Chapter 8

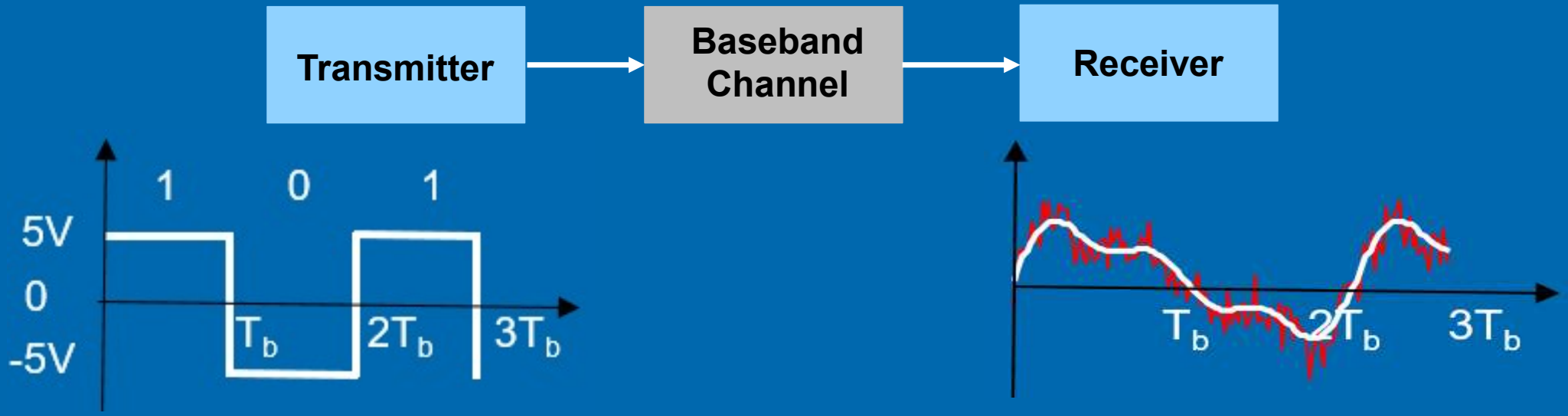
Baseband Transmission of Digital Signals

(Part 1 of 2)

Introduction

- The objective of a digital communication system is to transmit data with a minimum number of errors.
- Signal waveform gets distorted when going through the channel due to:

Channel noise	Added to the signal and may cause signal wrongly received.
Limited channel bandwidth	Cause loss of some frequency components and thus Intersymbol interference (ISI).

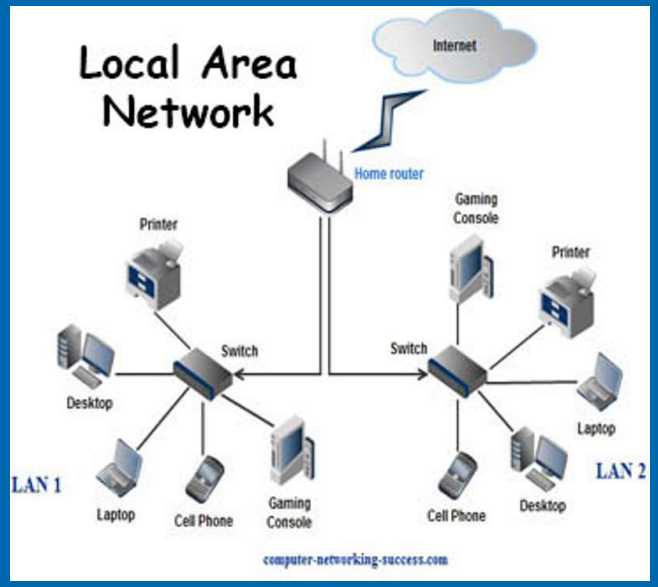


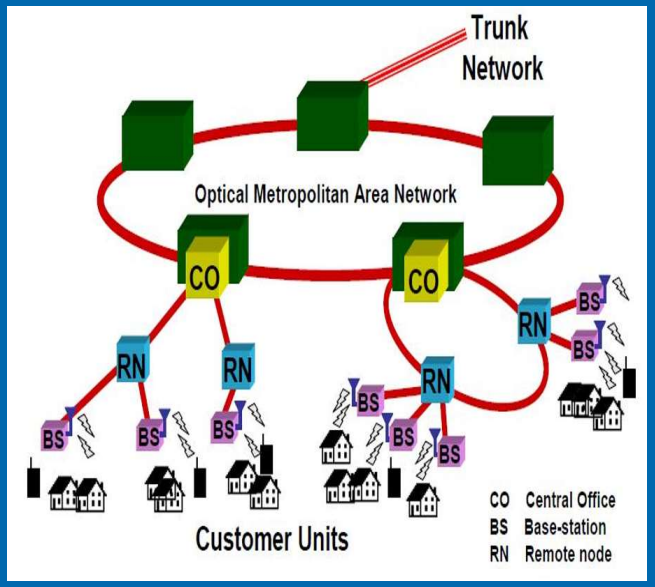
8.1 Line Coding

- Choice of a pair of pulses to represent ‘1’ and ‘0’ is called line coding / line formatting.

- **Baseband transmission systems** transmits these pulses directly without modulation.

e.g. LANS (Ethernet), optical communication systems





8.1 Line Coding

- Representing binary “1’ and “0” using pulses is known as line coding.

- Line code waveforms are Classified into 4 main groups:

1. Non return–to-zero (NRZ)
2. Return–to-zero (RZ)
3. Phase encoded
4. Multilevel binary

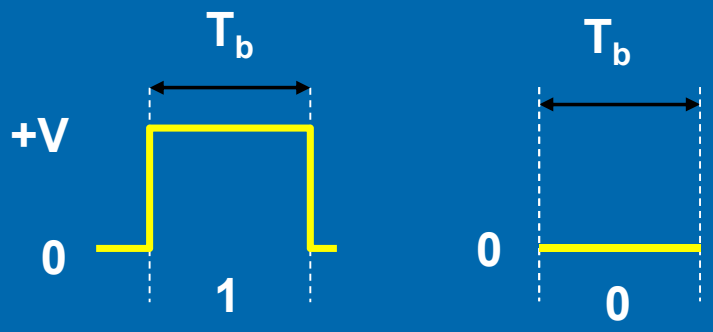
8.1 Line Coding

- **Group 1** - Non return–to-zero (NRZ)

Unipolar NRZ

Used in digital logics

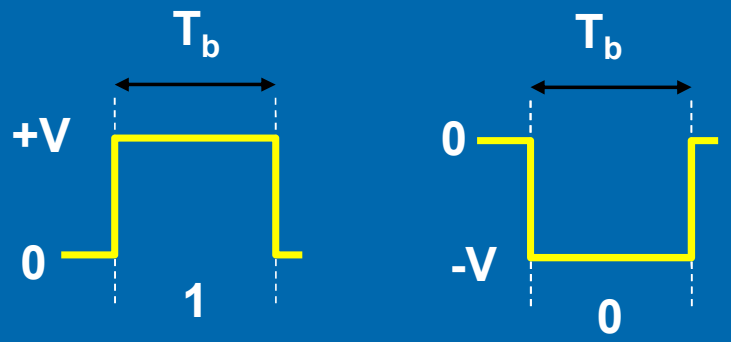
Seldom used in direct transmission



+V level **zero level**

Polar NRZ

Used in RS232C interface, digital logic and magnetic tape recording.



+V level **-V level**

T_b = bit duration

8.1 Line Coding

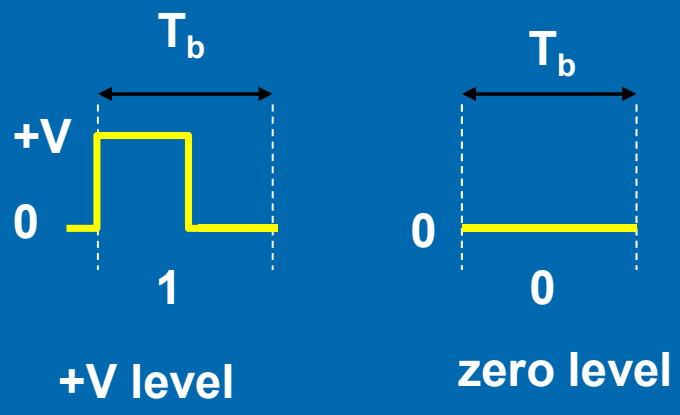
- Group 2 – Return-to-zero (RZ)

Unipolar RZ
Polar RZ
RZ-AMI

Binary bits are represented by half-width pulses

Unipolar RZ

Used in data transmission and magnetic recording

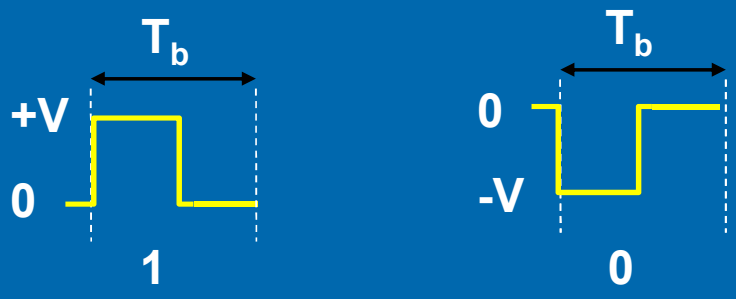


+V level

zero level

half-width pulse

Polar RZ



+V level

-V level

half-width pulse

8.1 Line Coding

- Group 2 – Return-to-zero (RZ)

Unipolar RZ
Polar RZ
RZ-AMI

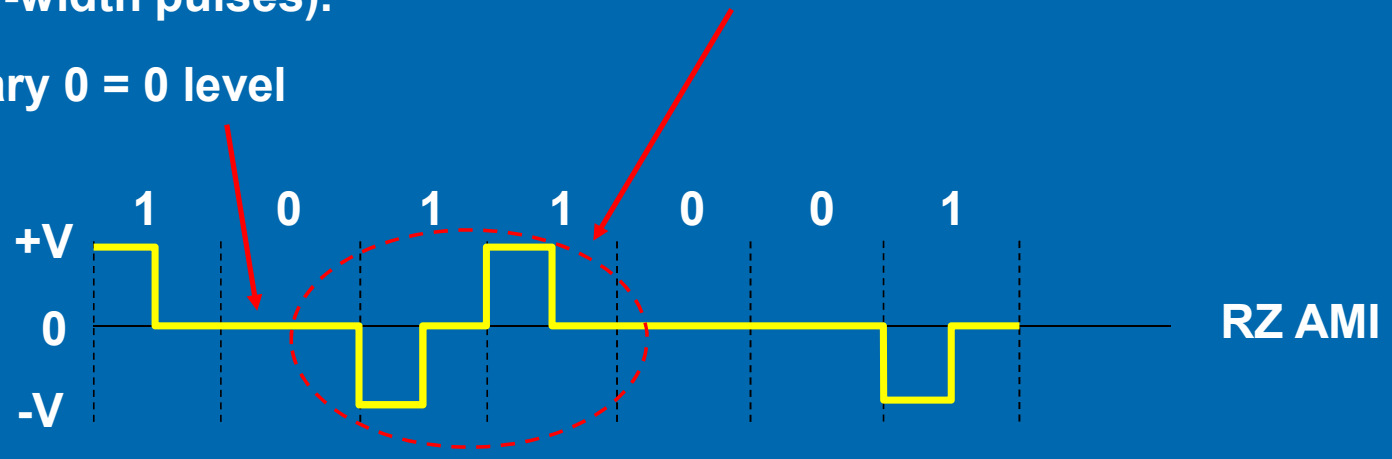
} Binary bits are represented by half-width pulses

RZ-AMI " Alternate Mark Inversion"

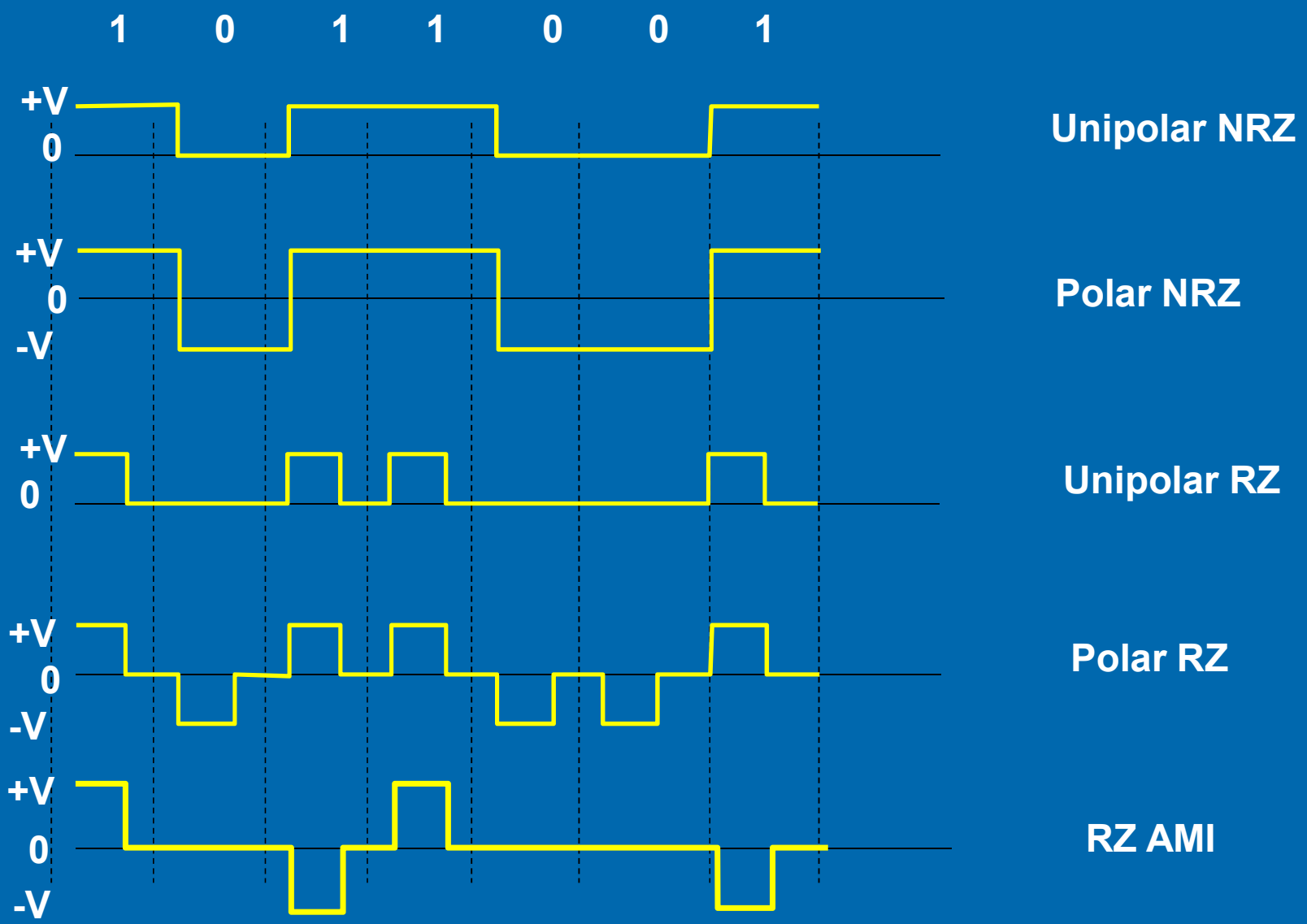
Most often used in telemetry systems

Binary 1 is represented by alternating pulses of opposites polarities (half-width pulses).

Binary 0 = 0 level



8.1 Line Coding

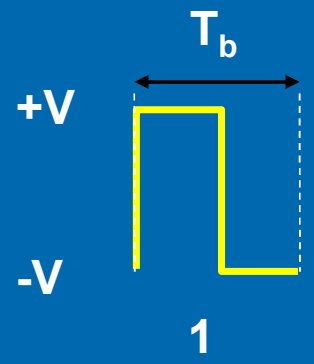


8.1 Line Coding

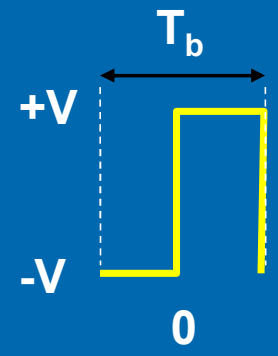
- **Group 3 – Phase encoded waveforms**

Used in magnetic recording, optical communication and satellite telemetry links.

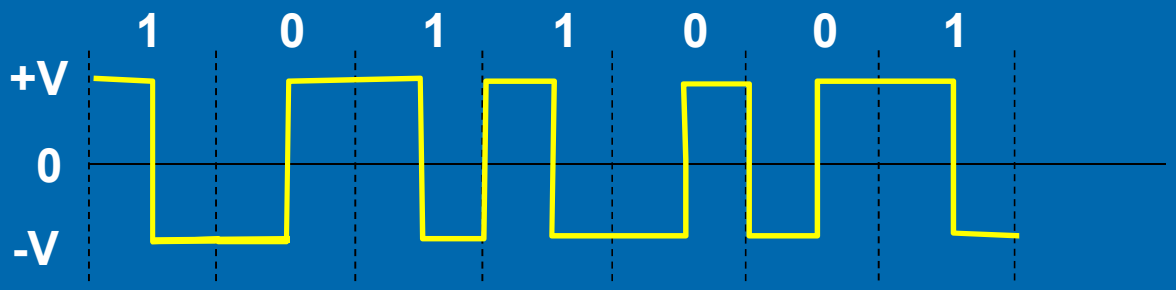
Manchester coding **used in Ethernet LAN networks.**



a half-bit-wide pulse positioned during 1st half bit interval.



a half-bit-wide pulse positioned during 2nd half bit interval.



Manchester coding

8.1 Line Coding

- **Group 4 - Multilevel binary**

Binary data is represented by 3 levels instead of 2.

e.g. polar RZ and RZ-AMI

8.1 Line Coding

- **Choice of a coding scheme is mainly based on 4 important parameters**

Transmission bandwidth	**As small as possible**
DC component	**System that requires AC coupling cannot use line codes that have DC component. e.g. unipolar NRZ**
Self-Clocking	**Some systems require line codes with self-clocking capability for symbol or bit synchronization. e. g. Manchester code**
Noise immunity	**Some codes are more immune to noise than others. e.g. NRZ waveforms have better error performances than RZ.**

End

CHAPTER 8

(Part 1 of 2)