COMPUTER COMMUNICATION AND NETWORKS

ENCODING TECHNIQUES

Encoding

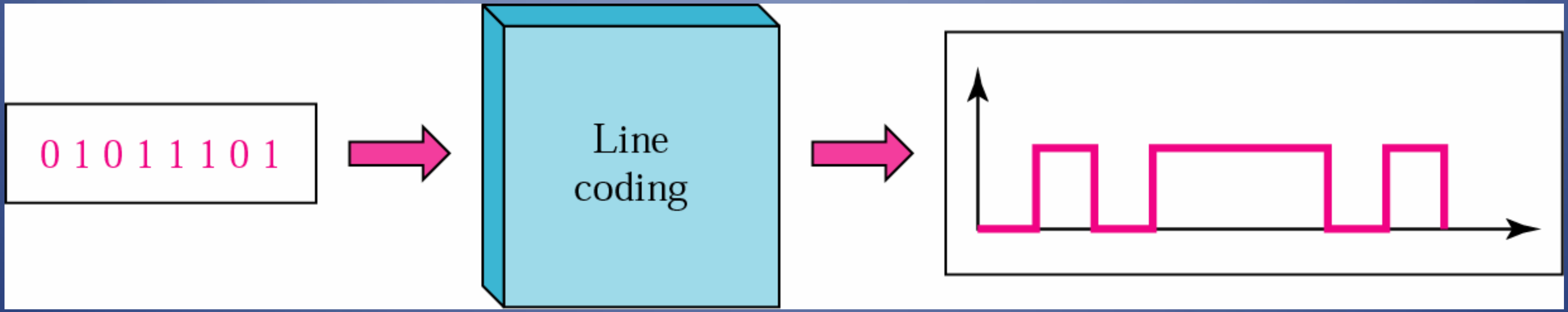
- Coding is the process of embedding clocks into a given data stream and producing a signal that can be transmitted over a selected medium.
- Transmitter is responsible for "encoding" i.e. inserting clocks into data according to a selected coding scheme
- Receiver is responsible for "decoding" i.e. separating clocks and data from the incoming embedded stream.
- Systems that use coding are synchronous systems .
- We must encode data into signals to send them from one place to another.
- There are 4 possible encoding techniques that can be used on the data:

Digital-to-digital, Digital-to-Analog, Analog-to-analog, Analog-to-digital.

Digital-to-Digital Encoding

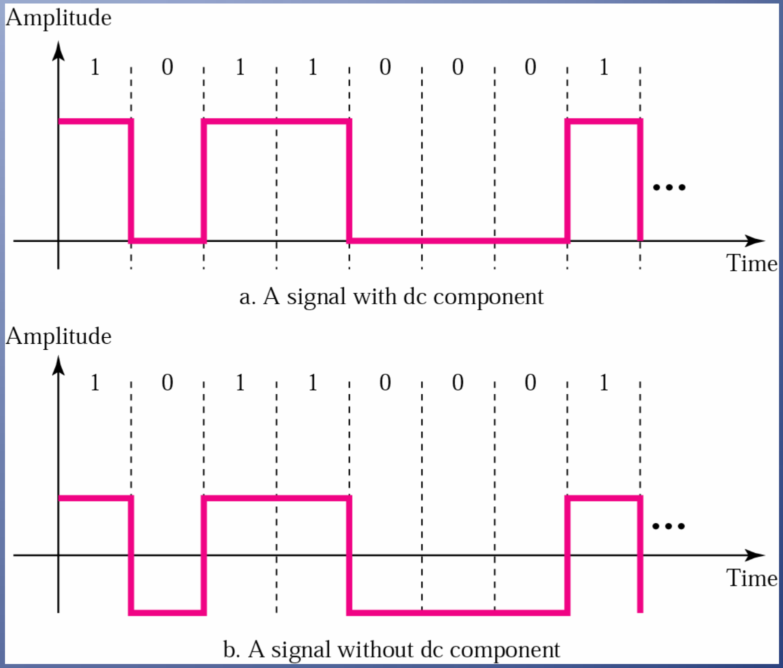
- The binary signals created by your computer (DTE) are translated into a sequence of voltage pulses that can be sent through the transmission medium.
- Binary signals have two basic parameters: amplitude and duration.
- As the number of bits sent per unit of time increases, the bit duration decreases.
- The three most common methods of encoding used are: unipolar , polar , and bipolar .

Digital-to-Digital Encoding



Unipolar Encoding

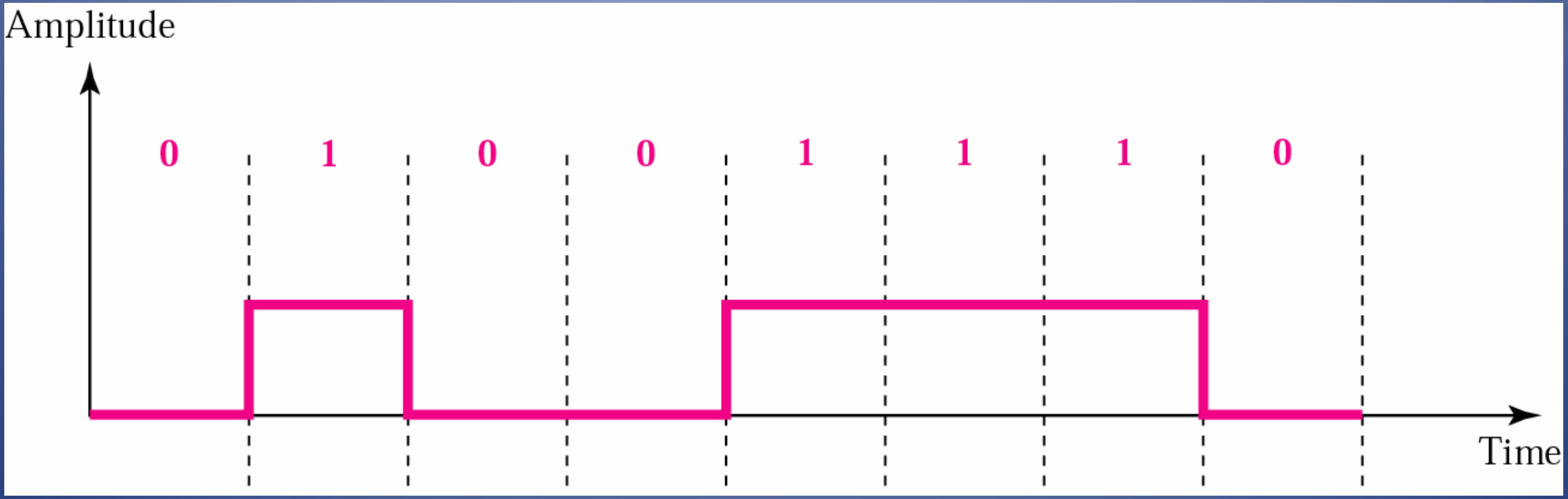
- The simplest and most primitive type of encoding is Unipolar encoding.
- Typically, one voltage level stands for binary 0 and another voltage level for binary 1.
- Polarity refers to whether you have a positive or a negative pulse.
- Unipolar encoding uses only one polarity, only one of the two binary states is encoded, usually the 1.
- Two problems with unipolar encoding: *DC component and synchronization* .



a. A signal with dc component

b. A signal without dc component

UNIPOLAR ENCODING



Unipolar encoding uses only one voltage level.

Problems in Unipolar encoding

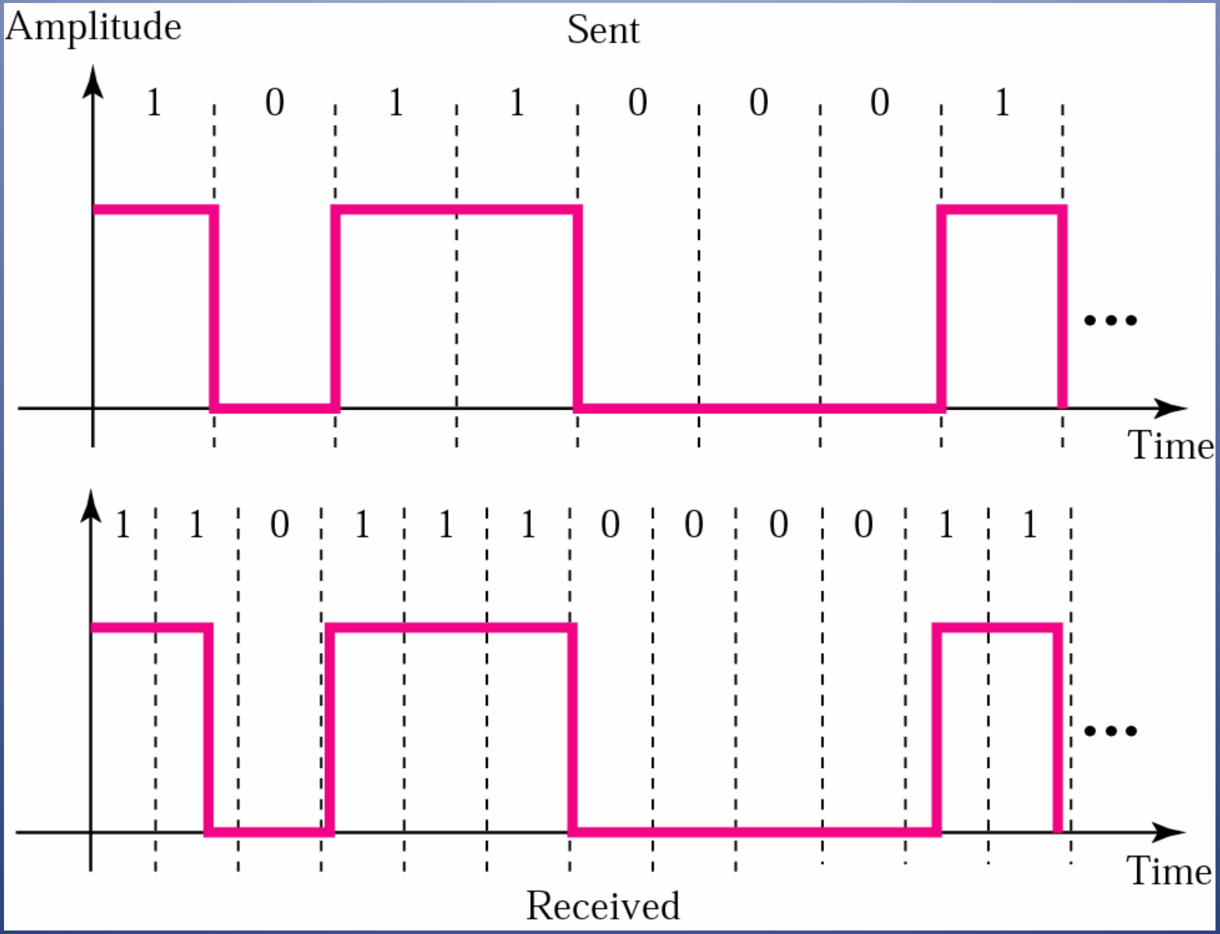
DC Component

- Average amplitude of a unipolar encoded signal is nonzero.
- This creates a direct current (DC component) -- shifts the zero level that cannot travel through some media (e.g. microwave).

Synchronization

- The change in voltage for each bit is what allows a digital encoding system to indicate changes in bit type.
- Long strings of zeros and ones do not produce any transitions which may create problems in error detection and recovery.

Lack of synchronization



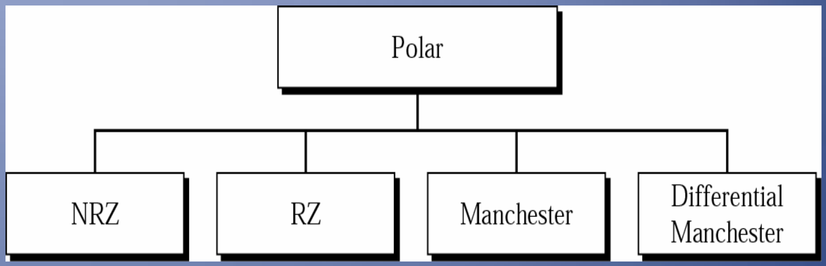
Polar Encoding

Polar encoding uses two levels (positive and negative) of amplitude.

Polar encoding eliminates some of the DC residual problem, because the average voltage level on the line is reduced.

The power to transmit this signal is one half that of unipolar signal.

Several types: NRZ, RZ, and biphase.



Polar encoding uses two voltage levels (positive and negative).

Non Return to Zero

NRZ

- Non-return to Zero (NRZ) -- signal is always positive or negative.
- Two main types of NRZ: NRZ-L and NRZ-I

NRZ-L

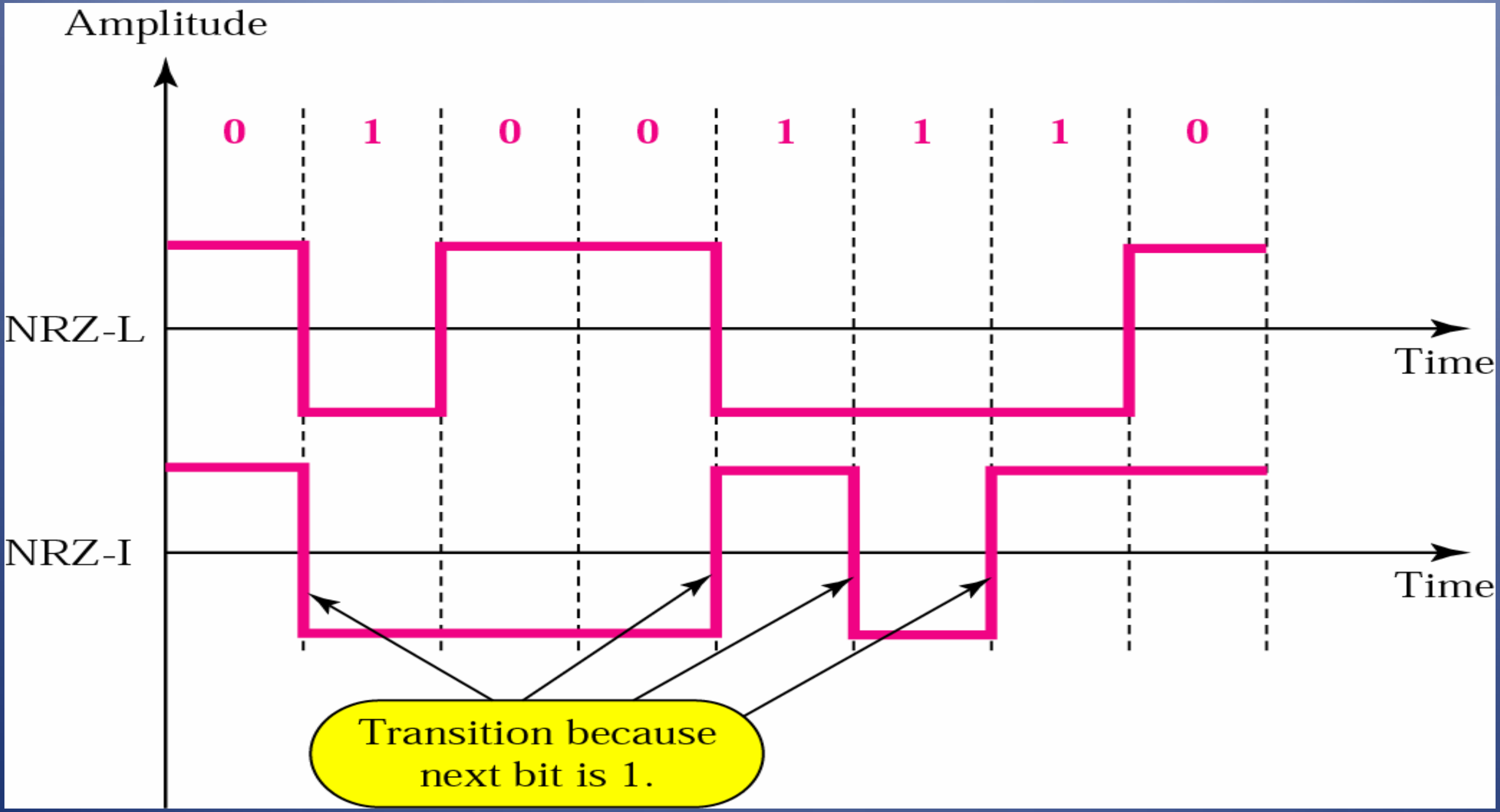
- NRZ-L: signal never returns to zero voltage, and the value during a bit time is a level voltage.
- Good for short and well- shielded transmission paths.
- *In NRZ-L the level of the signal is dependent upon the state of the bit, dependent upon the state of the bit*

Non Return to Zero- Inversion

NRZ-I

- NRZ-I : invert on ones
- The transition between a positive and negative voltage represents a 1 bit.
- Provides more synchronization than NRZ-L because there is a transition for each 1 bit.
- *In NRZ-I the signal is inverted if a 1 is encountered.*

NRZ-L and NRZ-I encoding



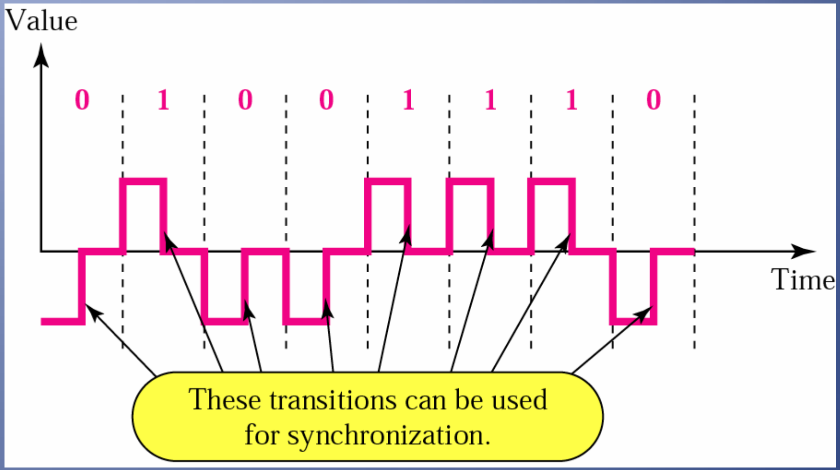
RZ encoding

Tries to solve the problem of losing synchronization due to long strings of consecutive 1s or 0s.

•Signal change during each bit promotes synchronization.

Positive voltage=1;Negative voltage=0

Signal returns to zero halfway through the bit interval.



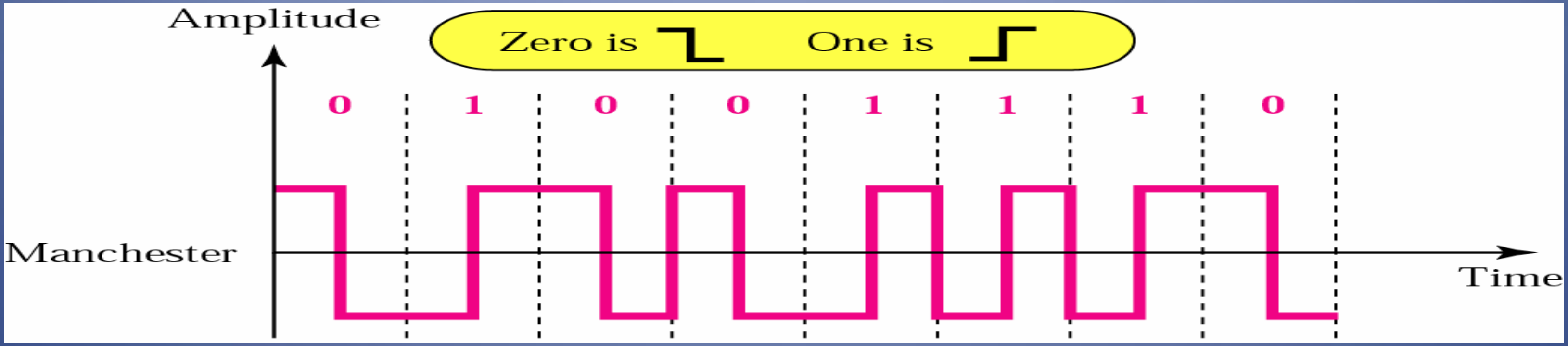
Biphase

- *Signal changes at the middle of the bit interval,does not return to zero, goes to opposite pole.*
- Good solution to synchronization problem
- Two types of biphase encoding used in networks:
- *Manchester and Differential Manchester*

Manchester

- This code is self-clocking.
- Provides a *transition for every bit in the middle of the bit* cell. This transition is used only to provide clocking.
- +ve to -ve transition for a "0" bit; -ve to +ve transition for a "1" bit
- *This scheme is used in Ethernet and IEEE 802.3 compliant LANs*

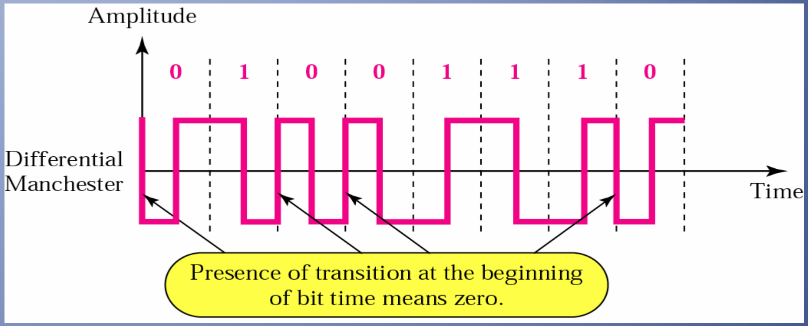
Manchester Encoding



In Manchester encoding, the transition at the middle of the bit is transition at the middle of the bit is used for both synchronization and bit used for both synchronization and bit representation.

Differential Manchester Coding

- Code is self-clocking
- *Transition for every bit in the middle of the bit cell*
- *Transition at the beginning of the bit cell if the next bit is " 0 "*
- *NO Transition at the beginning of the bit cell if the next bit is " 1 "*
- *Used in Token Ring or IEEE 802.5-compliant LANs.*



In differential Manchester encoding, the transition at the middle of the bit is used Transition at the middle of the bit is used only for synchronization. The bit representation is defined by the inversion or noninversion at the beginning of the bit.