Chapter 4

Digital Transmission

4.1 Line Coding

Some Characteristics

Line Coding Schemes

Some Other Schemes

Figure 4.1 *Line coding*

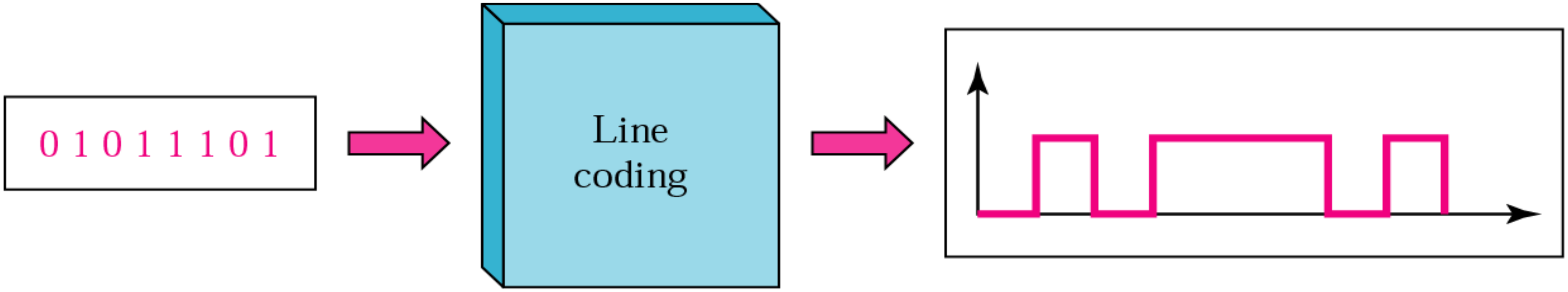
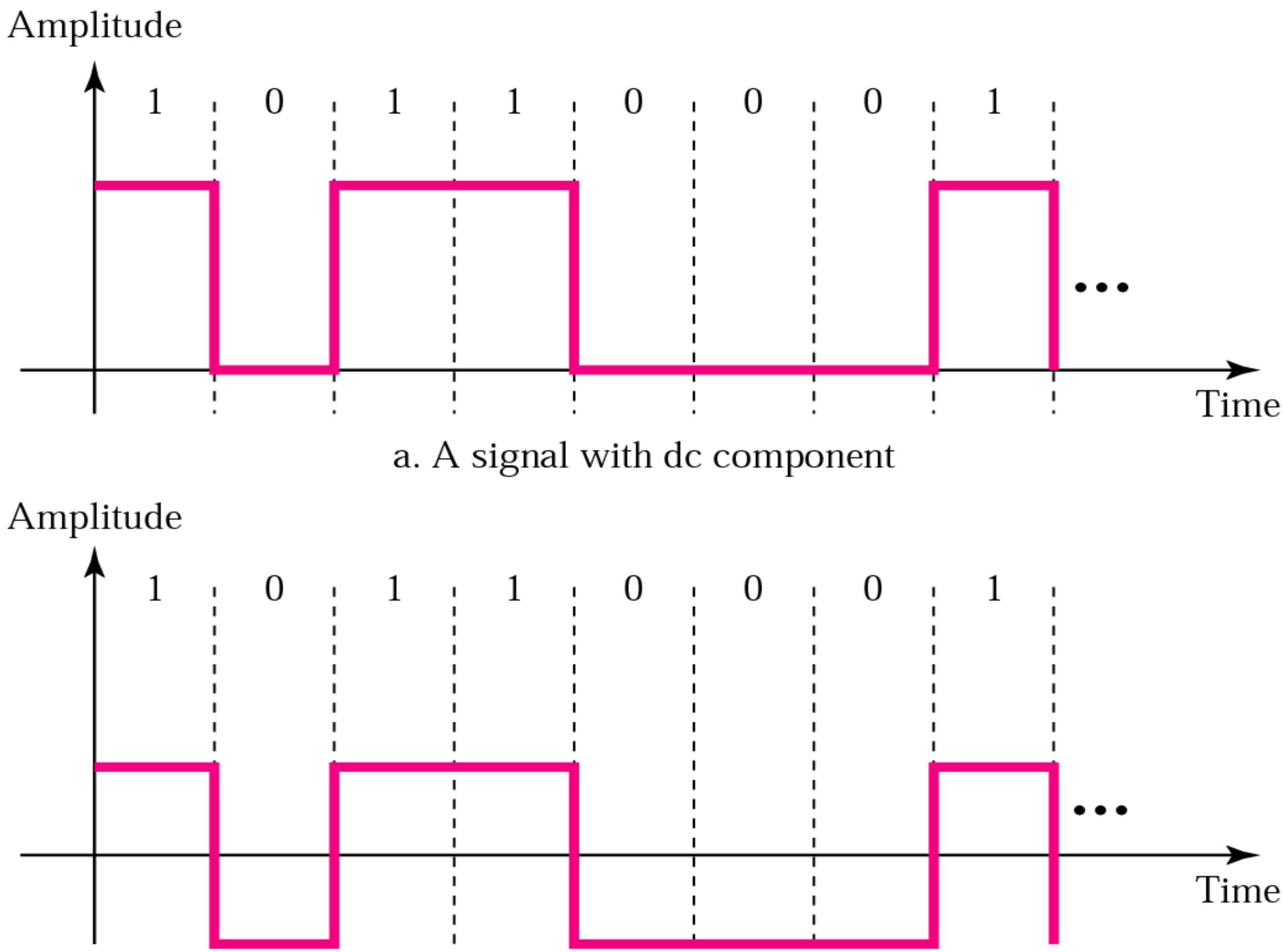


Figure 4.3 *DC component*



a. A signal with dc component

b. A signal without dc component

Example 1

A signal has two data levels with a pulse duration of 1 ms. We calculate the pulse rate and bit rate as follows:

Pulse Rate = $1/10^{-3}$= 1000 pulses/s

Bit Rate = Pulse Rate x $\log_2 L$ = 1000 x $\log_2 2$ = 1000 bps

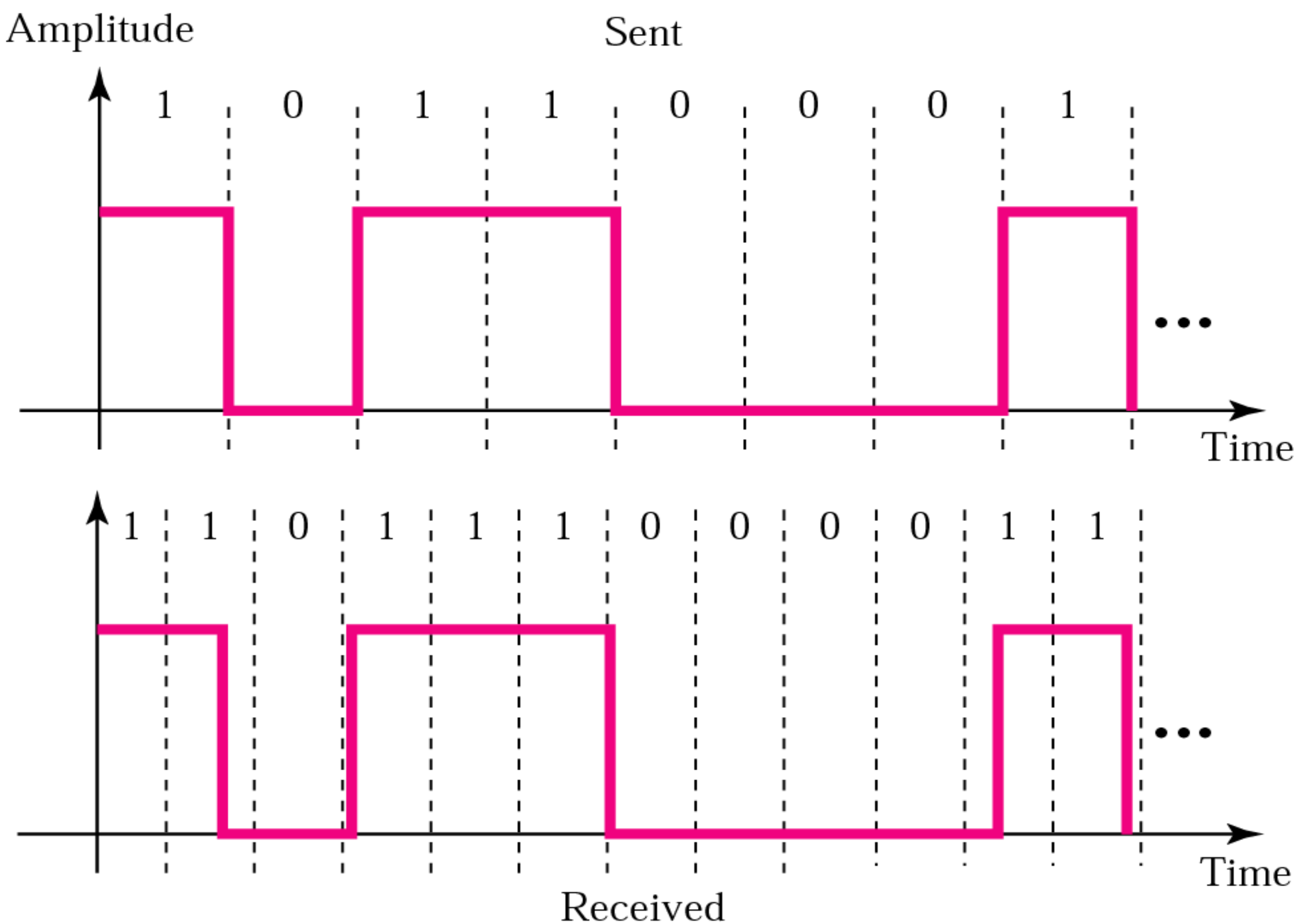
Example 2

A signal has four data levels with a pulse duration of 1 ms. We calculate the pulse rate and bit rate as follows:

Pulse Rate = = 1000 pulses/s

Bit Rate = PulseRate x $\log_2$ L = 1000 x $\log_2$ 4 = 2000 bps

Figure 4.4 *Lack of synchronization*



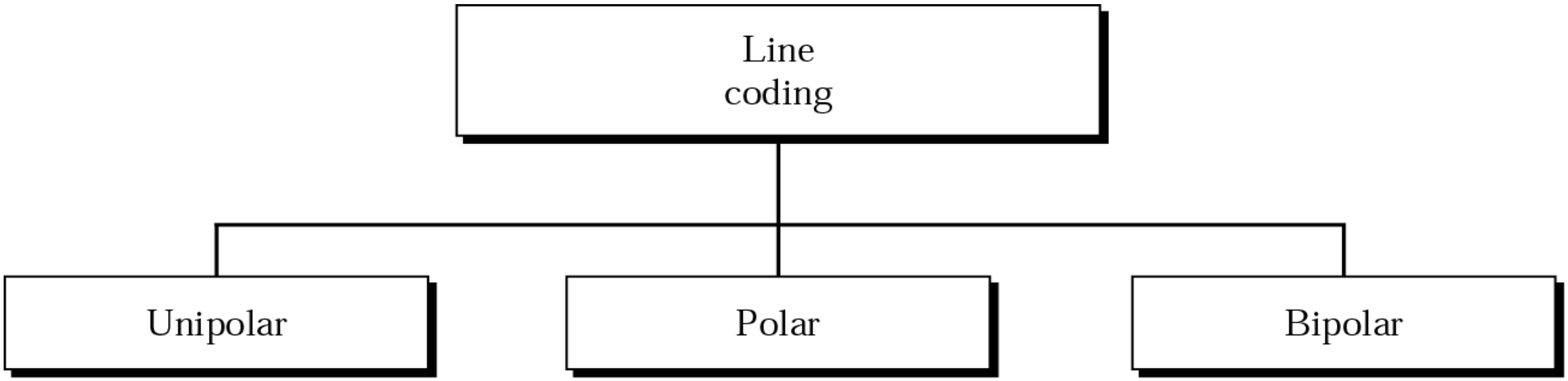
Example 3

In a digital transmission, the receiver clock is percent faster than the sender clock. How many extra bits per second does the receiver receive if the data rate is Mbps ?

Solution

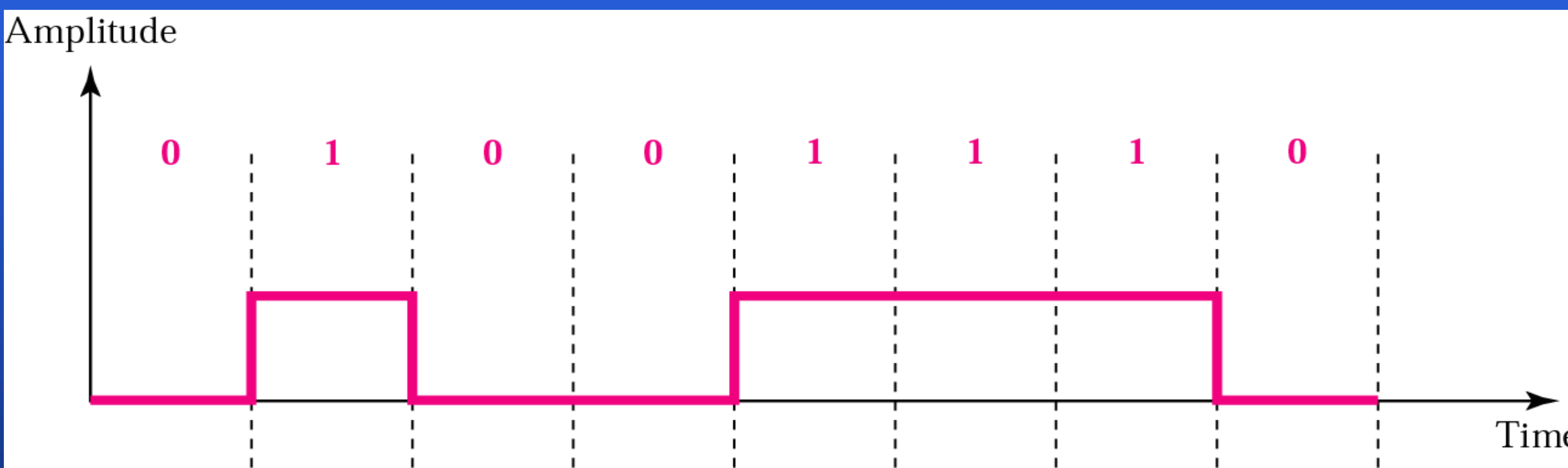
Given,
Receiver clock is 0.1% faster than sender clock.
At 1 Mbps bits send by sender = 1000000
The receiver clock is 0.1% faster than sender clock
So Extra bits received by receiver = 1000000 * .10/100
=1000 bits
Total bits received by received= 1001000 bits

Figure 4.5 *Line coding schemes*



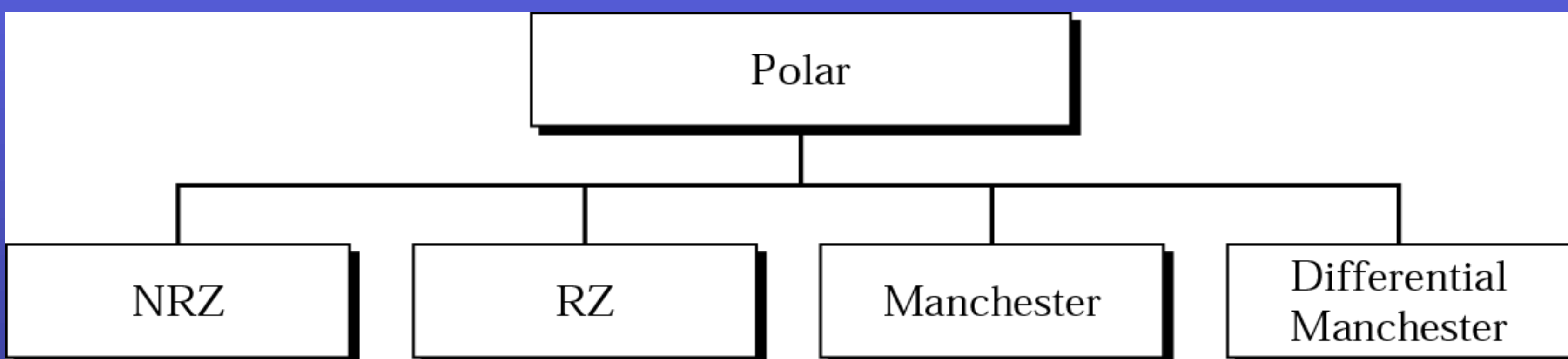
Note:

Unipolar encoding uses only one voltage level.



Note:

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



Note:

In NRZ-L the level of the signal is dependent upon the state of the bit.

In NRZ-I the signal is inverted if a 1 is encountered.

NRZ-L- Non-Return-to-Zero Level

NRZ-I- Non-Return-to-Zero Invert

Figure 4.8 *NRZ-L and NRZ-I encoding*

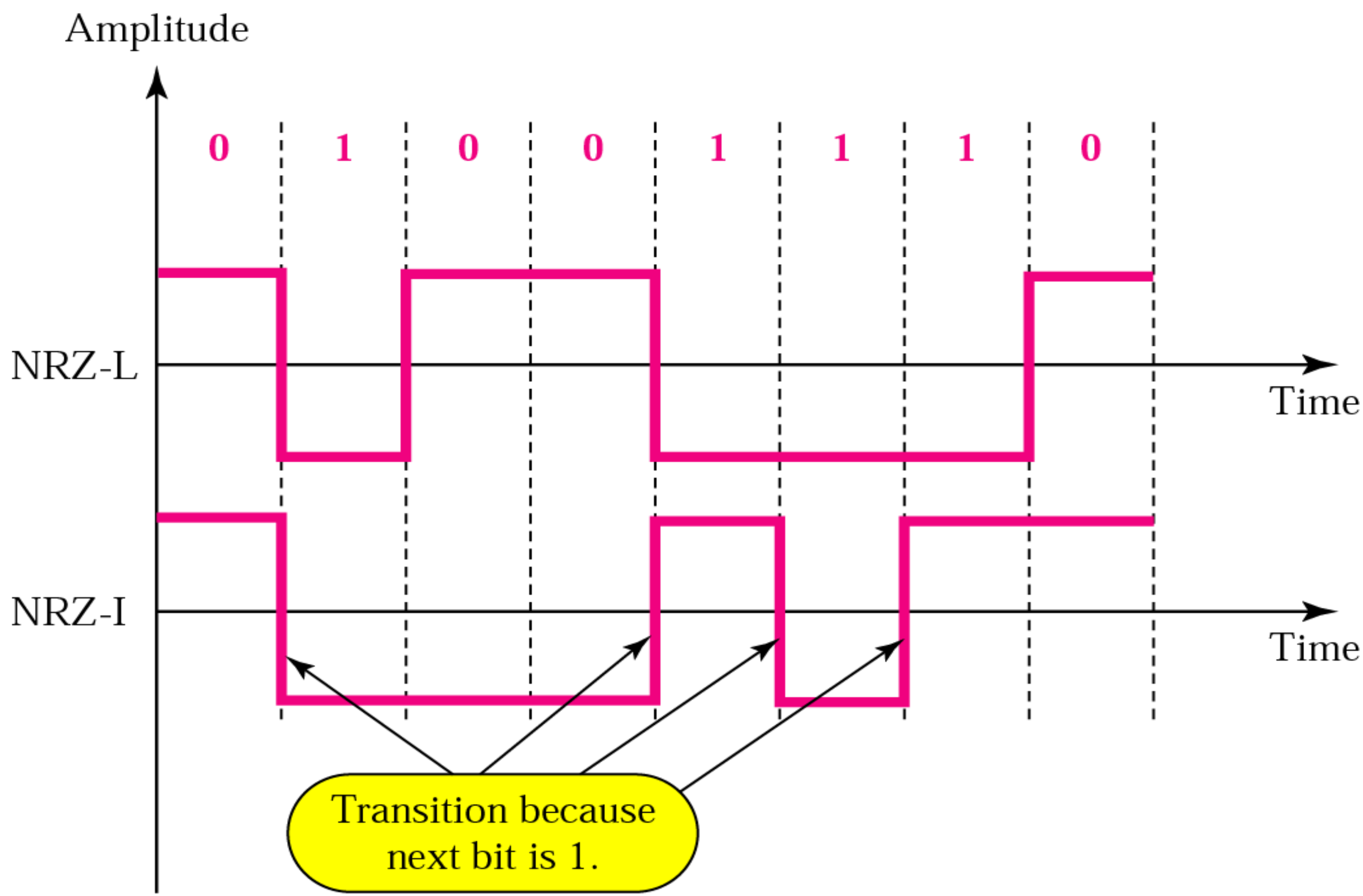
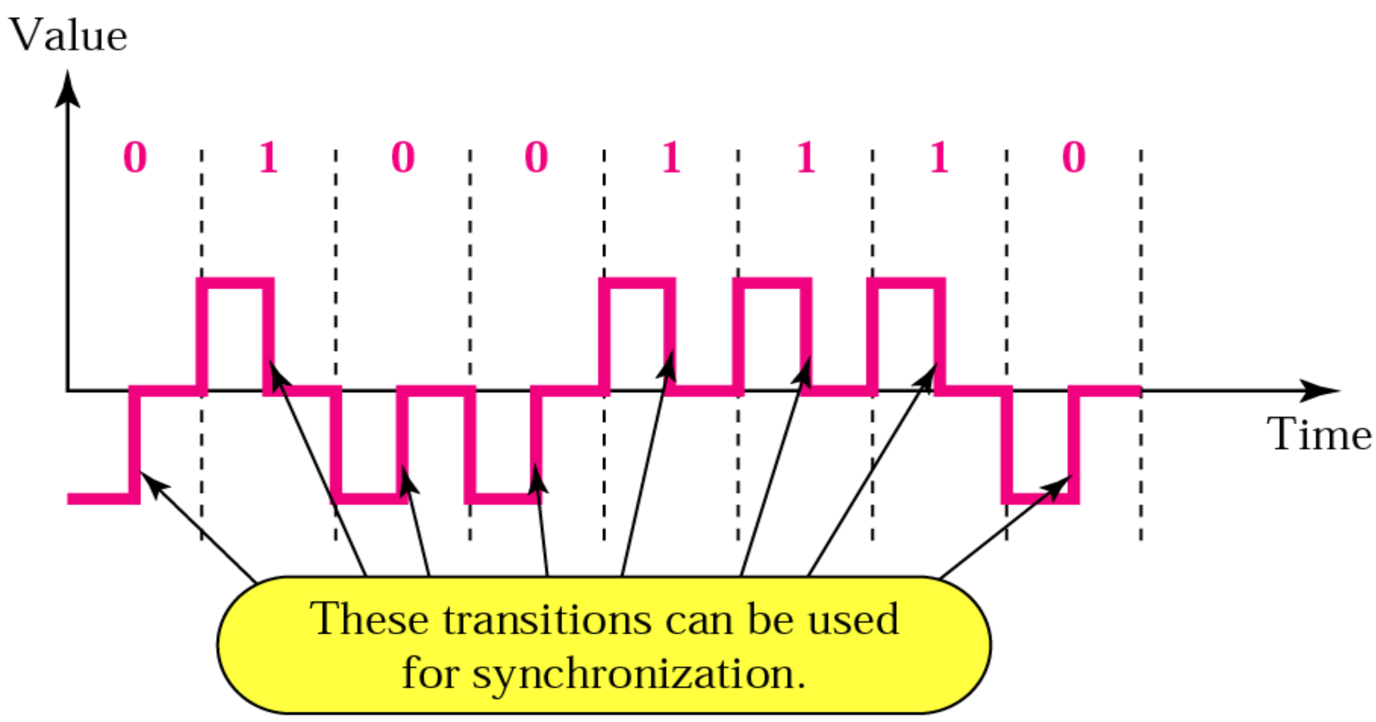


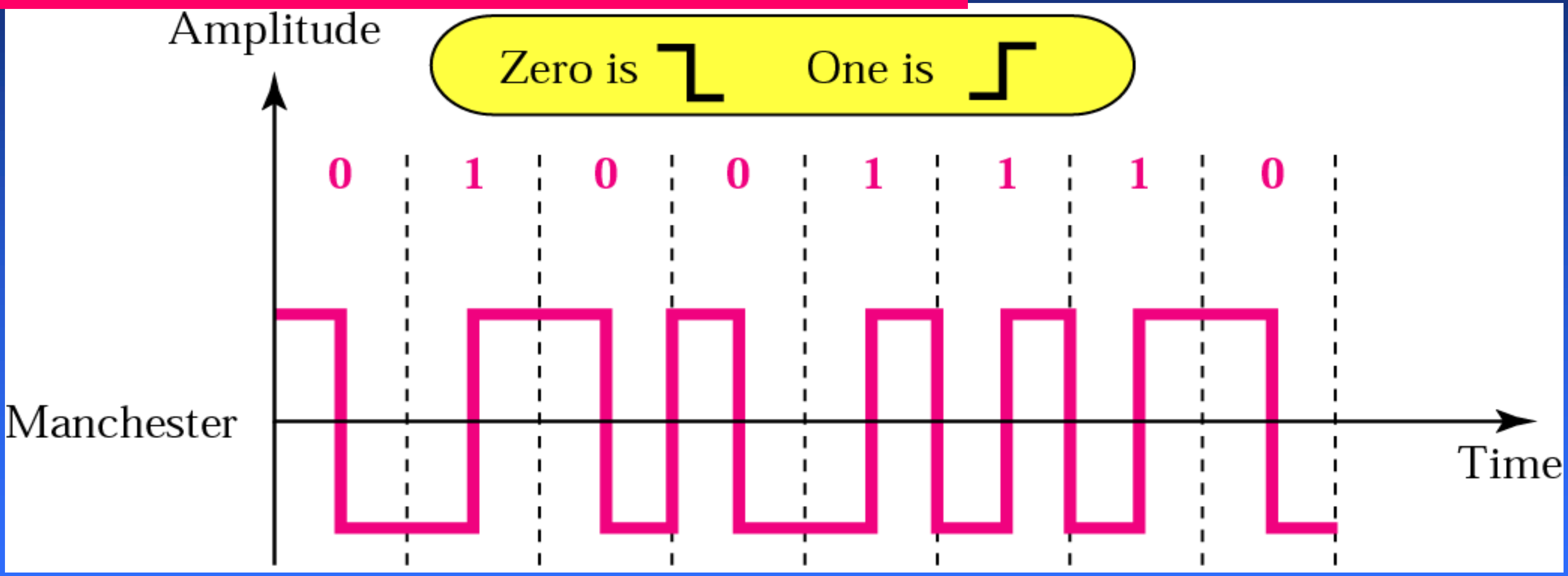
Figure 4.9 *RZ encoding*

Return-to-zero (RZ) describes a line code used in telecommunications signals in which the signal drops (returns) to zero between each pulse. This takes place even if a number of consecutive 0s or 1s occur in the signal.



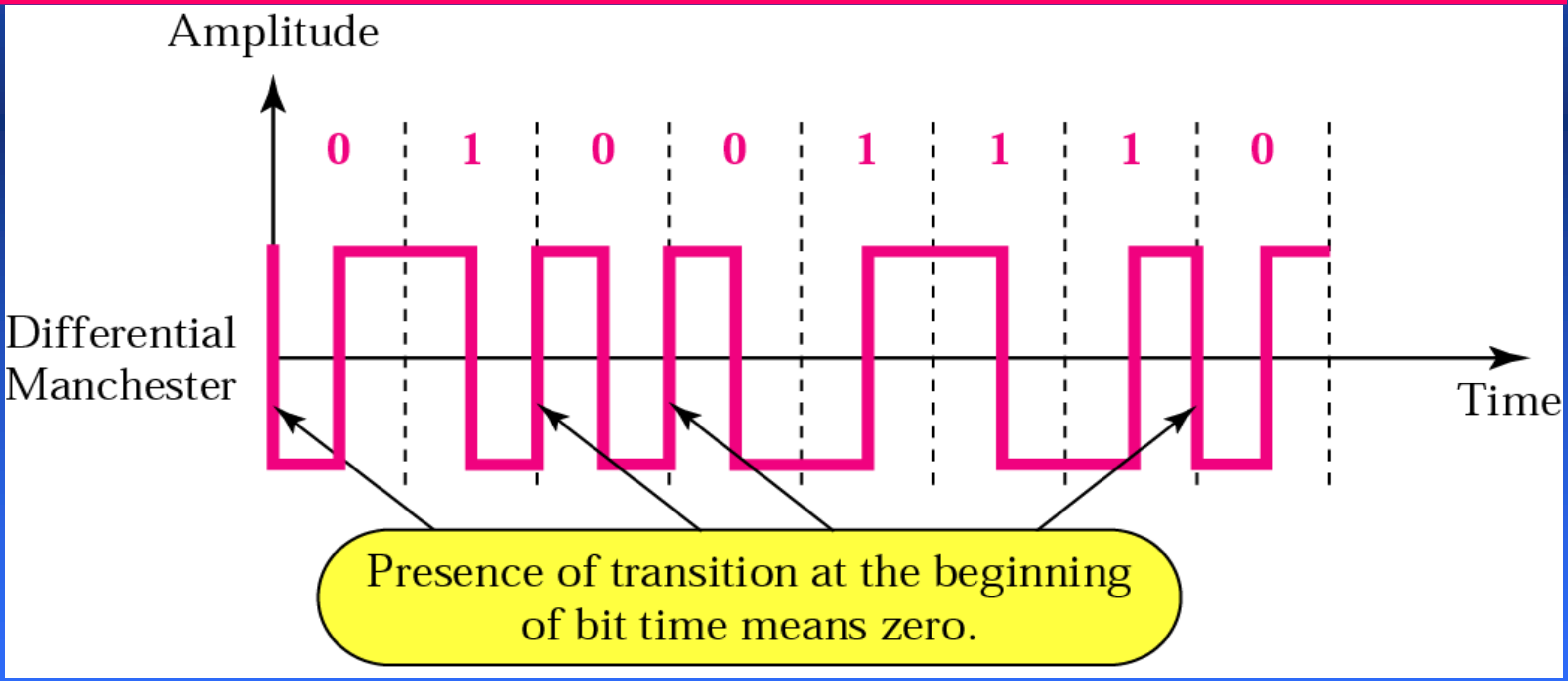
A good encoded digital signal must contain a provision for synchronization.

Manchester encoding



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

In differential Manchester encoding, the 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.



4.4 Transmission Mode

Parallel Transmission

Serial Transmission

Figure 4.24 *Data transmission*

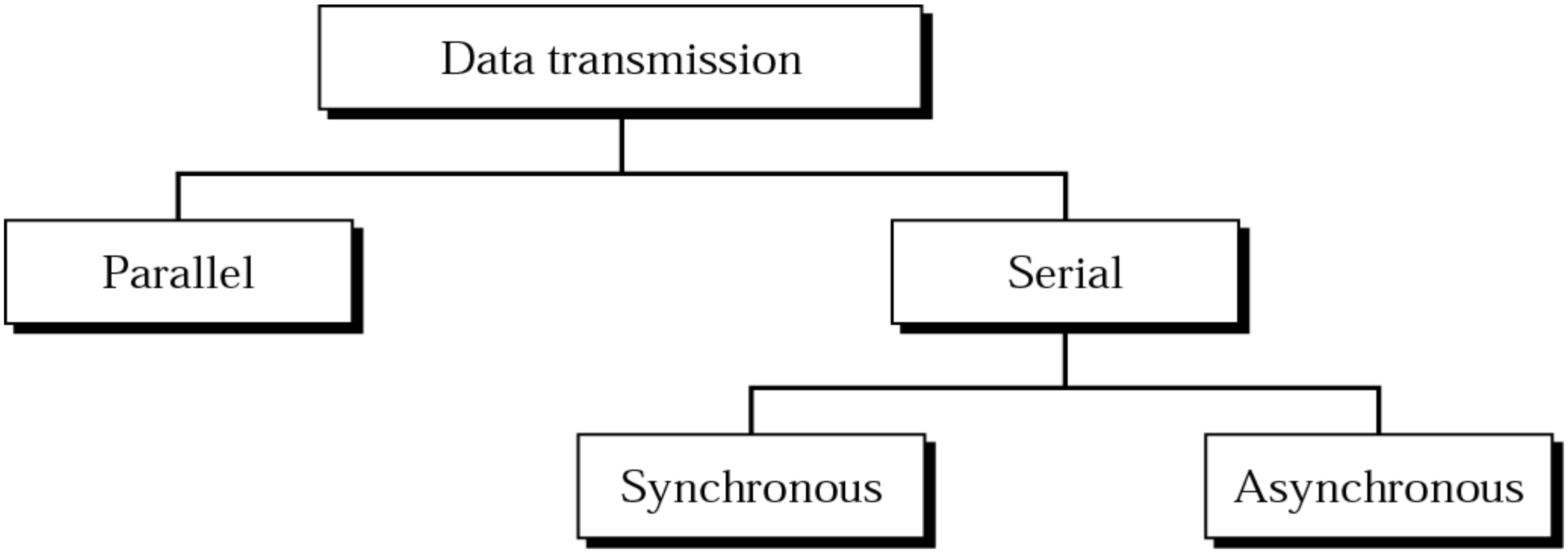


Figure 4.25 *Parallel transmission*

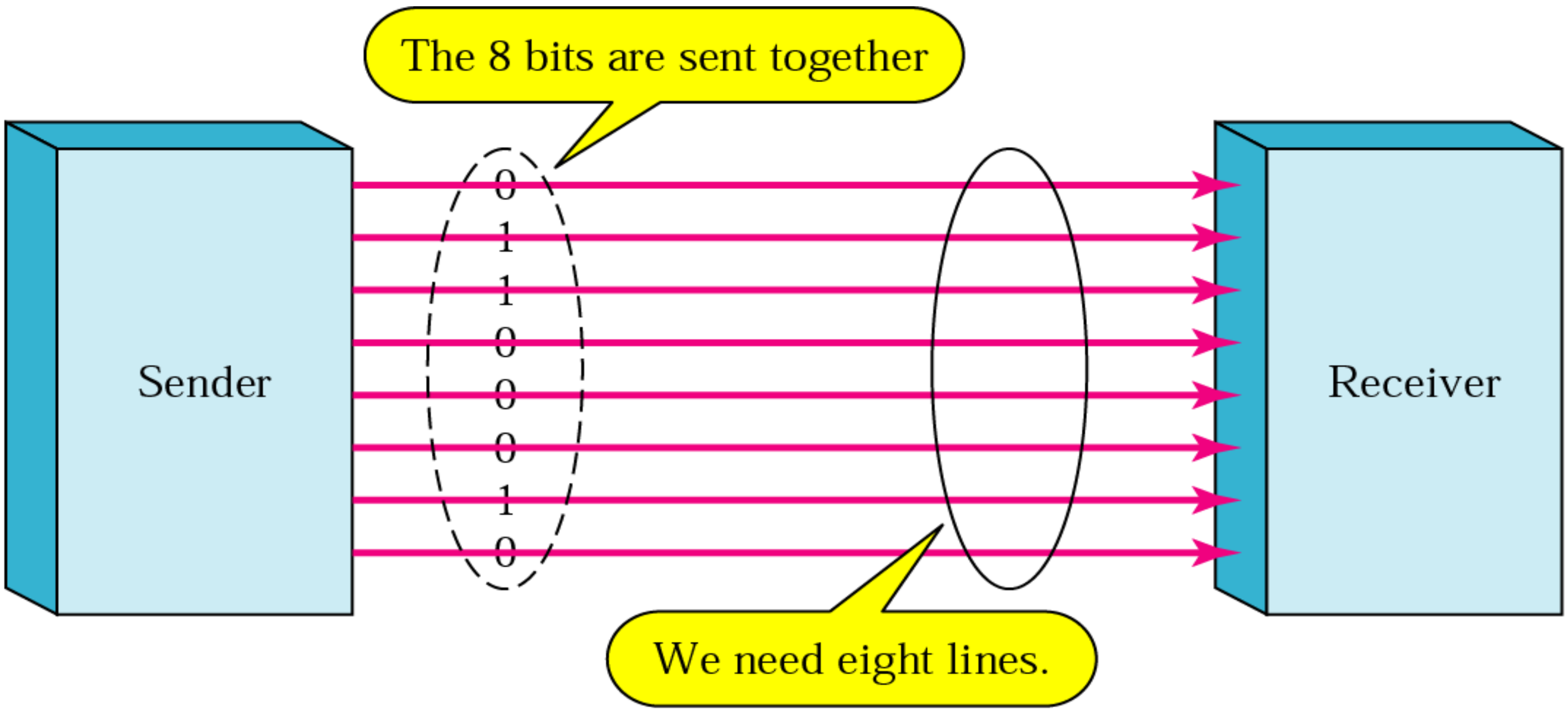
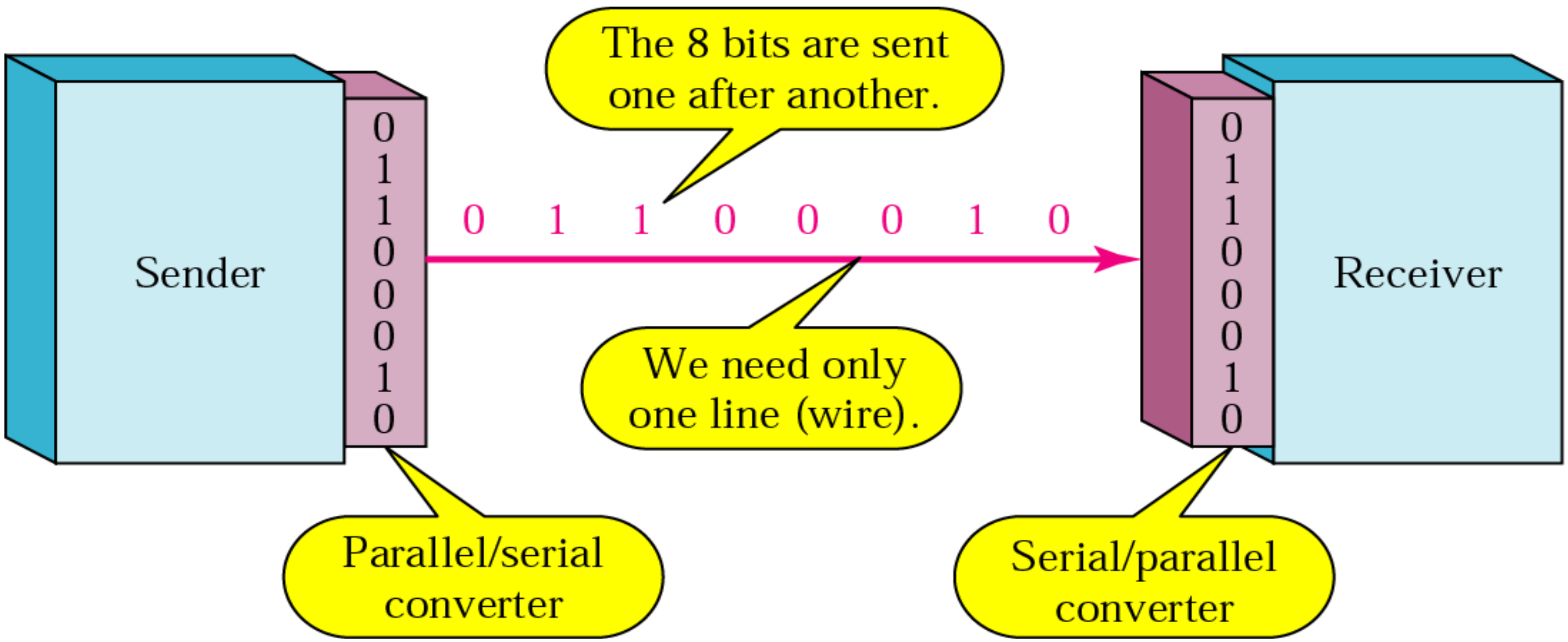


Figure 4.26 *Serial transmission*



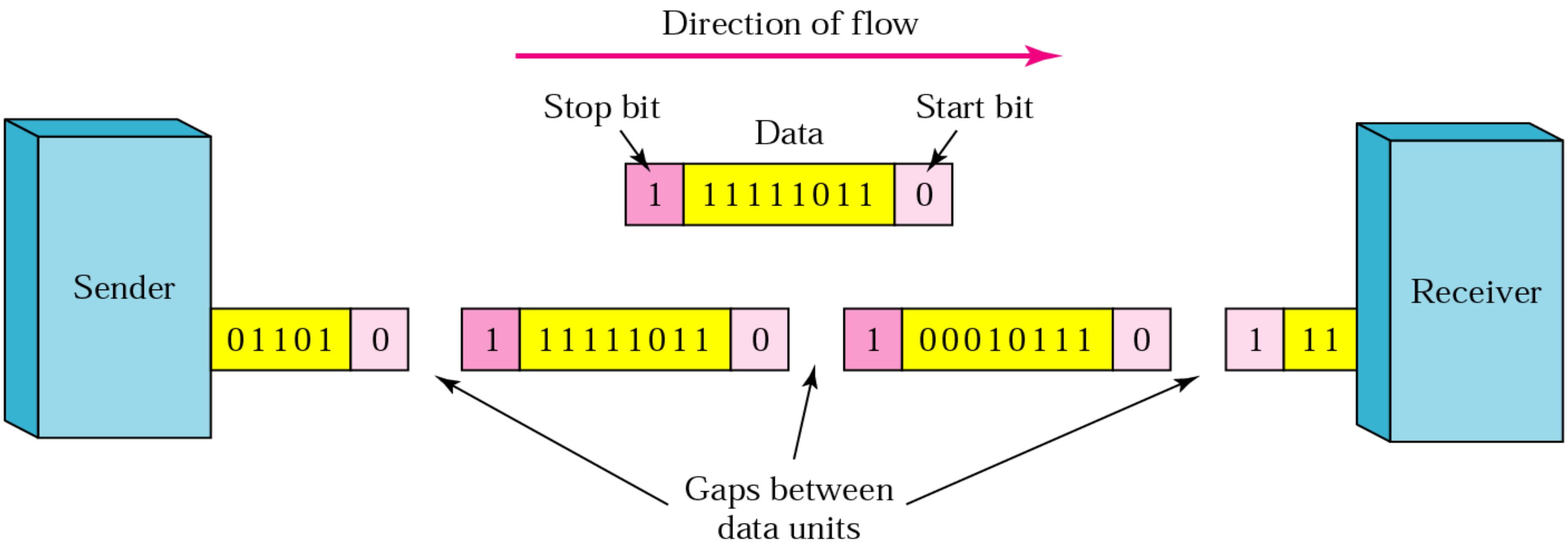
Note:

In asynchronous transmission, we send 1 start bit (0) at the beginning and 1 or more stop bits (1s) at the end of each byte. There may be a gap between each byte.

Note:

Asynchronous here means "asynchronous at the byte level," but the bits are still synchronized; their durations are the same.

Figure 4.27 *Asynchronous transmission*



Note:

In synchronous transmission, we send bits one after another without start/stop bits or gaps. It is the responsibility of the receiver to group the bits.

Figure 4.28 *Synchronous transmission*