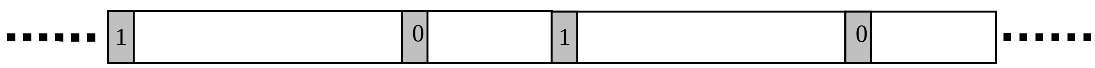
Department of Electrical Engineering
EC-305 Communication Systems

October 12, 2009 **Quiz #2** 20 marks

1. [3 marks] A framing code of length L_1=6 in used on a frame of length N=100, to give an average frame acquisition time of S bits. Find the new value L_2, of this framing overhead that will reduce the average frame acquisition time to T bits, where $T \leq S/10$. What are the values of S and T ?

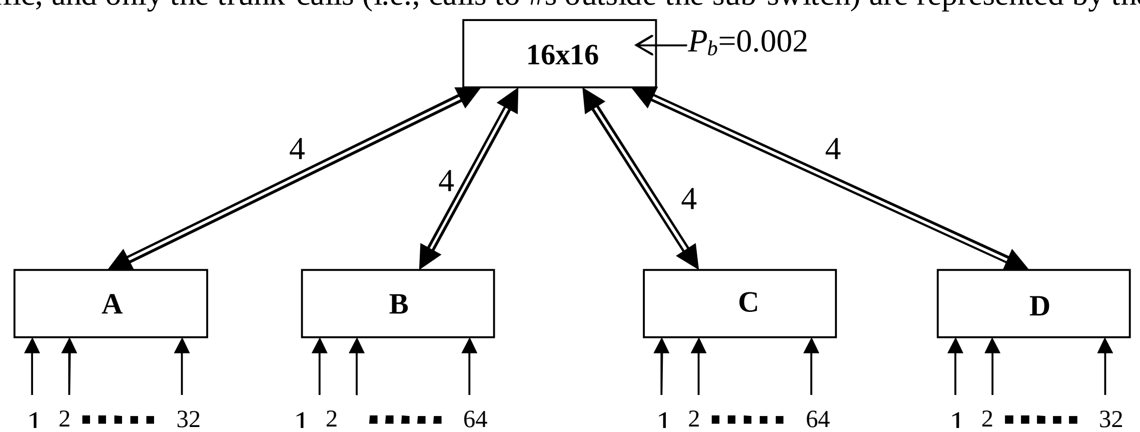
2. [3+4=7 marks] A particular synchronous link uses 100-bit long odd-numbered frames, and 50-bit long even numbered frames, as shown in figure below. The first bit in the 100-bit frame is always a "1" while the first bit is always "0" for the 50-bit frame. Framing is said to be achieved if over n=10 consecutive frames, this framing bit sequence "1-0-1-0…" is correctly detected. Further, assume that some sort of scrambling-across-frames is done to ensure that in no (data) regular bit position will there be more than (n/2)-1=4 consecutive "1"s or "0"s in as many consecutive frames (super-frames of length 150).



(a) Describe a "parallel search" approach for framing detection. How many bit-locations are searched in parallel? How many bit intervals (assuming T is the bit-duration) elapse before framing is achieved?
(b) Instead, for reasons of reducing complexity, if a "serial search" approach is take, what will be:
(i) the best case, and (ii) the worst case situations (in terms of bit intervals required to achieve framing)?

3. [4 marks] Consider the design of a 3-stage blocking switch for N=10,000 users, each offering E_u=0.02 Erlangs. All the sub-arrays in the switch will be of dimension 100×100 (and in the input and output stage sub-arrays, not all these links need to be used). Determine the (least) number of middle-stage subarrays, k, such that the blocking probability P_b is 10^{-6} or lower. What is the total number of 100×100 sub-arrays used in the switch?

4. [2+1+1+2=6 marks] We have 4 sub-switches A,B,C,&D, where the trunk traffic is served by 4 trunk lines each, as shown in the figure below. The trunk lines are in turn switched by a 16x16 blocking switch with Pb=0.002. Assume that each of the trunk inlet ports (to A,B,C,&D) offer E_u=1/16 Erlangs of traffic, and only the trunk-calls (i.e., calls to #s outside the sub-switch) are represented by the inlets.



(a) Find the blocking probabilities (for connecting to the trunk servers) at sub-switch A and also at sub-switch B. (*Hint*: use Erlang-B formula)
(b) What is the probability that a trunk user from switch A can connect to a trunk user in switch D?
(c) What is the probability that a trunk user from switch A cannot connect to a user in switch C?
(d) What is the overall average blocking probability of this switching trunk system?