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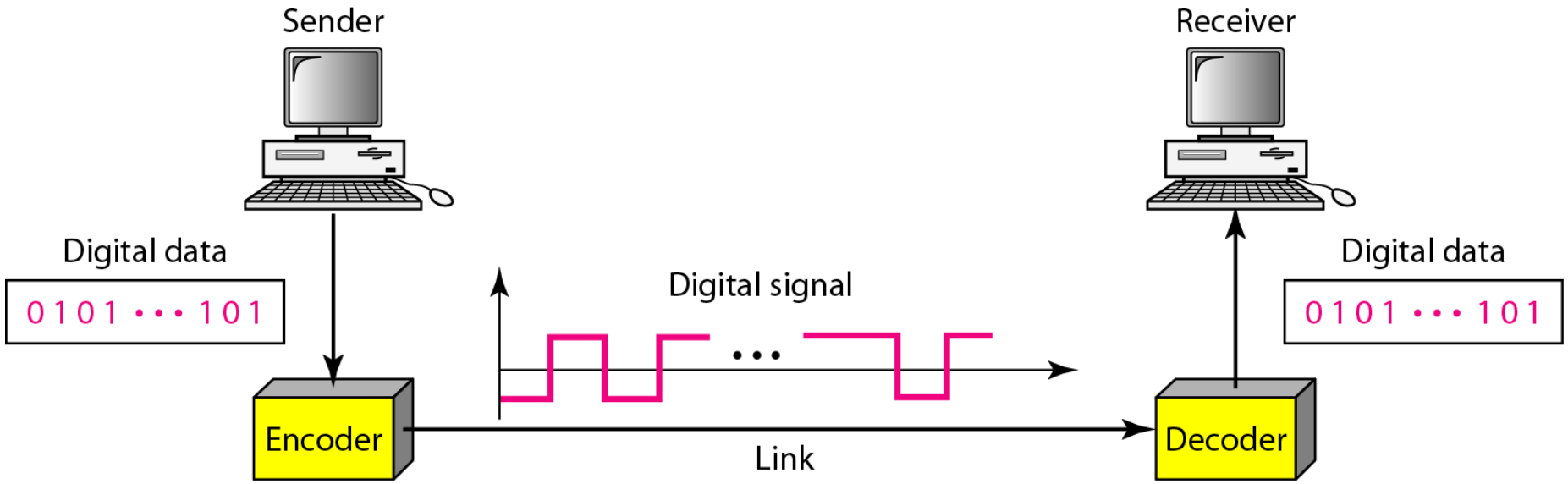
Physical Layer-Part3

Line coding Schemes-2

Line coding and Decoding



Line coding schemes

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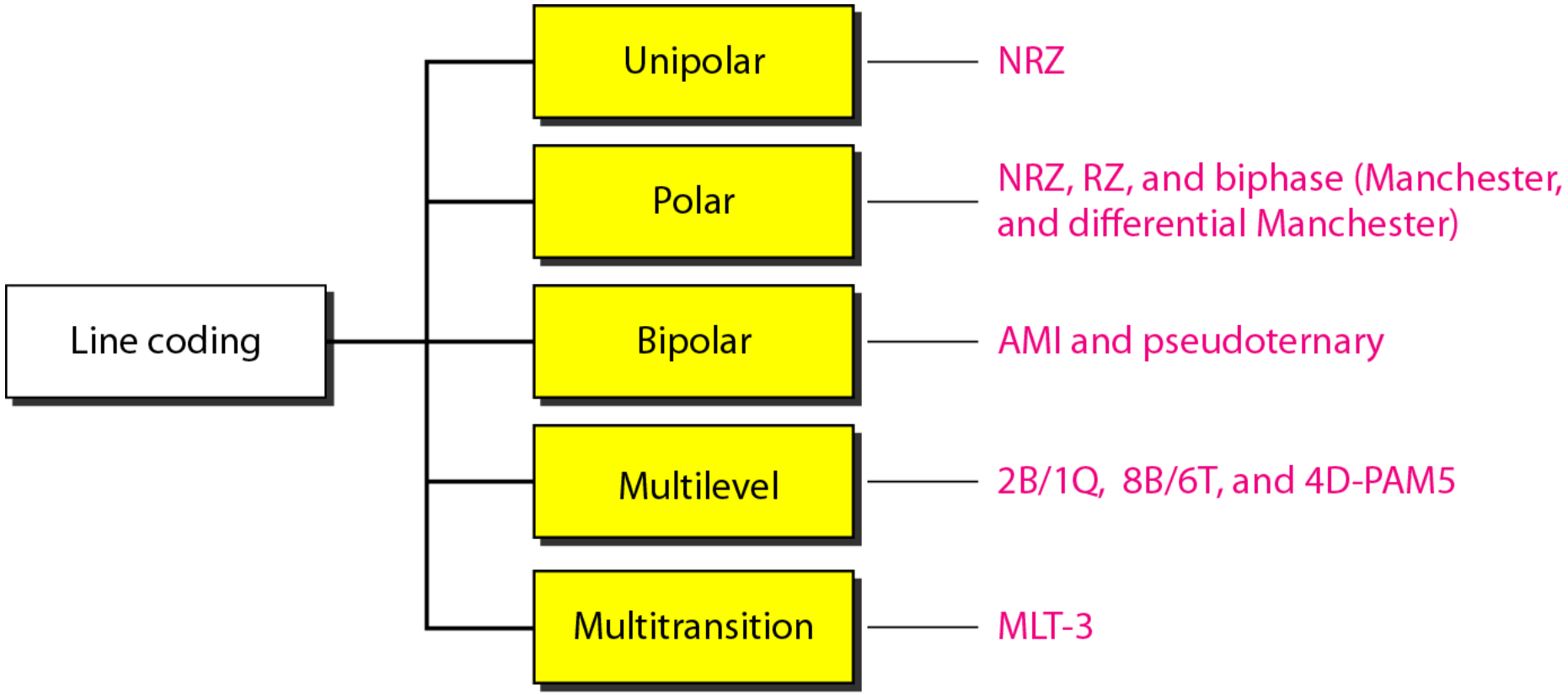
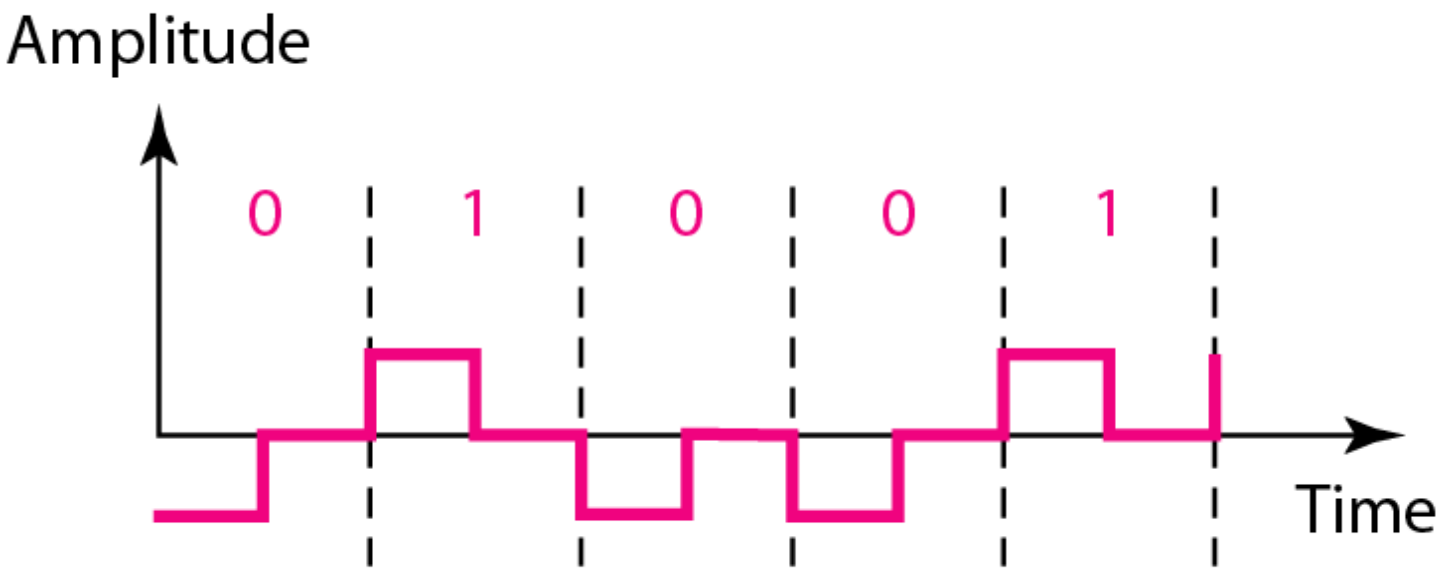
Line coding:- *It is the* process of converting digital data to digital signals



Polar RZ scheme

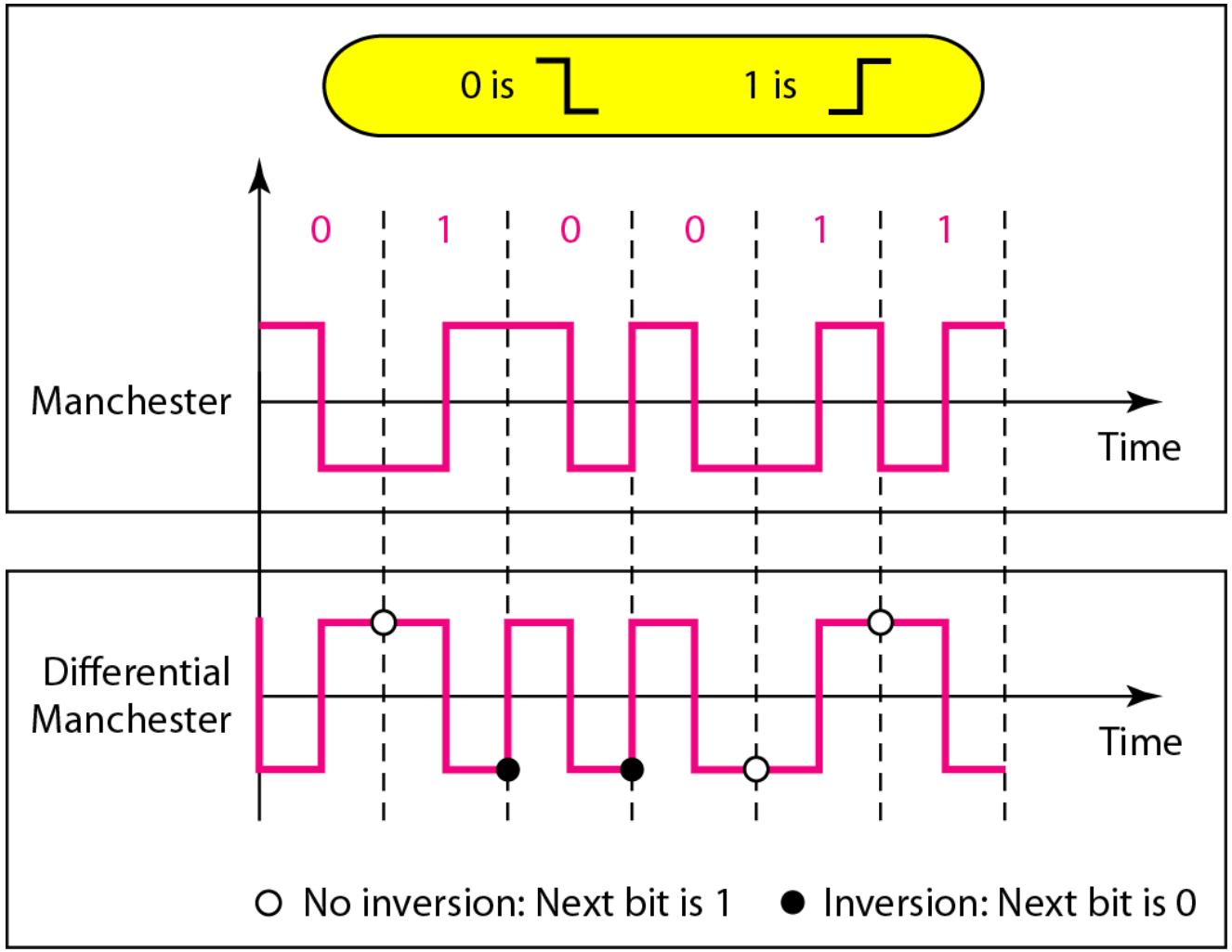
Polar RZ:- Return-to-zero (RZ) scheme uses three values: positive, negative, and zero.

- In RZ, the signal changes not between bits but during the bit also.



- No DC component problem.
- It occupies **greater bandwidth**.
- **Complexity**: RZ uses three levels of voltage, which is more complex to create and discern.

Polar Biphase: Manchester and differential Manchester schemes



- The idea of RZ (transition at the middle of the bit) and the idea of NRZ-L are combined into the Manchester scheme.
- In Manchester encoding, the duration of the bit is divided into two halves.
- Differential Manchester, on the other hand, combines the ideas of RZ and NRZ-I.
- In both the encodings, the transition at the middle of the bit is used for synchronization

Bipolar schemes

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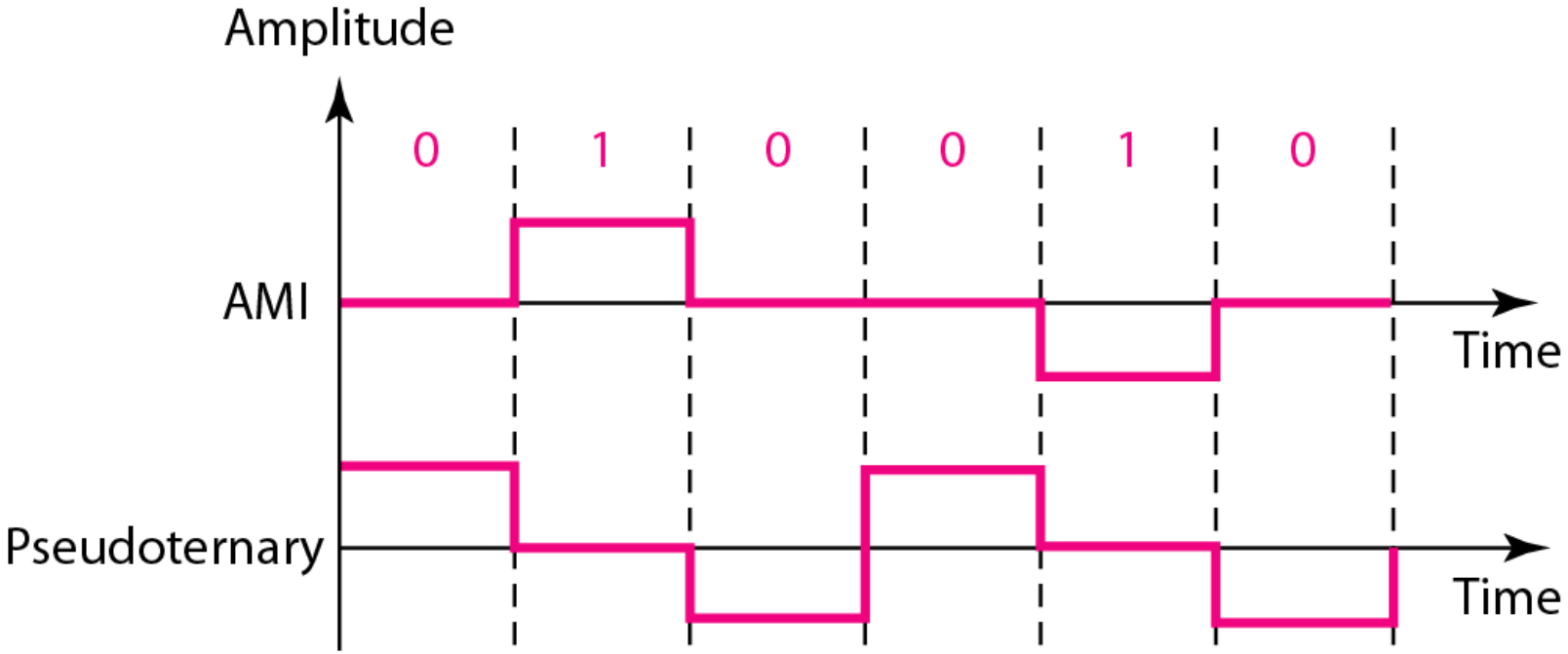
- In bipolar encoding, Three levels are used: positive, zero, and negative.
- Two schemes: - **AMI** (Alternate Mark Inversion) and **Pseudoternary**



- No DC component.
- Commonly used for long-distance communication
- Synchronization problem when a long sequence of 0s is present in the data.

Multilevel schemes

The desire to increase the data speed or decrease the required bandwidth has resulted in the creation of many schemes. The goal is to increase the number of bits per baud by encoding a pattern of *m* data elements into a pattern of *n* signal elements.

In *m*B*n*L schemes, a pattern of *m* data elements is encoded as a pattern of *n* signal elements in which $2^m \leq L^n$.

Types of Multilevel scheme

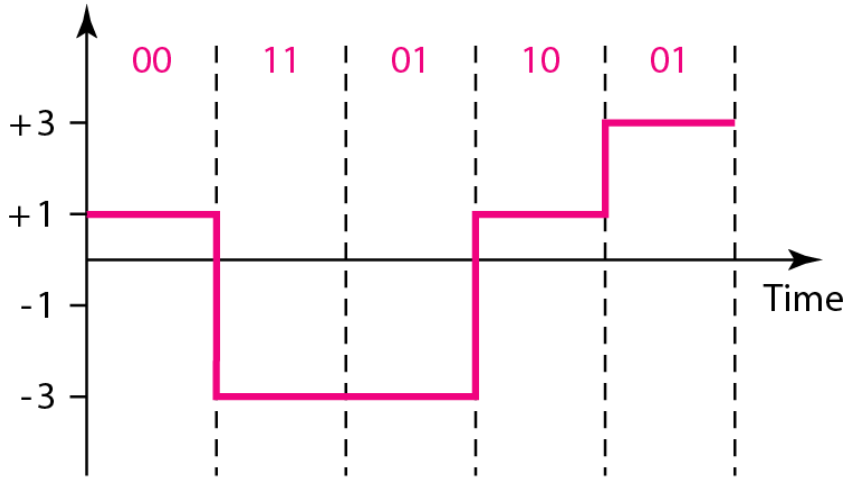
- ***2B1Q scheme***
- ***8B6T scheme***
- ***4D-PAM5 scheme***

Multilevel: 2B1Q scheme

- 2BIQ:- Two binary, one quaternary
- It uses data patterns of size 2 and encodes the 2-bit patterns as one signal element belonging to a four-level signal.

	Previous level: positive	Previous level: negative
Next bits	Next level	Next level
00	+1	-1
01	+3	-3
10	-1	+1
11	-3	+3

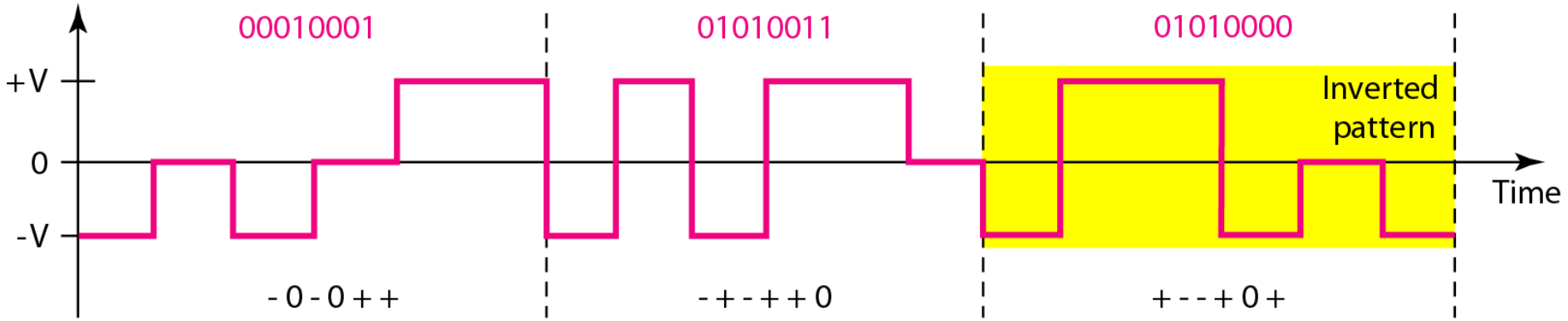
Transition table



Assuming positive original level

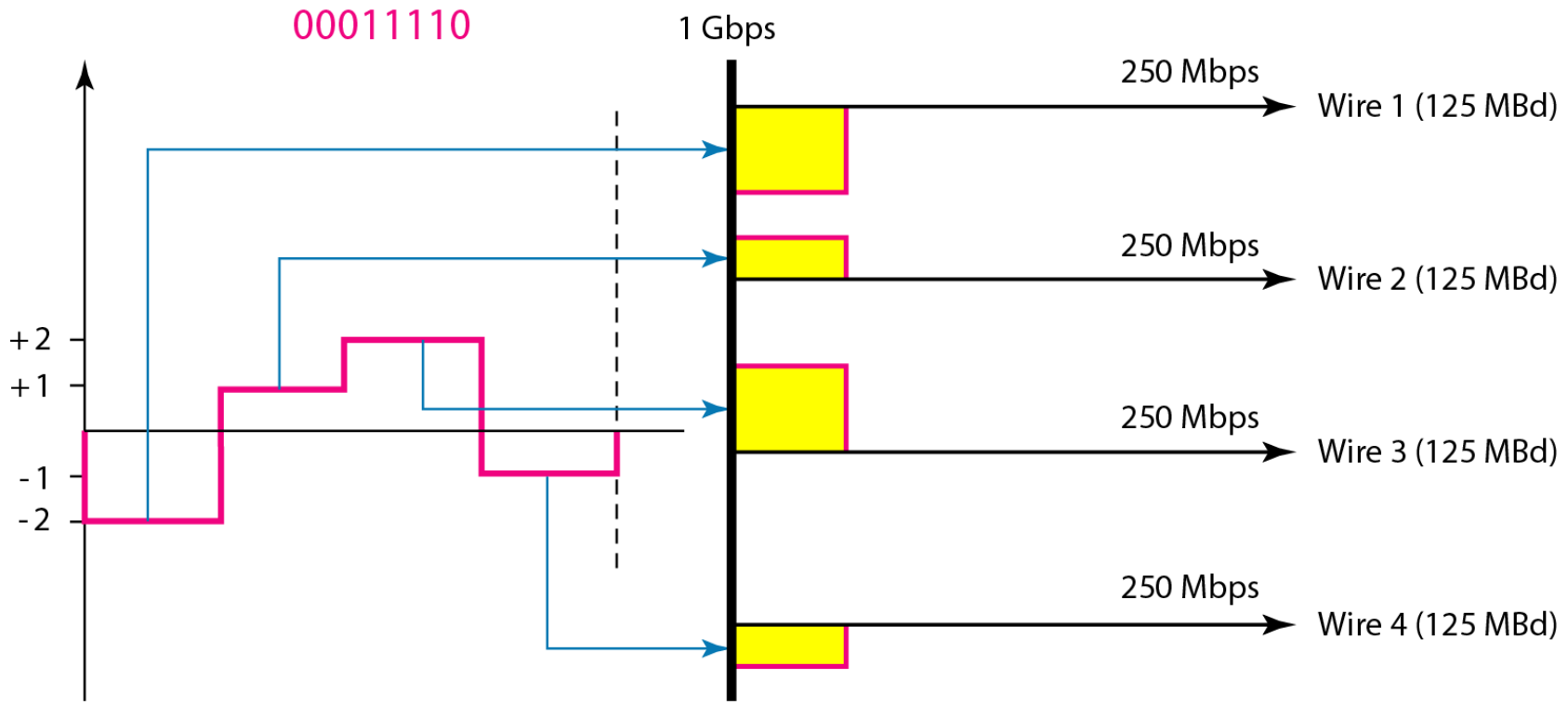
Multilevel: 8B6T scheme

- ***8B6T -*** Eight binary, Six ternary
- Encode a pattern of 8 bits as a pattern of 6 signal elements, where the signal has three levels (ternary).
- Each signal pattern has a weight of 0 or +1.
- To make the whole stream DC-balanced, the sender keeps track of the weight. If two groups of weight 1 are encountered one after another, the first one is sent as is, while the next one is totally inverted to give a weight of -1.



Multilevel: 4D-PAM5 scheme

- 4D-PAM5 – **Four dimensional five-level pulse amplitude modulation**
- The 4D means that data is sent over four wires at the same time.
- It uses five voltage levels, such as -2, -1, 0, 1, and 2.



Multi-transition

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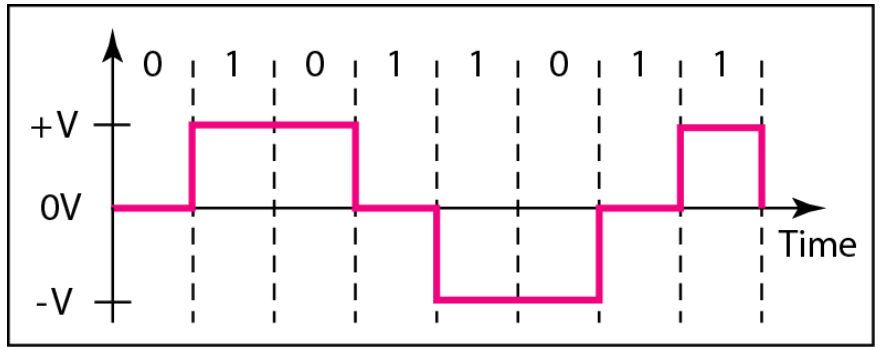
MLT-3 scheme (Multi level Transmit)

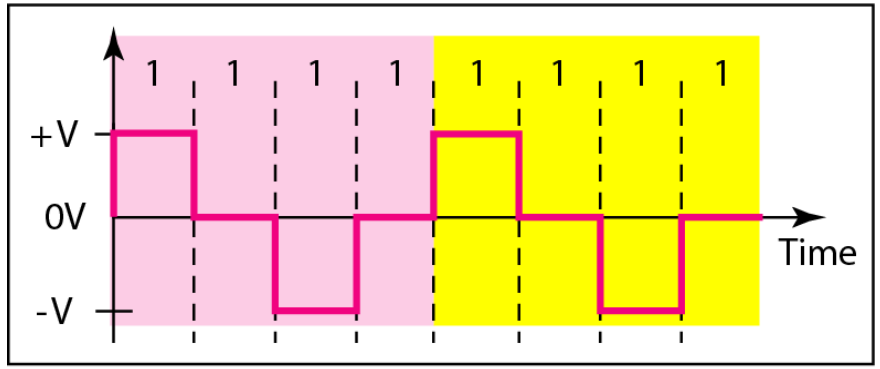
- NRZ-I and differential Manchester uses two transition rules to encode binary data (no inversion, inversion).
- This line coding scheme uses **three level** (+*V*, 0, and - *V*) and **three transition rules** to move between the levels.

1. If the next bit is 0, there is no transition.
2. If the next bit is 1 and the current level is not 0, the next level is 0.
3. If the next bit is 1 and the current level is 0, the next level is the opposite of the last nonzero level.

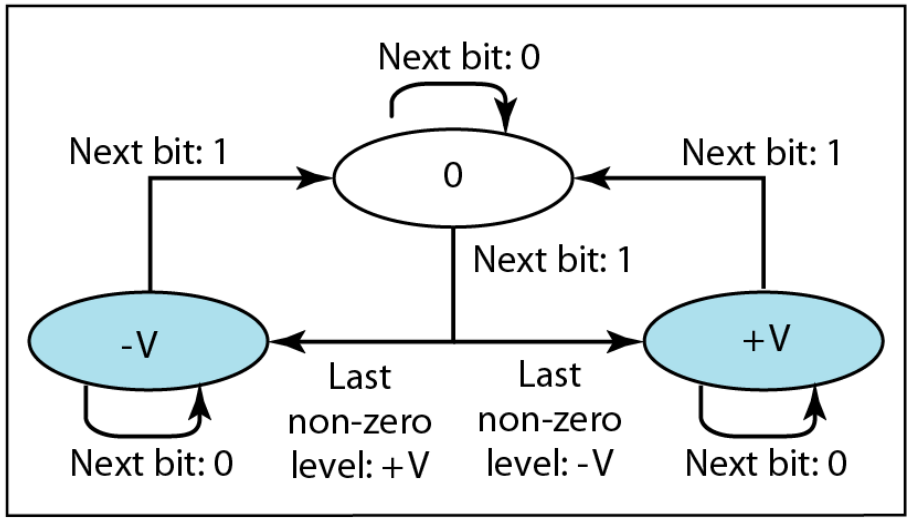
Multi-transition: MLT-3 scheme



a. Typical case



b. Worse case



c. Transition states