Bangladesh Army University of Engineering & Technology

CSE-3215
Data Communication

Lecture-17

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Chapter 4

Digital Transmission

DIGITAL DATA-TO-DIGITAL SIGNAL CONVERSION

In this section, we will see how we can represent digital data by using digital signals. The conversion involves three techniques: line coding, block coding, and scrambling. Line coding is always needed; block coding and scrambling are optional.

Topics to be discussed in this section:

Line Coding
Line Coding Schemes
Block Coding
Scrambling

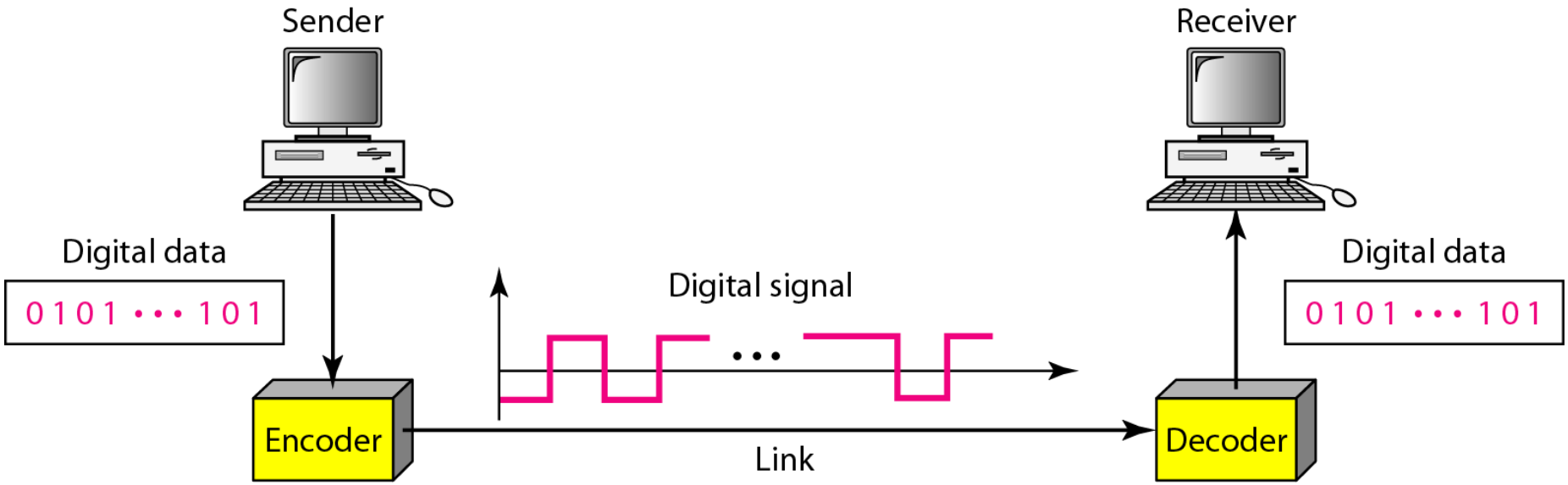
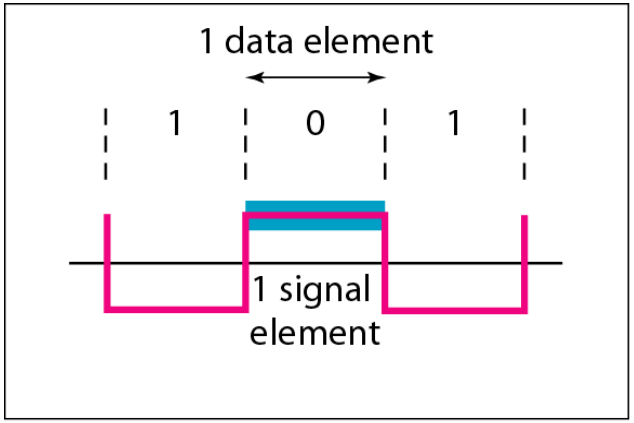


Figure 1: ***Line coding and decoding***

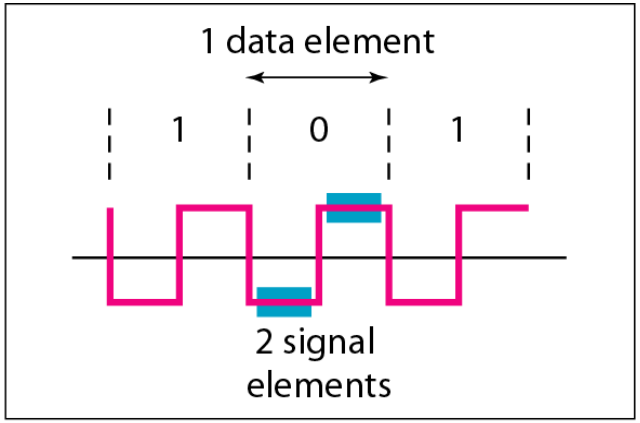
Signal Element versus Data Element

- Data element
  - The smallest entity that can represent a piece of information: this is **bit**.
- Signal element
  - The shortest unit (timewise) of a **digital signal**.
- In other words
  - Data element are what we need to send.
  - Signal elements are what we can send.

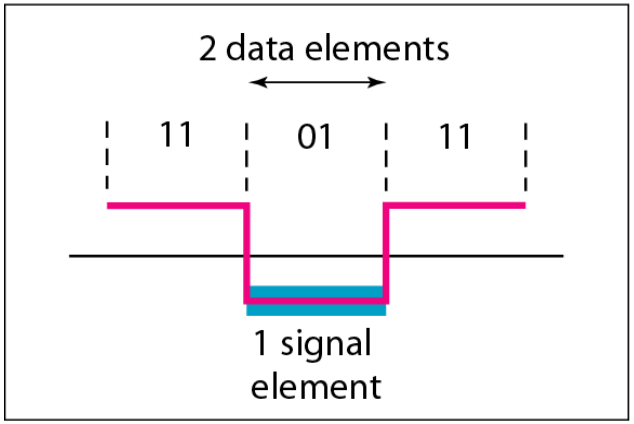
NOTE:
The ratio that indicates no. of data elements per signal element is denoted as 'r' where, r = No. of data element / No. of signal element



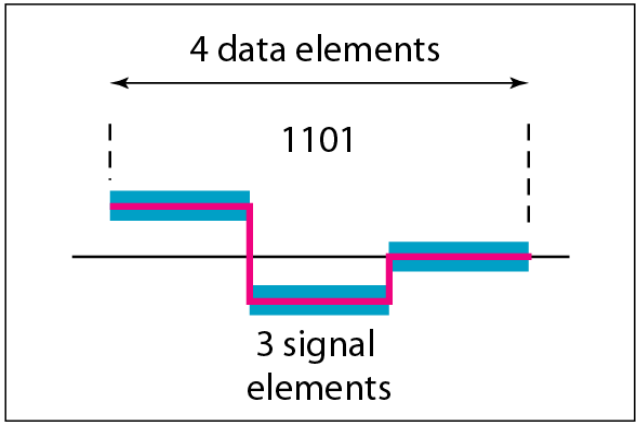
a. One data element per one signal element (r = 1)



b. One data element per two signal elements $\left(r = \frac{1}{2}\right)$



c. Two data elements per one signal element (r = 2)



d. Four data elements per three signal elements $\left(r = \frac{4}{3}\right)$

Figure 2: ***Data element, signal element and their ratio (r)***

# # #

A signal is carrying data in which one data element is encoded as one signal element (r = 1). If the bit rate is 100 kbps, what is the average value of the baud rate if case factor 'c' is between 0 and 1?

Solution

We assume that the average value of c is 1/2 . The baud rate is then

$$S = c \times N \times \frac{1}{r} = \frac{1}{2} \times 100{,}000 \times \frac{1}{1} = 50{,}000 = 50 \text{ kbaud}$$

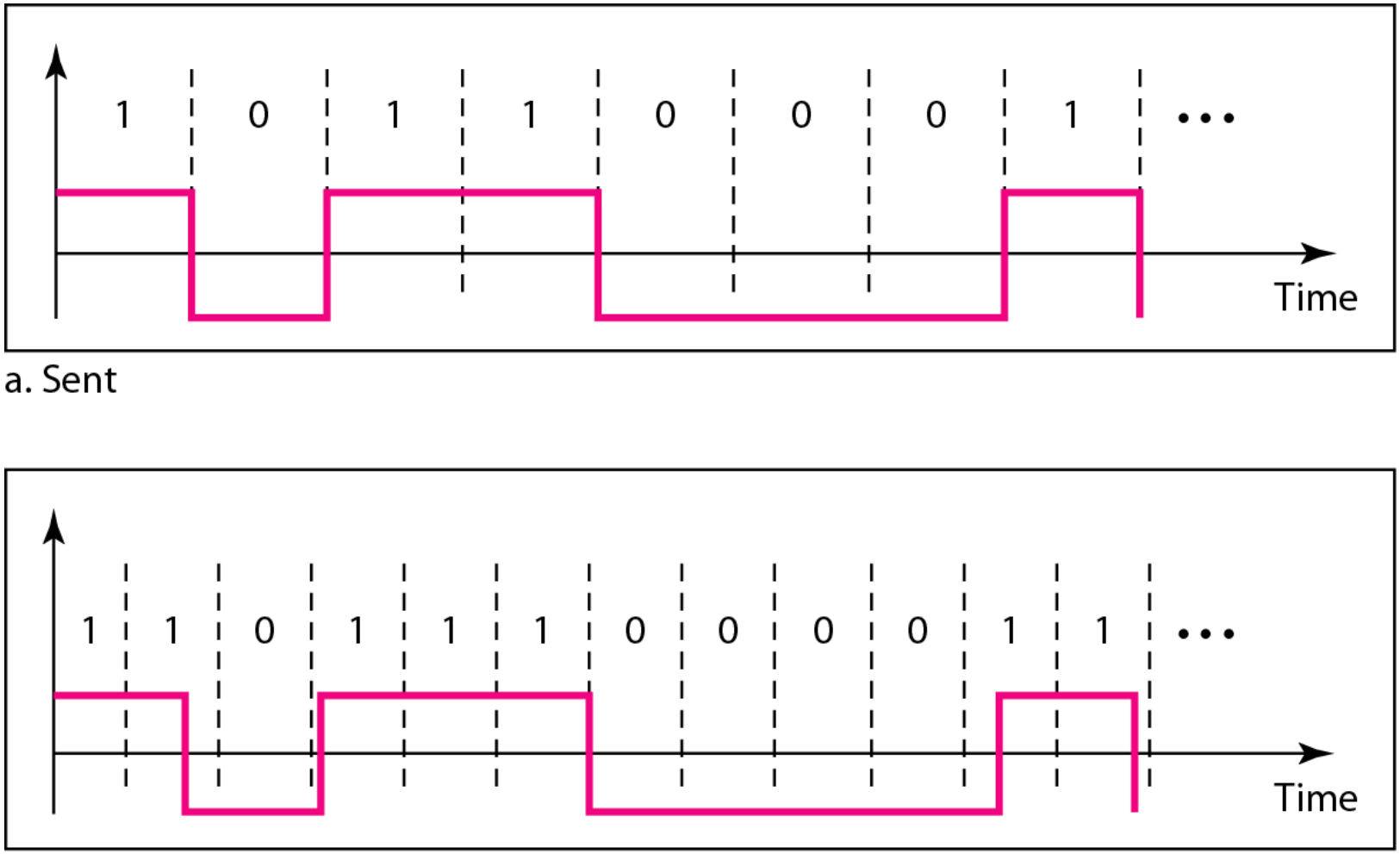


Figure 3: ***Effect of lack of synchronization***

In a digital transmission, the receiver clock is 0.1 percent faster than the sender clock. How many extra bits per second does the receiver receive if the data rate is 1 kbps? How many if the data rate is 1 Mbps?

Solution

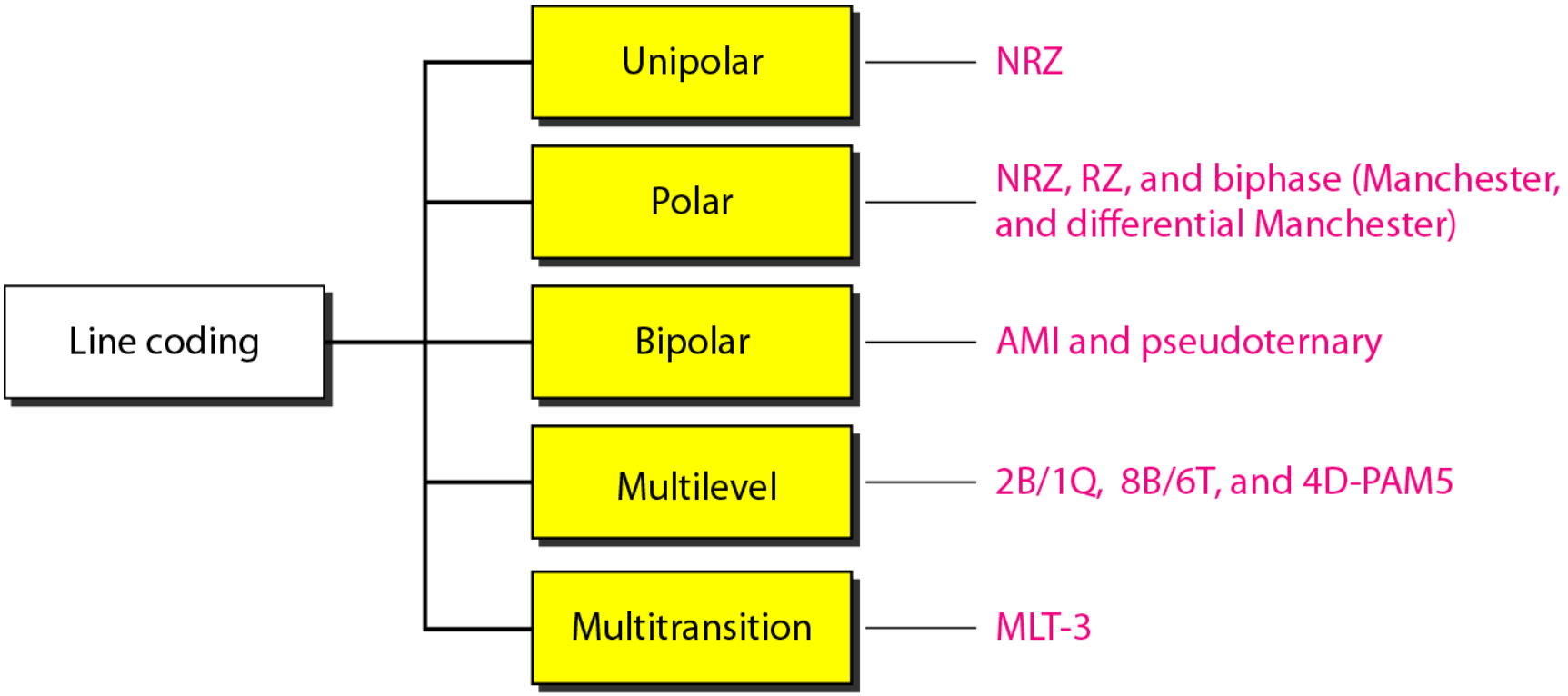
At 1 kbps, the receiver receives 1001 bps instead of 1000 bps.

1000 bits sent	1001 bits received	1 extra bps

At 1 Mbps, the receiver receives 1,001,000 bps instead of 1,000,000 bps.

1,000,000 bits sent	1,001,000 bits received	1000 extra bps

Line coding schemes



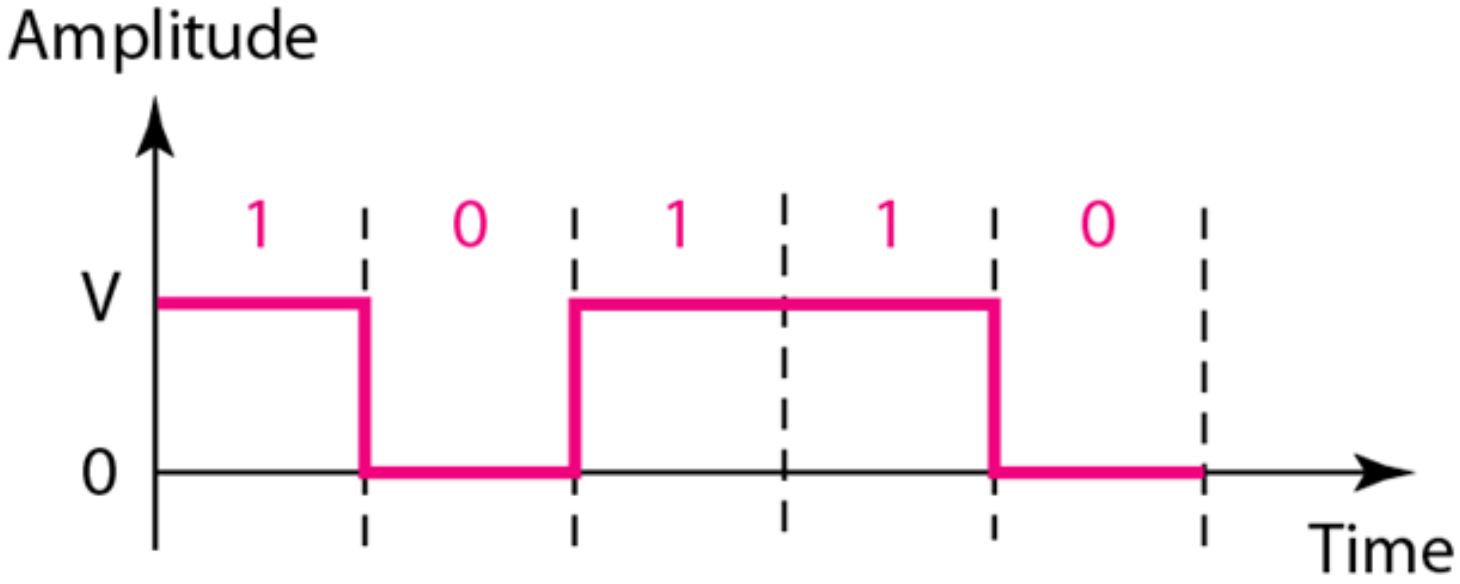


Figure 4: ***Unipolar NRZ scheme***

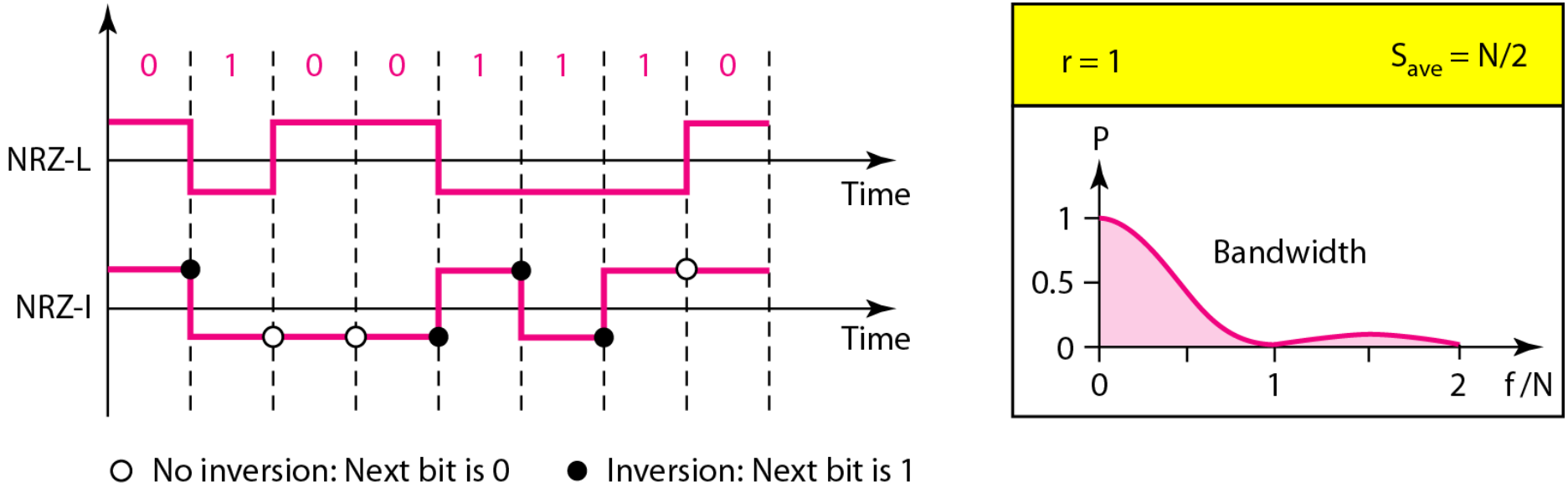


Figure 5: ***Polar NRZ-L and NRZ-I schemes***

Note

In NRZ-L the level of the voltage determines the value of the bit. In NRZ-I the inversion or the lack of inversion determines the value of the bit.

Note

NRZ-L and NRZ-I both have an average signal rate of N/2 Bd.

NRZ-L and NRZ-I both have DC component problem and synchronization problem.

That's all for today

Thank You