunks.

$$P_b \approx \underline{\underline{0.3\%}}$$