Formatting (2A)

Please send corrections (or suggestions) to youngwlim@hotmail.com.

This document was produced by using OpenOffice and Octave.

Young Won Lim
11/1/13

Formatting and Source Coding

Formatting

Make the source signal compatible with digital processing

Transmit Formatting

A transformation from source information to digital symbols

Source Coding

Formatting + Data Compression

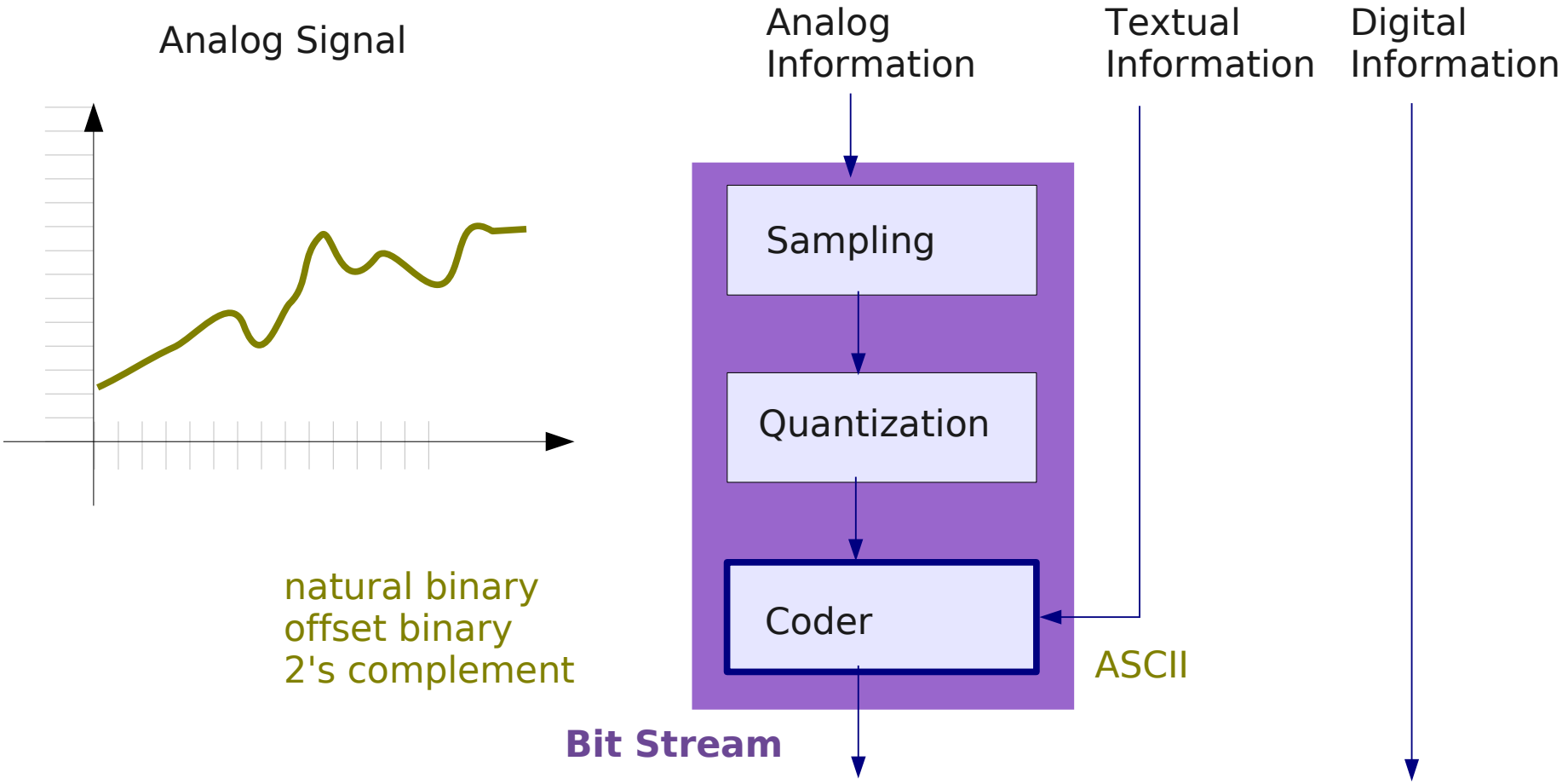
Baseband Signal

From DC up to some finite frequency (< a few MHz)
Transmitted over the cable
Not appropriate to transmit over long distance → Bandpass Mod

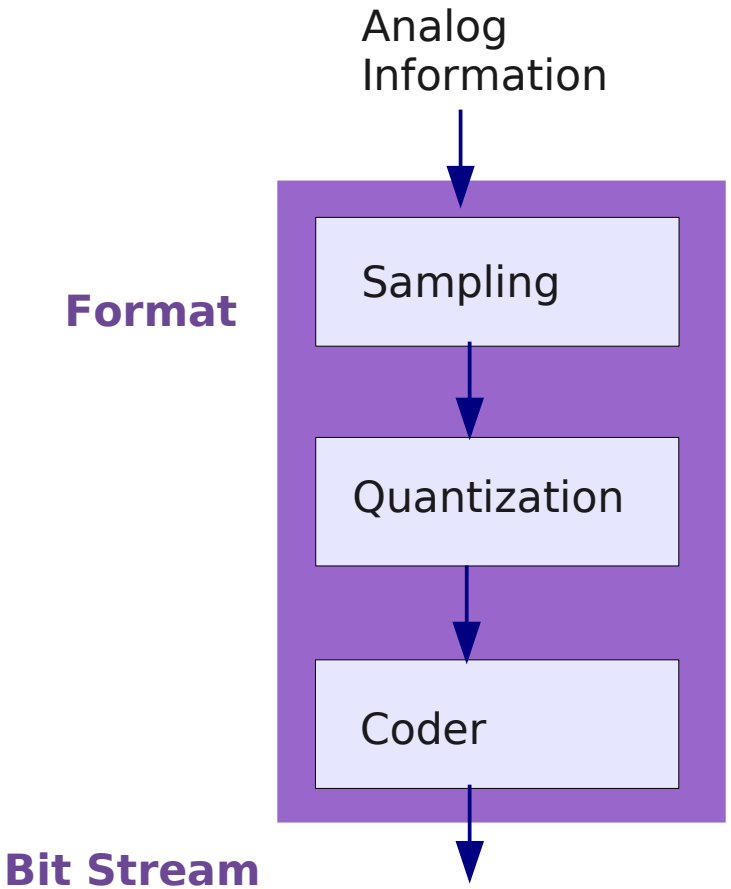
Pulse (Baseband) Modulation

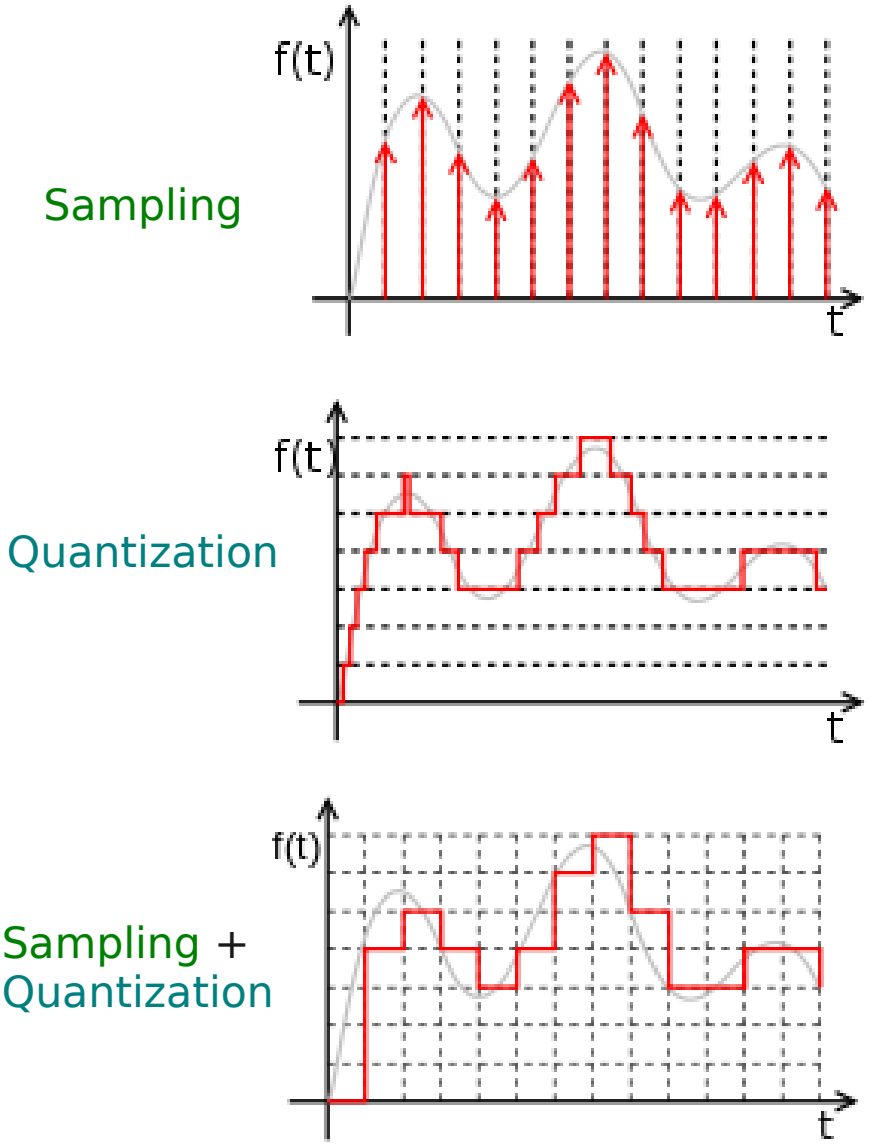
Pulse waveforms are assigned that represent formatted symbols

Baseband Signal Format

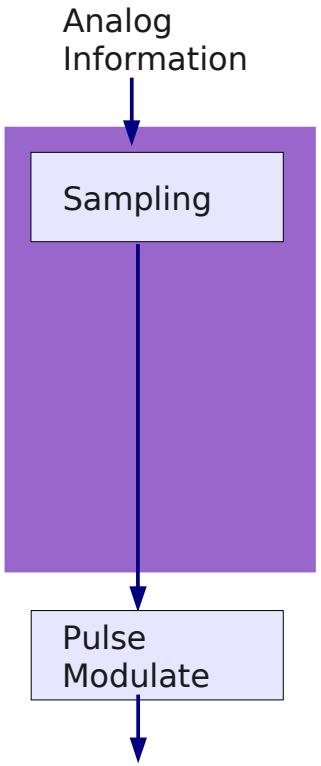


Sampling and Quantization

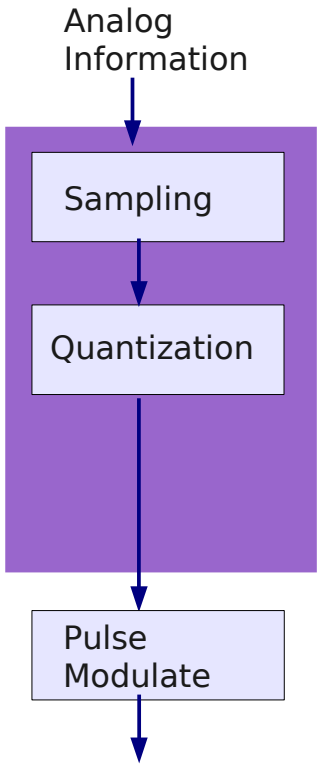




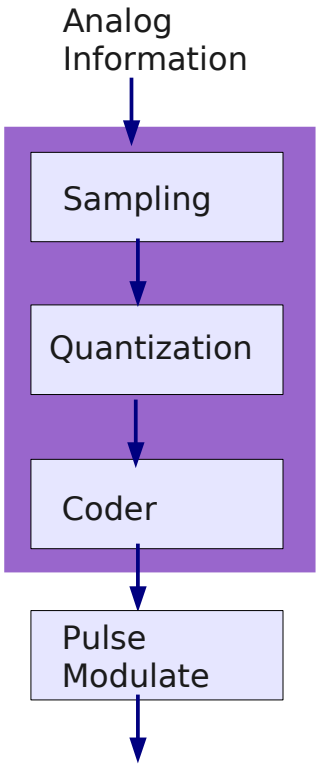
Pulse Modulation



PAM
PDM
PPM



M-ary PAM

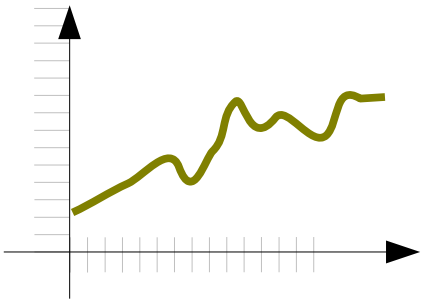


PCM
DM
DPCM

Analog Pulse Modulation

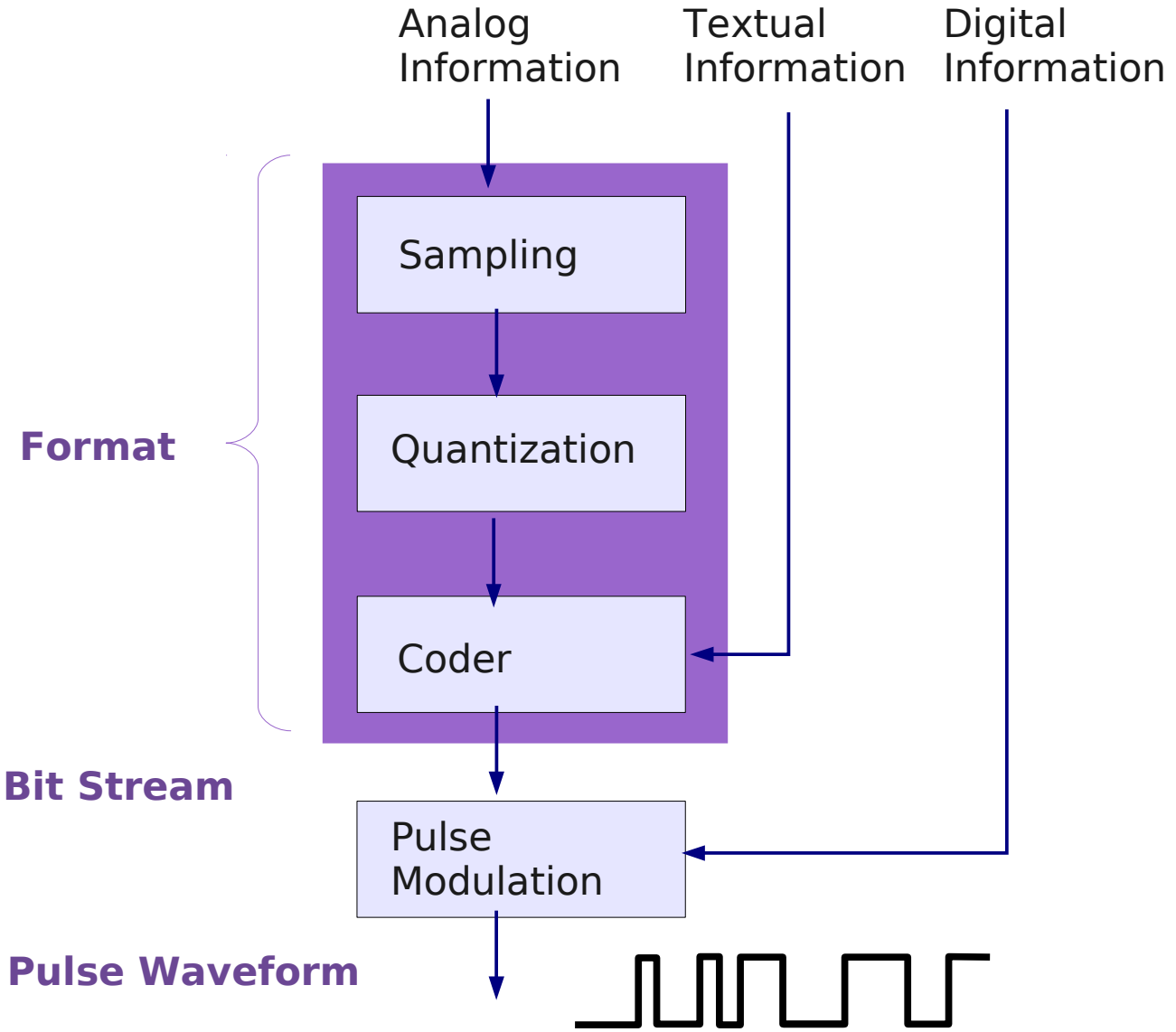
Digital Pulse Modulation

Baseband Signal



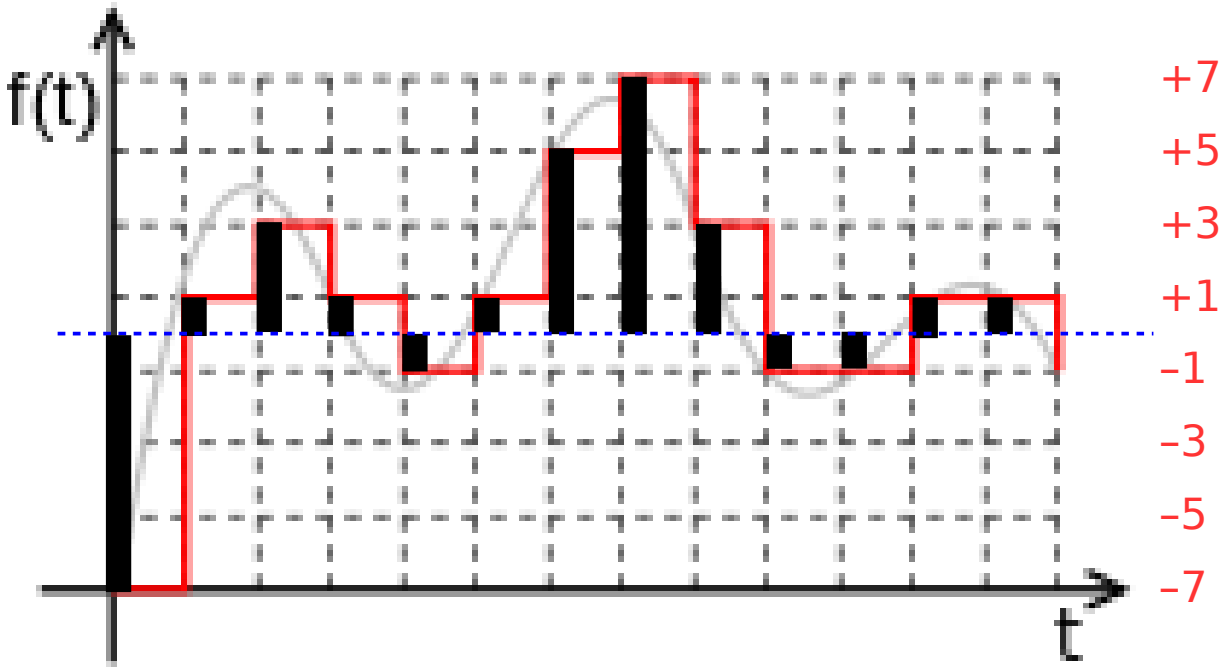
PAM M-ary PAM
PDM
PPM

PCM
DM
DPCM



M-ary PAM (Pulse Amplitude Modulation)

PAM is usually used as a analog pulse modulation scheme

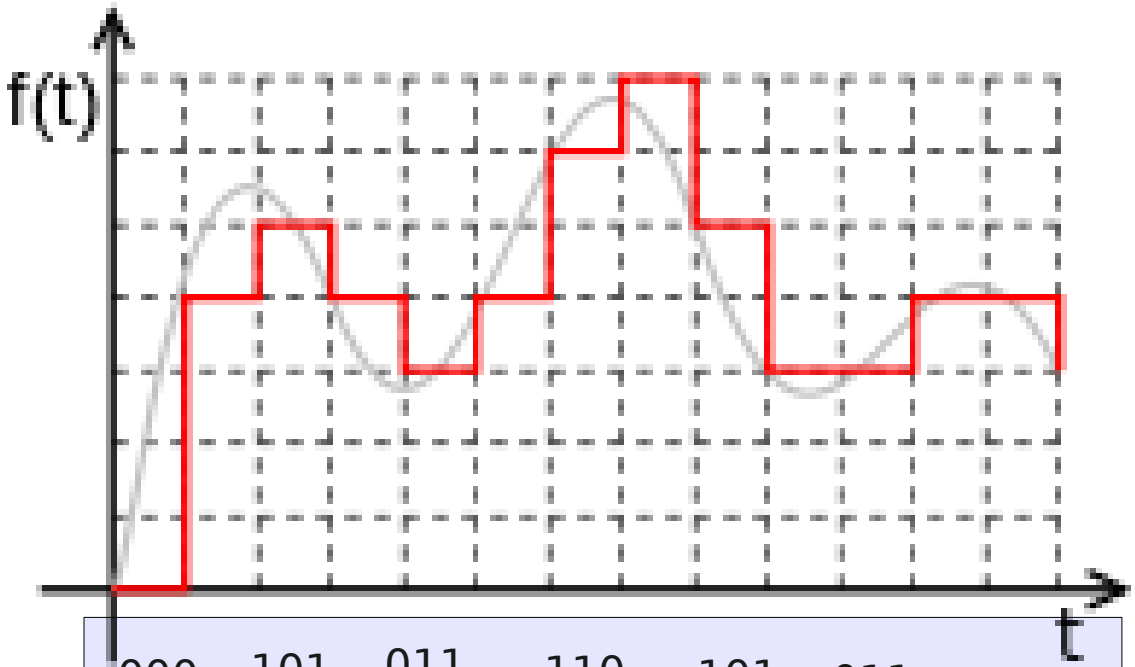


4-ary PAM **2-bit modulator** **4 levels :** -3, -1, +1, +3 volts

8-ary PAM **3-bit modulator** **8 levels :** -7,-5,-3,-1,+1,+3,+5,+7

PCM (Pulse Coded Modulation)

- natural binary
- offset binary
- 2's complement

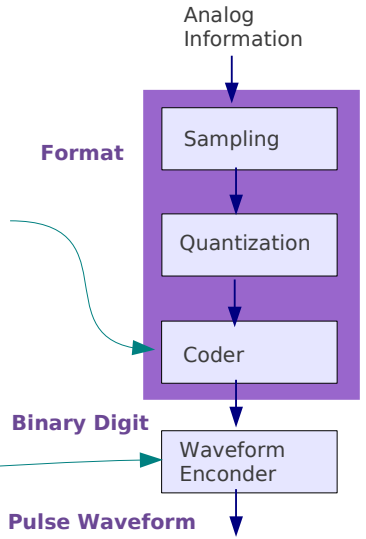


7	111
6	110
5	101
4	100
3	011
2	010
1	001
0	000

000 101 011 110 101 011 100
100 100 100 111 011 100

CODED

Line Encoder : NRZ, ...



Symbols

T H I N K

Message

001010 000100 100100 011100 110100

6-bit ASCII

0 0 1 0 1 0 0 0 0 1 0 0 1 0 0 1 0 0 0 1 1 1 0 0 1 1

0 0 1 0 1 0 0 0 0 1 0 0 1 0 0 1 0 0 0 1 1 1 0 0 1 1

binary digits
(binary symbols)

$s_0(t)$ $s_0(t)$ $s_1(t)$ $s_0(t)$ $s_1(t)$ $s_0(t)$ $s_0(t)$ $s_0(t)$ $s_0(t)$ $s_1(t)$ $s_0(t)$ $s_0(t)$

binary (Pulse) waveform

001 010 000 100 100 100 011 100 110 100

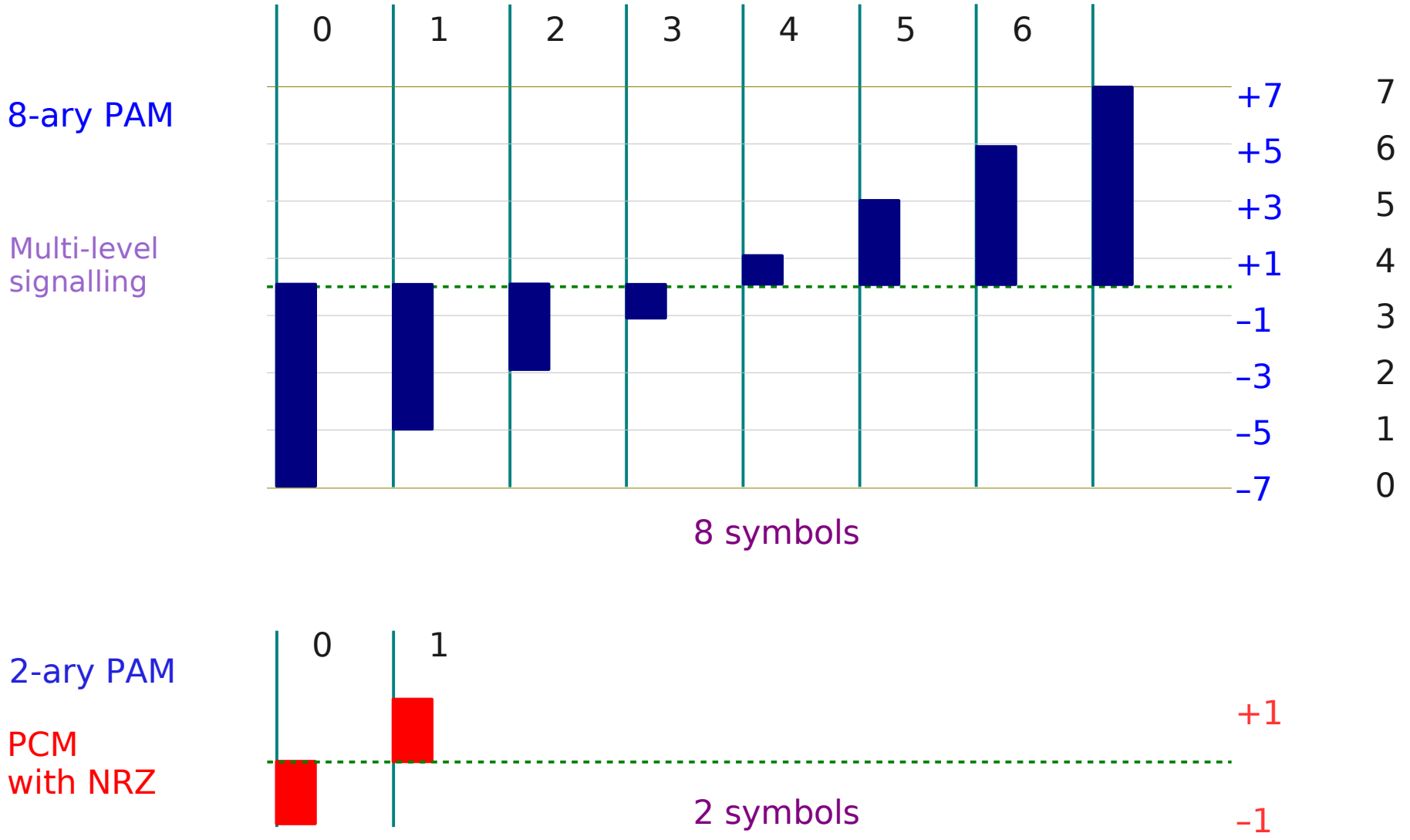
1 2 0 4 4 4 3 4 6 4

8-ary digits
(8-ary symbols)

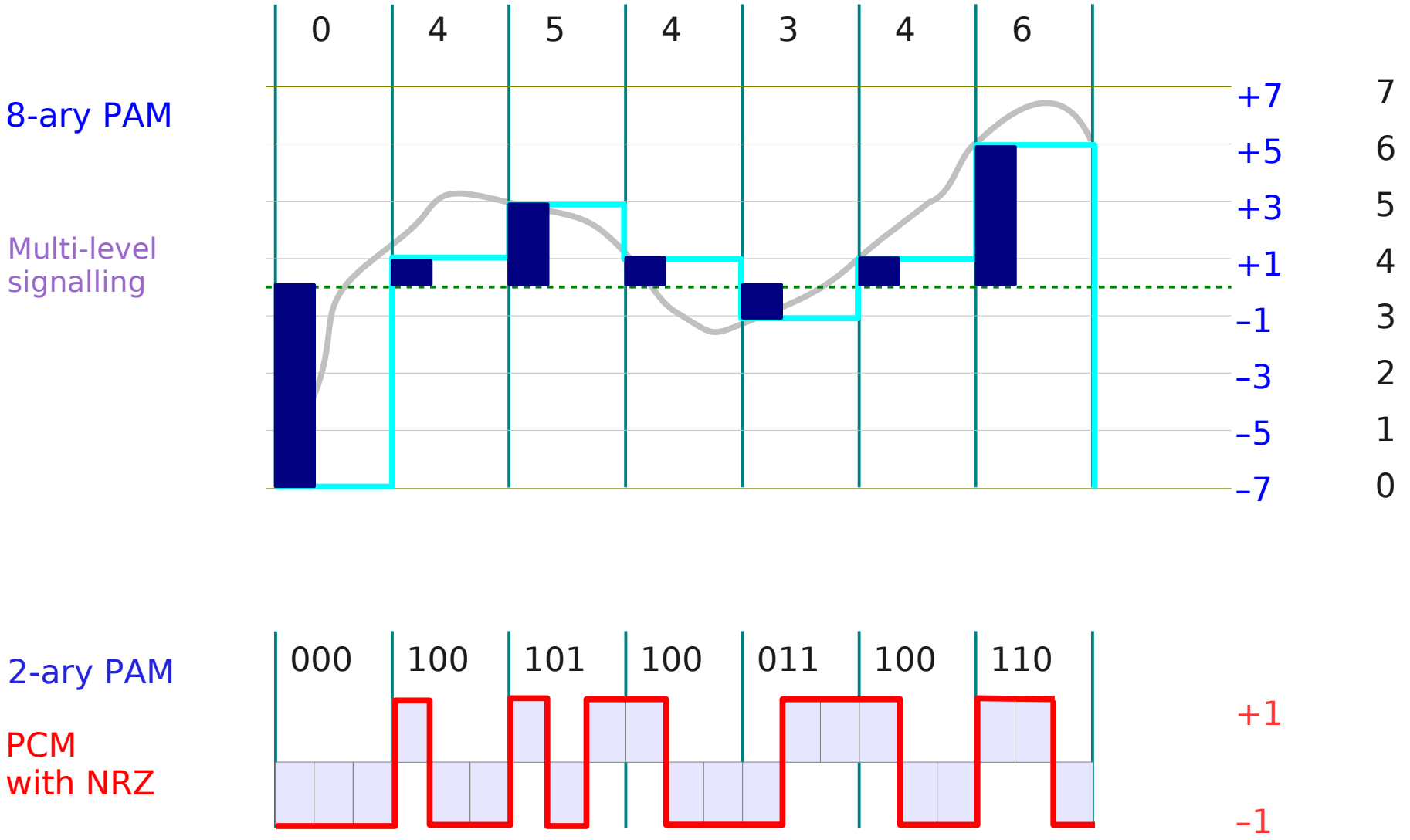
$s_1(t)$ $s_2(t)$ $s_0(t)$ $s_4(t)$ $s_4(t)$ $s_4(t)$ $s_3(t)$ $s_4(t)$ $s_6(t)$ $s_4(t)$

8-ary (Pulse) waveform

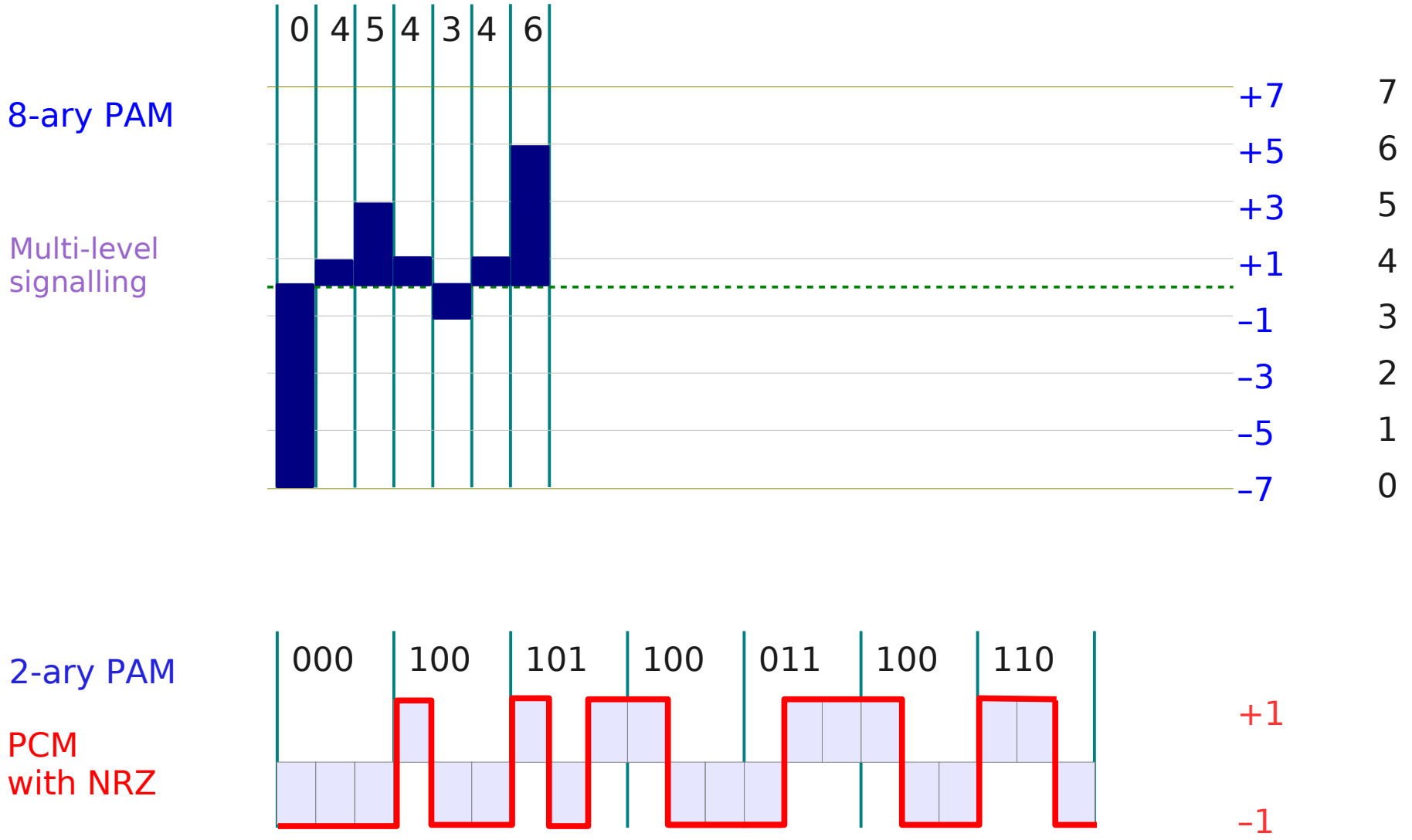
8-ary vs Binary Waveforms



8-ary PAM vs PCM



8-ary PAM vs PCM



Line Encode

Digital BaseBand Modulation

NRZ-L

NRZ-M

NRZ-S

Unipolar RZ

Bipolar RZ

RZ-AMI

Bi-Phi-L

Bi-Phi-M

Bi-Phi-S

Delay Modulation

Dicode NRZ

Dicod RZ

- DC component
- Self-Clocking
- Error Detection
- Bandwidth Compression
- Differential Encoding
- Noise Immunity

References

[1] http://en.wikipedia.org/
[2] http://planetmath.org/
[3] B. Sklar, “Digital Communications: Fundamentals and Applications”
[4] S. Haykin, M Moher, “Introduction to Analog and Digital Communications”, 2ed