Lecture 8

Discrete, Pulse and Digital Modulation

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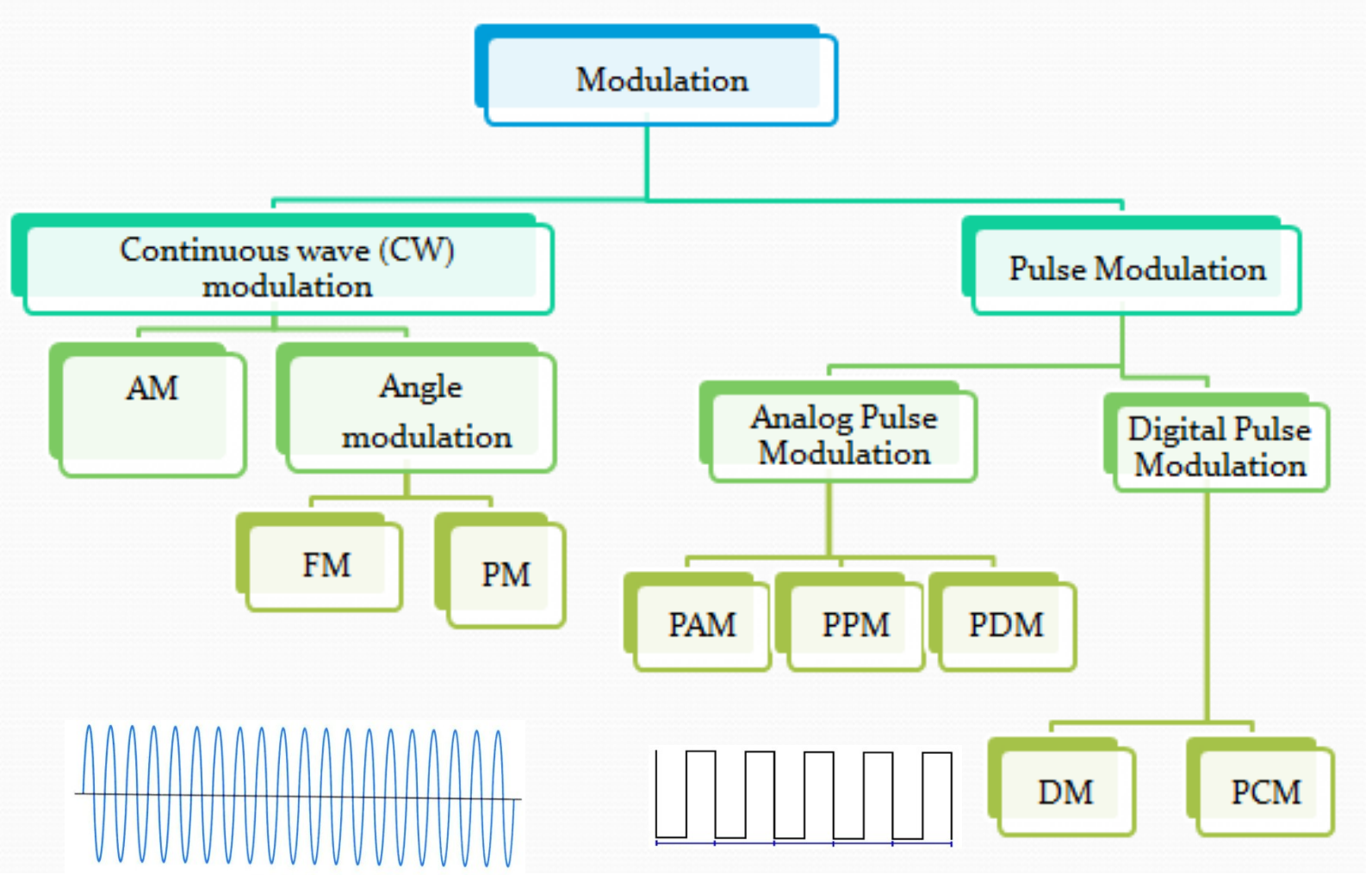
Outline

PAM Pulse Amplitude Modulation
Time Division Multiplexing (TDM)
Analog to Digital Conversion
Encoding


Modulation
Continuous wave (CW) modulation
Pulse Modulation
AM
Angle modulation
Analog Pulse Modulation
Digital Pulse Modulation
FM
PM
PAM
PPM
PDM
DM
PCM
Carrier Signal

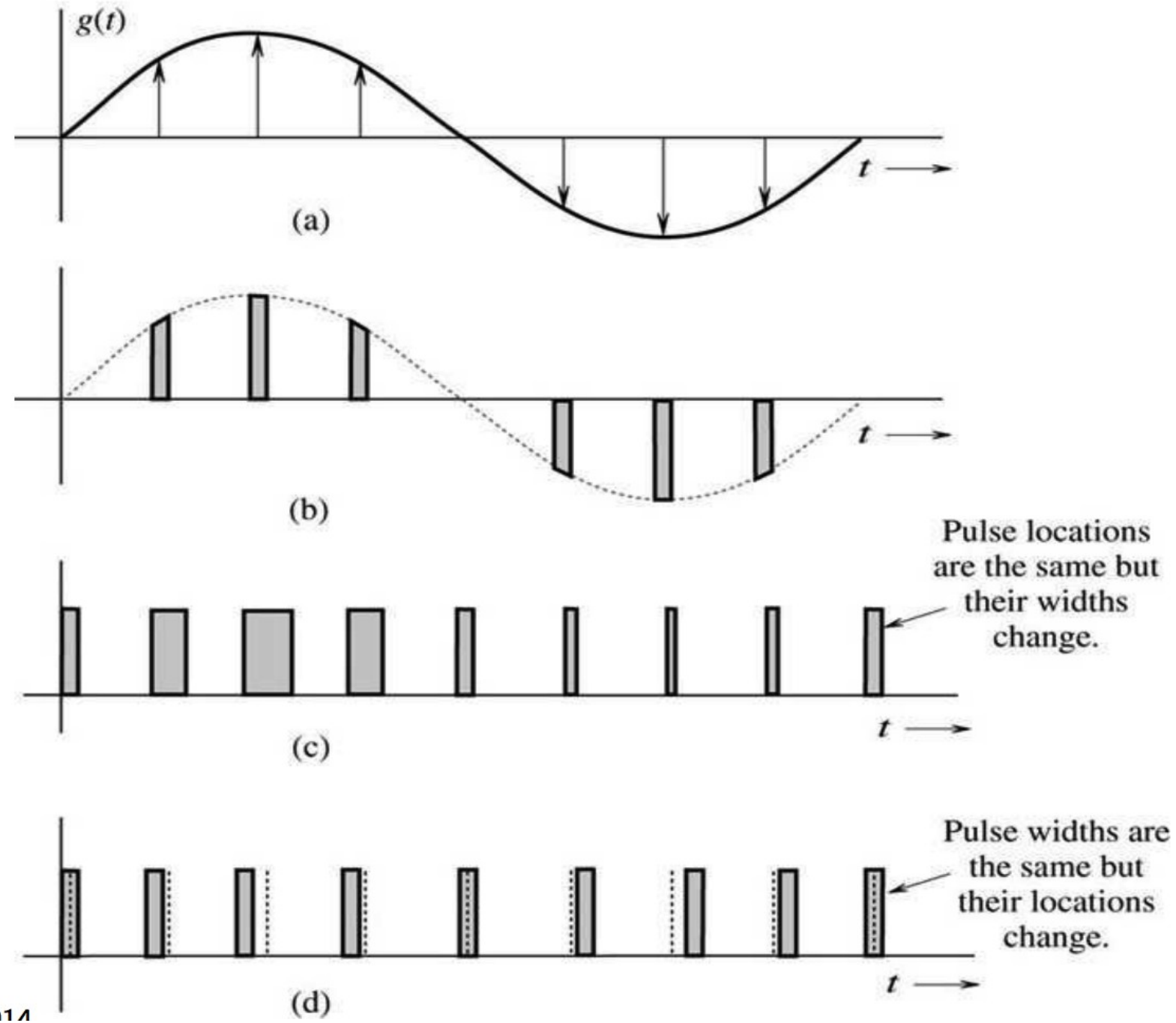
Introduction

- **CW modulation:** a parameter of a sinusoidal carrier wave is varied continuously in accordance with the message signal.

Amplitude, frequency and phase.

- **Pulse Modulation:** signal is transmitted at discrete intervals of time.

- Pulse modulation can be analog pulse modulation or digital pulse modulation.

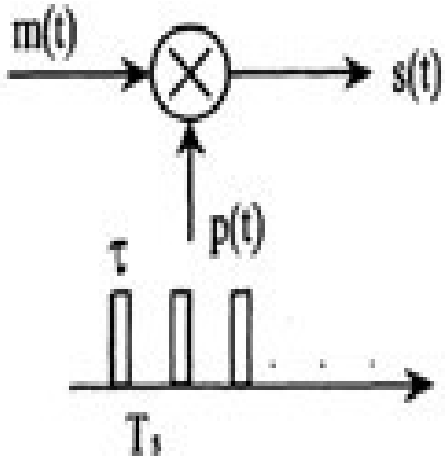

g(t)
t
(a)
t
(b)
Pulse locations are the same but their widths change.
t
(c)
Pulse widths are the same but their locations change.
t
(d)

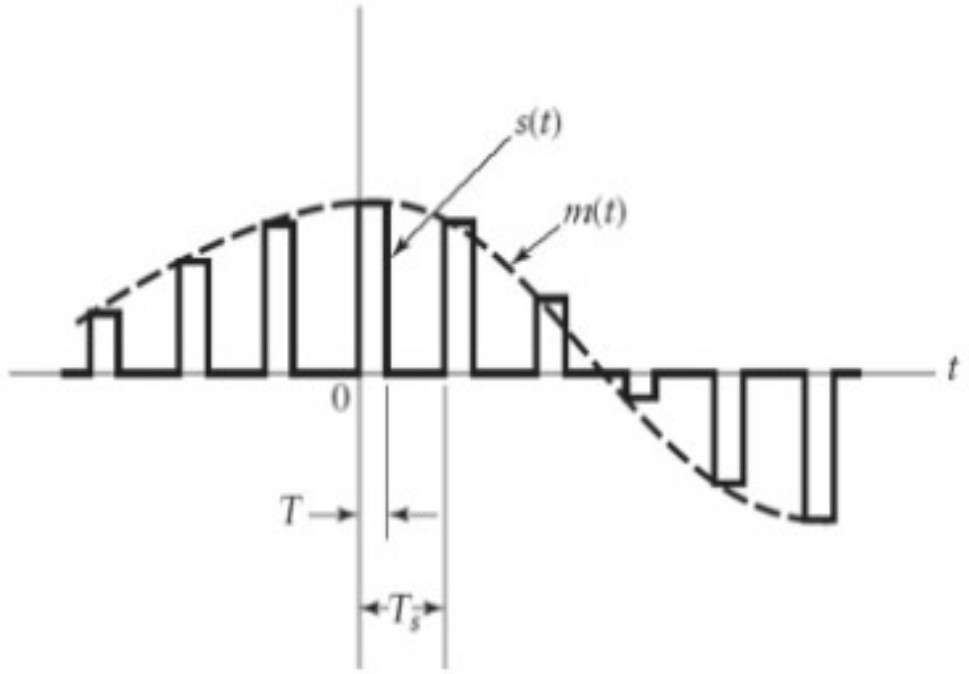
Pulse Amplitude Modulation (PAM)

- In the PAM, the amplitude of periodic pulse train is varied with a amplitude of the corresponding sample value of a continuous message signal.

- In PAM: width and position are fixed but amplitude varies.

Pulse Amplitude Modulation (PAM)

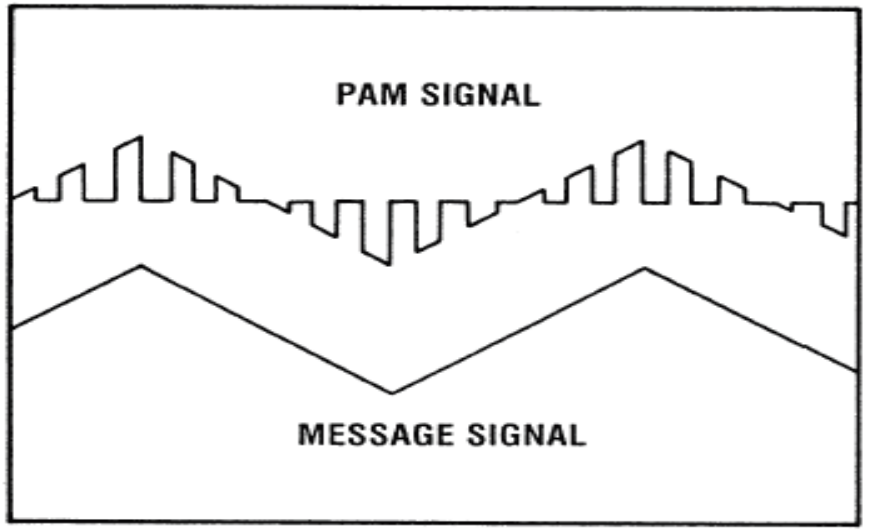


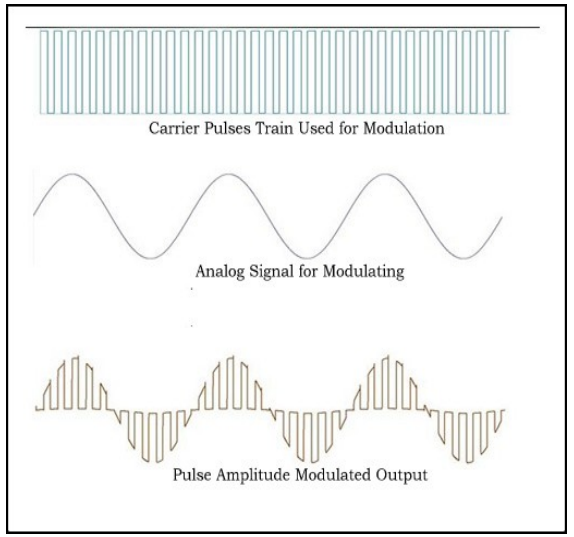


Pulse Amplitude Modulation (PAM)

- Natural PAM

top portion of the pulses are subjected to follow the modulating wave.





Pulse Amplitude Modulation (PAM)

- **Pulse width modulation** is also called pulse duration modulation (PDM).

- **Pulse width modulation:** position and amplitude are fixed but width varies.

- **PWM** is more often used for control than for communication.

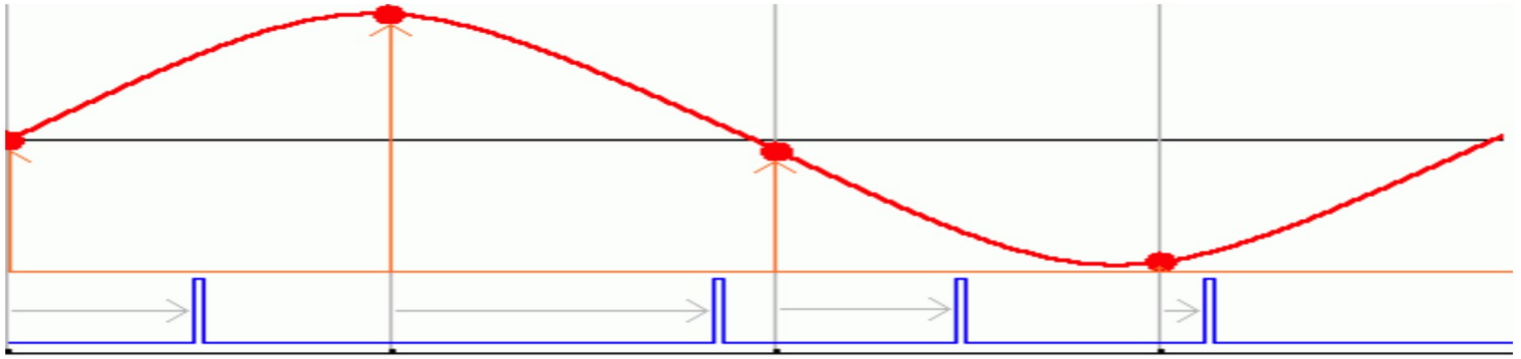
LEDs: output luminosity is proportional to average current.

Pulse Amplitude Modulation (PAM)

- **Pulse position modulation:**

  width and amplitude are fixed but position varies.

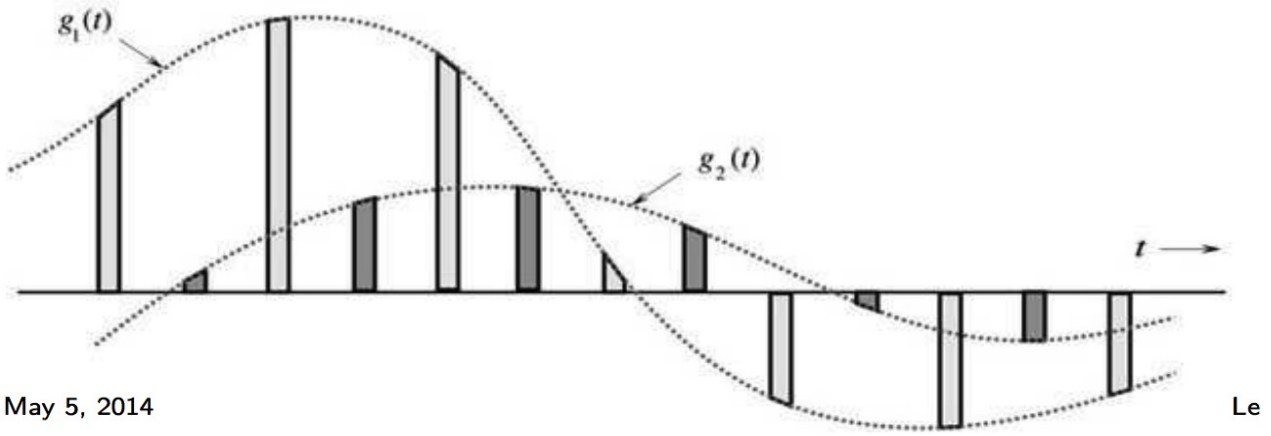
- The value of the signal determines the delay of the pulse from the clock.



Time Division Multiplexing (TDM)

- In many cases, bandwidth of communication link is much greater than signal bandwidth.

- All three methods can be used with time-division multiplexing (TDM) to carry multiple signals over a single channel.



Analog to Digital Conversion

- A digital signal is superior to an analog signal.
- Digital is less prone to noise and distortion.
- We can't use analog signals for long distance (lose their strength, which means amplifiers are needed to amplify signal. However the amplifier creates distortion in the signal and adds some noise).
- The tendency today is to change an analog signal (such as audio ,voice and music) to digital data.
- **Pulse Code Modulation (PCM)** is a technique to convert analog data to digital signal.

Binary Encoding

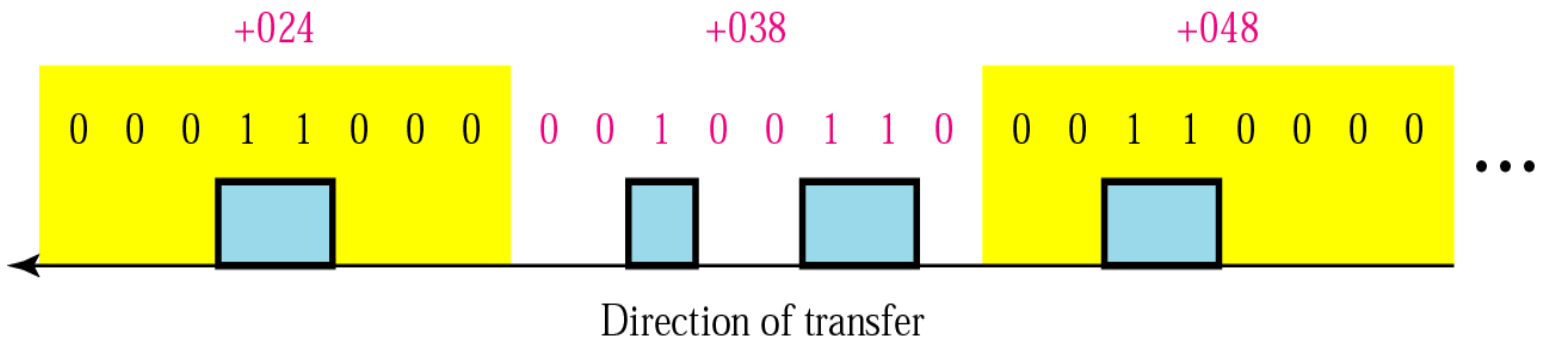
- Each quantized samples is translated into equivalent binary codes .

+024	00011000	–015	10001111	+125	01111101
+038	00100110	–080	11010000	+110	01101110
+048	00110000	–050	10110010	+090	01011010
+039	00100111	+052	00110110	+088	01011000
+026	00011010	+127	01111111	+077	01001101

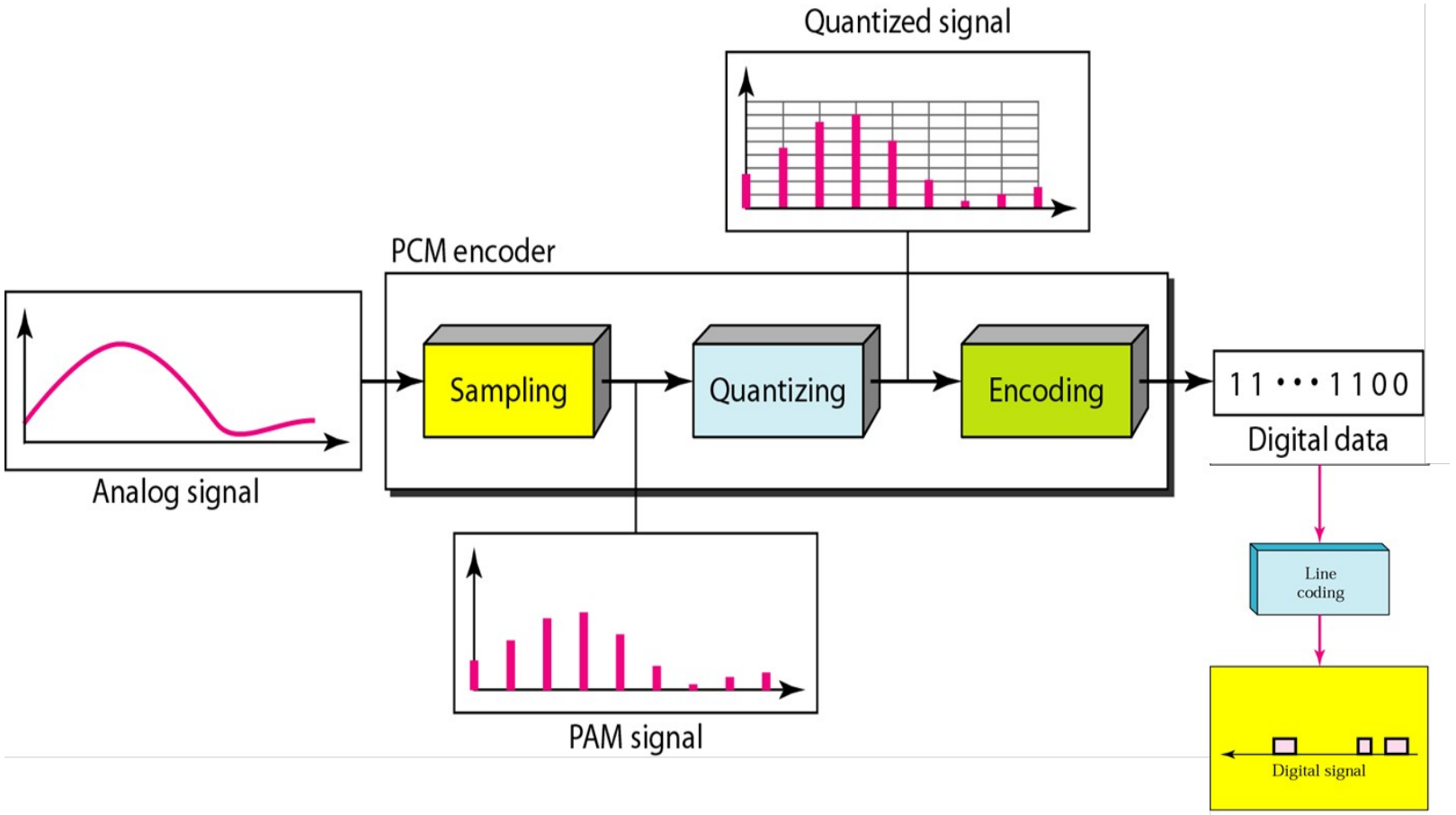
Sign bit
+ is 0 – is 1

Line Encoding

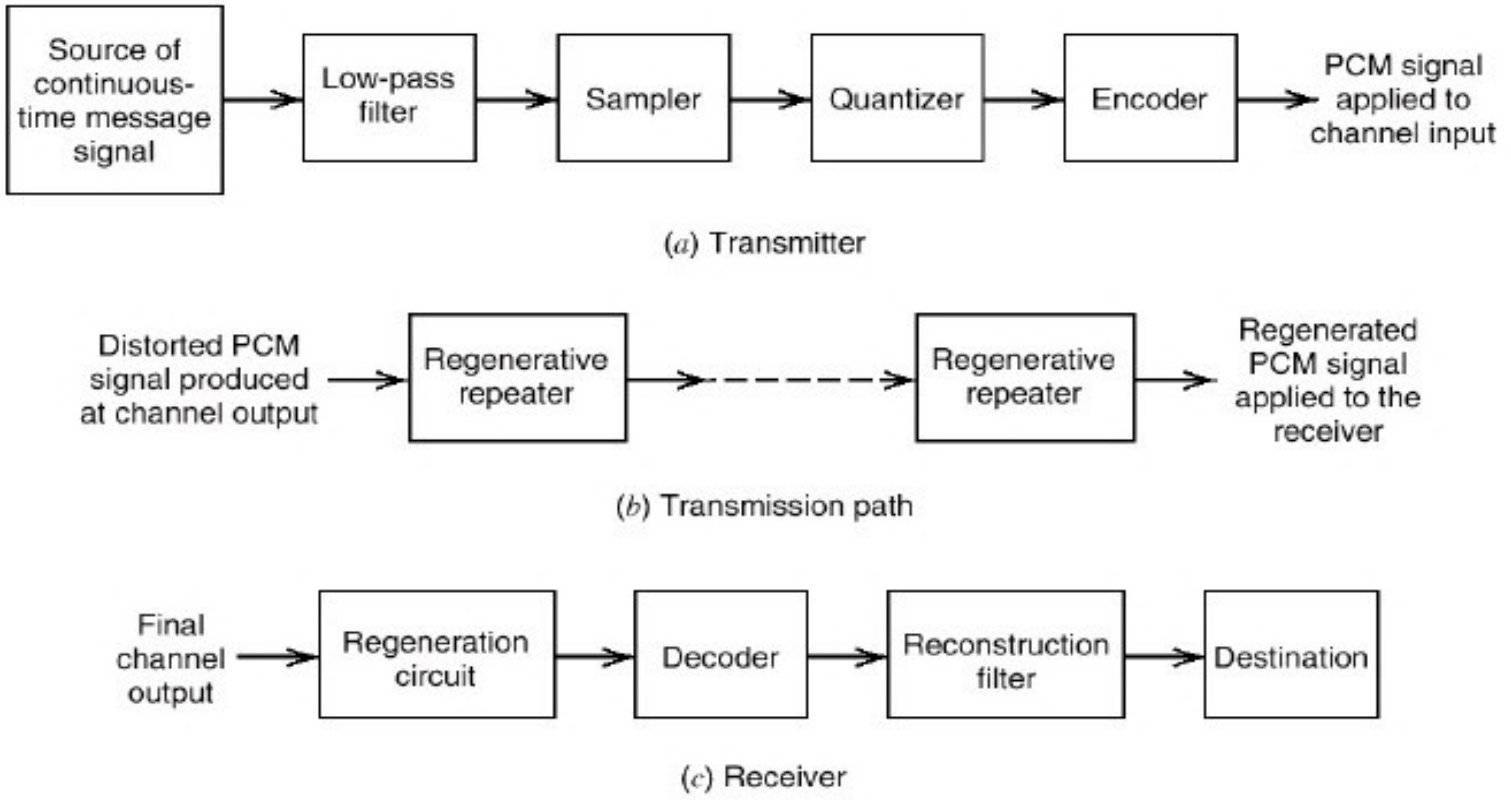
- The binary digits are then transformed to a digital signal using one of the line encoding.



Components of PCM Encoder



PCM Block



The basic elements of a PCM system

Pulse Code Modulation Advantages

1. Analog signal can be transmitted over a high speed digital communication system.
2. Probability of occurring error will reduce by the use of appropriate coding methods.
3. PCM is used in Telkom system, digital audio recording, digitized video special effects, digital video, voice mail.
4. PCM is also used in Radio control units as transmitter and also receiver for remote controlled cars, boats, planes.
5. The PCM signal is more resistant to interference than normal signal.

Thank You