BLOCK CODING

- In general, block coding changes a block of m bits into a block of n bits, where n is larger than m. Block coding is referred to as an mB/nB encoding technique.

- Block coding normally involves three steps: division, substitution, and combination.
- In the division step, a sequence of bits is divided into groups of m bits.

- The heart of block coding is the substitution step and in this step, we substitute an m-bit group for an n-bit group.

- Finally, the n-bit groups are combined together to form a stream

BLOCK CODING

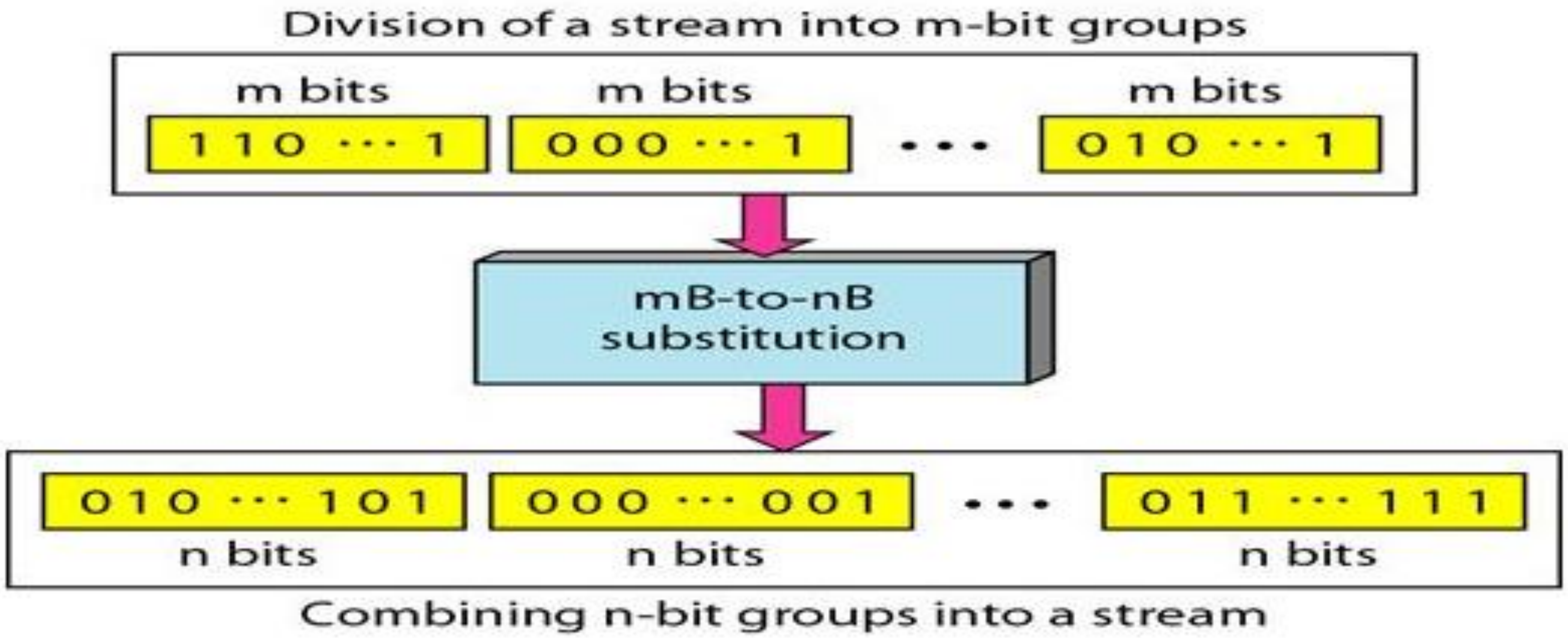
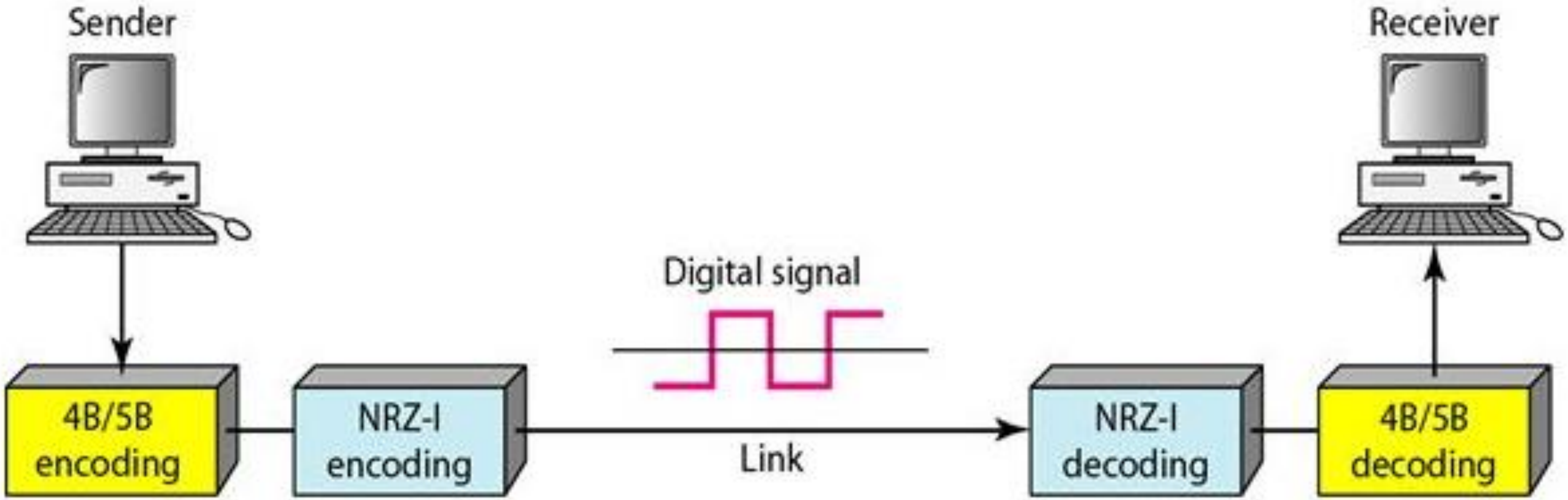


Fig. Block Coding Concept

4B/5B

- The four binary/five binary (4B/5B) coding scheme was designed to be used in combination with NRZ-I.
- Recall that NRZ-I has a good signal rate, one-half that of the biphase, but it has a synchronization problem.
- The block-coded stream does not have more that three consecutive as, as we will see later.
- At the receiver, the NRZ-I encoded digital signal is first decoded into a stream of bits and then decoded to remove the redundancy.
- 4B/5B, the 5-bit output that replaces the 4-bit input has no more than one leading zero (left bit) and no more than two trailing zeros (right bits)
- So when different groups are combined to make a new sequence, there are never more than three consecutive as

4B/5B

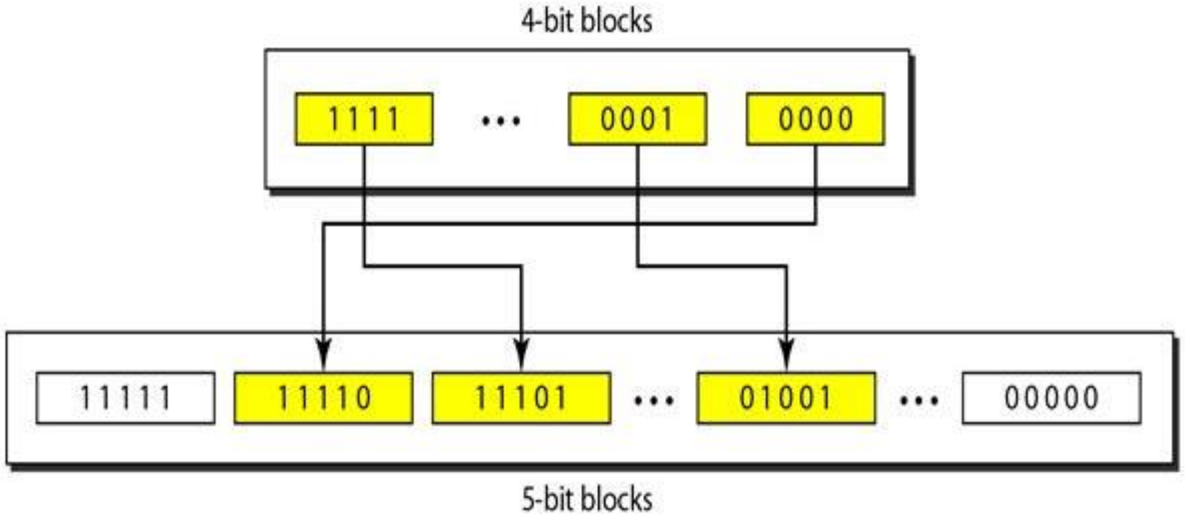


<u>Fig. Using block coding 4B/5B with NRZ-I line coding scheme</u>

Data Sequence	Encoded Sequence	Control Sequence	Encoded Sequence
0000	11110	Q (Quiet)	00000
0001	01001	I (Idle)	11111
0010	10100	H (Halt)	00100
0011	10101	J (Start delimiter)	11000
0100	01010	K (Start delimiter)	10001
0101	01011	T (End delimiter)	01101
0110	01110	S (Set)	11001
0111	01111	R (Reset)	00111
1000	10010		
1001	10011		
1010	10110		
1011	10111		
1100	11 010		
1101	11011		
1110	11100		
1111	11101		

Table. 4B/5B mapping codes

- Above table shows the corresponding pairs used in 4B/5B encoding.
- Note that the first two columns pair a 4-bit group with a 5-bit group.
- A group of 4 bits can have only 16 different combinations while a group of 5 bits can have 32 different combinations.
- This means that there are 16 groups that are not used for 4B/5B encoding. Some of these unused groups are used for control purposes; the others are not used at all.

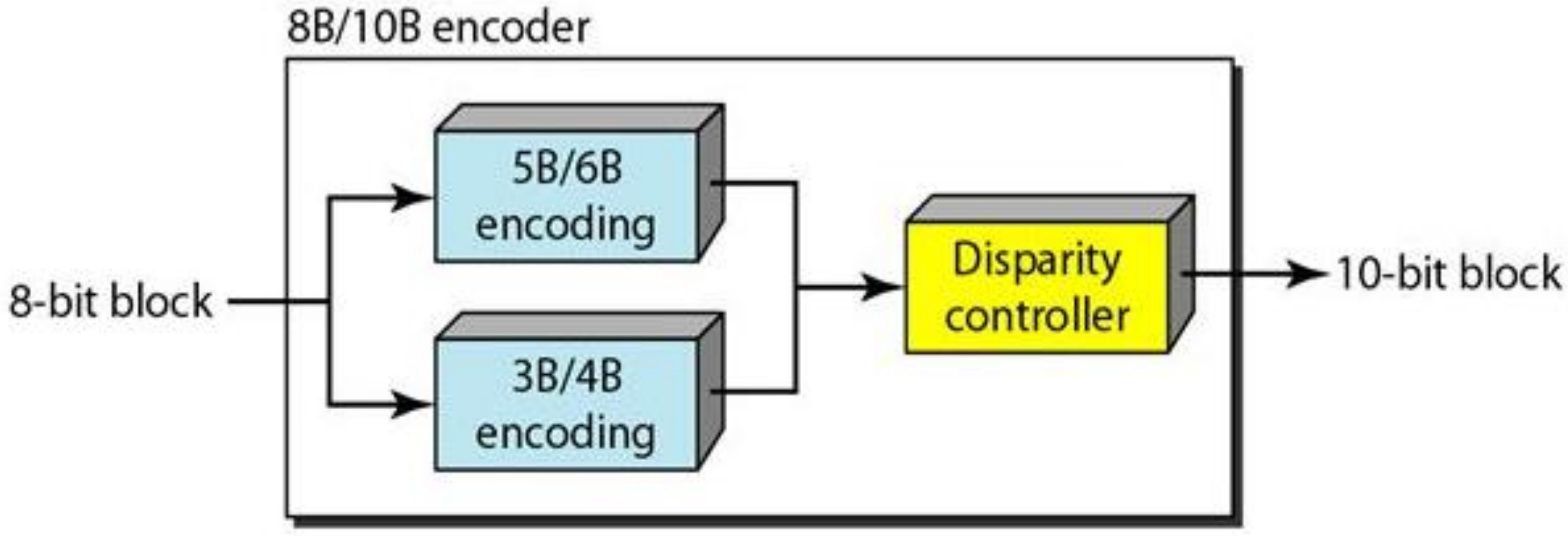


<u>Fig. Substitution in 48/5B block coding</u>

- 4B/5B encoding solves the problem of synchronization and overcomes one of the deficiencies of NRZ-1.
- However, we need to remember that it increases the signal rate of NRZ-1.
- Still, the result is less than the biphase scheme which has a signal rate of 2 times that of NRZ-1.
- However, 4B/5B block encoding does not solve the DC component problem of NRZ-1.
- If a DC component is unacceptable, we need to use biphase or bipolar encoding.

8B/10B

- The eight binary/ten binary (8B/10B) encoding is similar to 4B/5B encoding except that a group of 8 bits of data is now substituted by a 10-bit code.
- It provides greater error detection capability than 4B/5B.
- The 8BIlOB block coding is actually a combination of 5B/6B and 3B/4B encoding, as shown in Fig. below.



<u>Fig. 8B/1OB block encoding</u>

8B/10B

- The most five significant bits of a 10-bit block is fed into the 5B/6B encoder; the least 3 significant bits is fed into a 3B/4B encoder.
- The split is done to simplify the mapping table. To prevent a long run of consecutive Os or Is, the code uses a disparity controller which keeps track of excess Os over Is (or Is over Os).
- If the bits in the current block create a disparity that contributes to the previous disparity (either direction), then each bit in the code is complemented (a 0 is changed to a 1 and a 1 is changed to a 0).
- In general, the technique is superior to 4B/5B because of better built-in error-checking capability and better synchronization.