Asynchronous Vs Synchronous Transmission

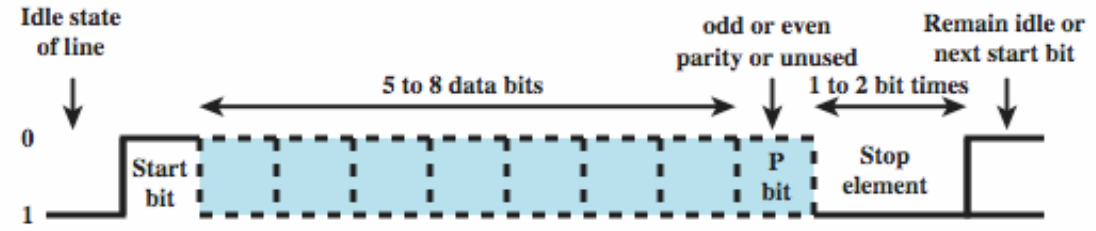
>Timing problems require a mechanism to synchronize the transmitter and receiver.

- receiver samples stream at bit intervals
- if clocks not aligned and drifting will sample at wrong time after sufficient bits are sent

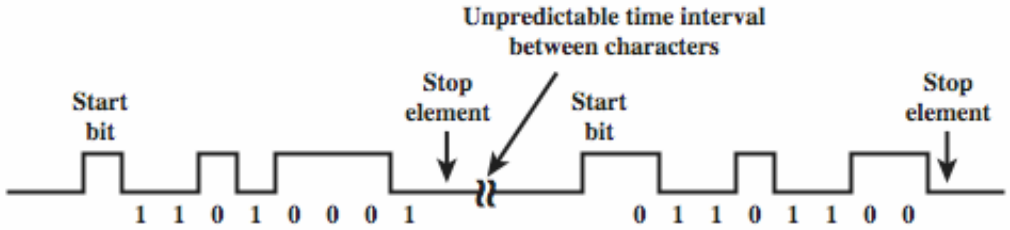
> two solutions to synchronizing clocks

- asynchronous transmission
- synchronous transmission

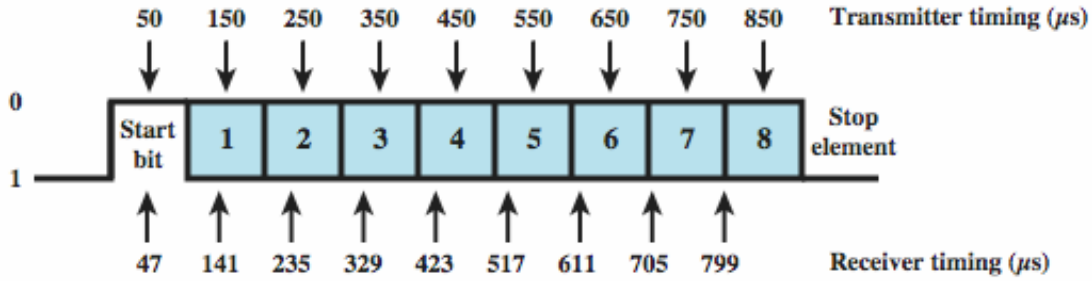
Asynchronous Transmission



(a) Character format



(b) 8-bit asynchronous character stream



(c) Effect of timing error

Asynchronous - Behavior

- Simple
- Cheap
- Overhead of 2 or 3 bits per char (~20%)
- Good for data with large gaps

  Ex) Keyboard

Synchronous Transmission

block of data transmitted sent as a frame

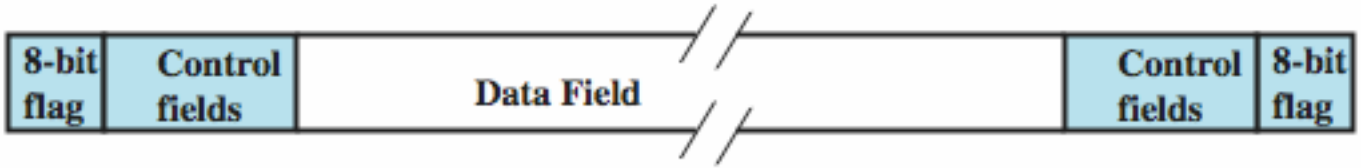
clocks must be synchronized

- can use separate clock line
- or embed clock signal in data

need to indicate start and end of block

- use preamble and postamble

more efficient (lower overhead) than async



Types of Error

an error occurs when a bit is altered between transmission and reception

single bit errors

- only one bit altered
- caused by white noise

burst errors

- contiguous sequence of *B* bits in which first last and any number of intermediate bits in error
- caused by impulse noise or by fading in wireless
- effect greater at higher data rates

Error Detection

will have errors

detect using error-detecting code

added by transmitter

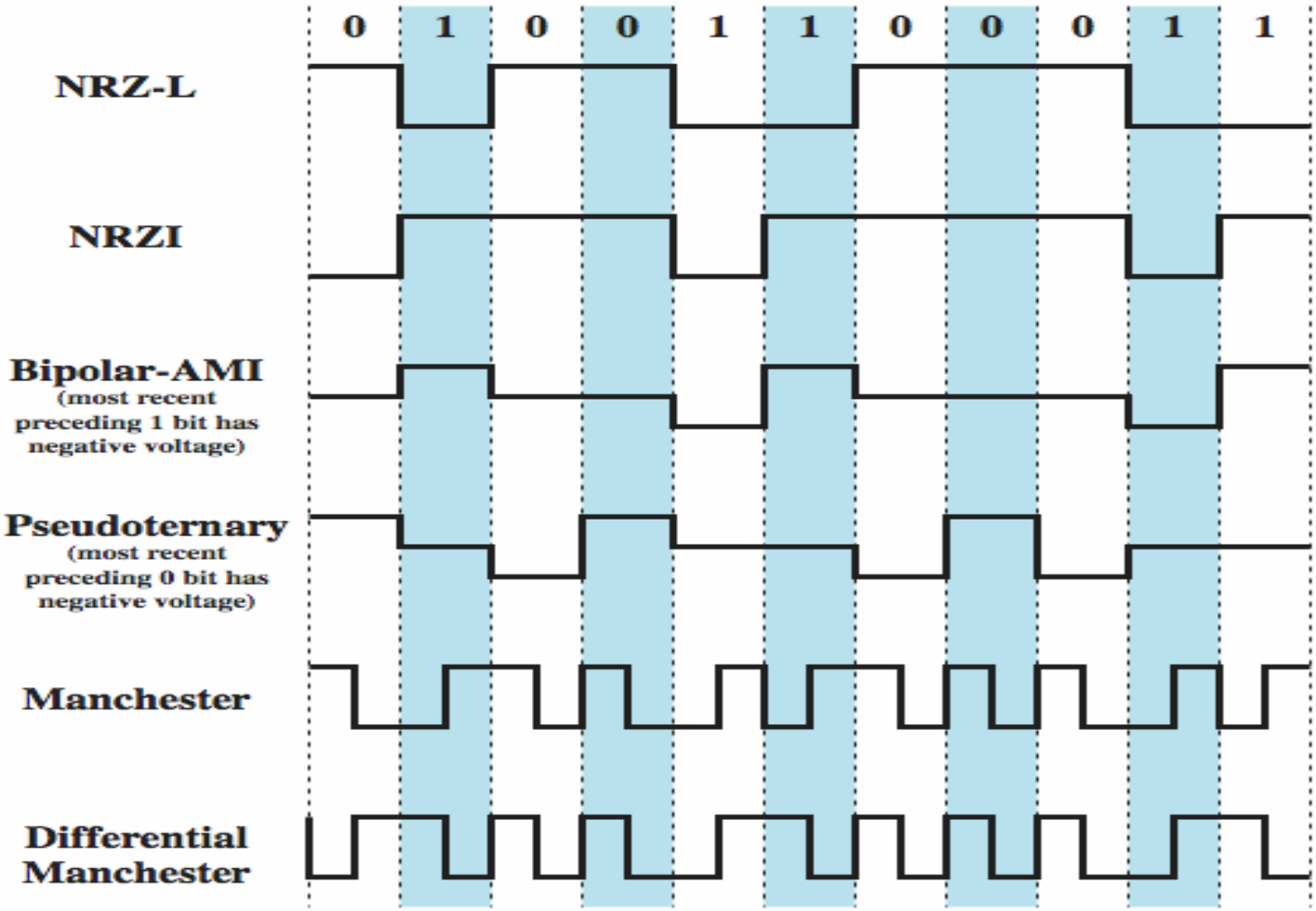
recalculated and checked by receiver

still chance of undetected error

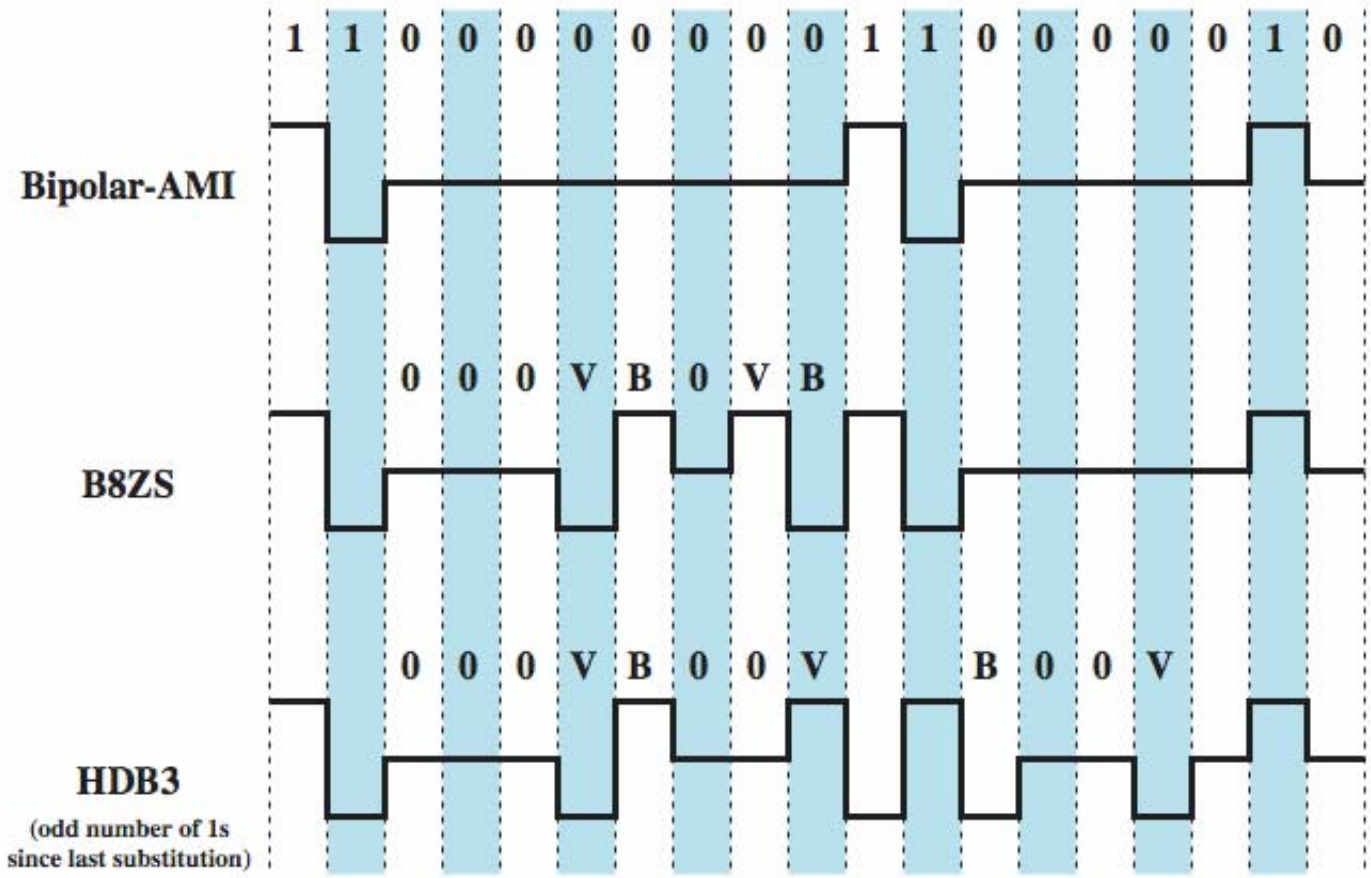
parity

- parity bit set so character has even (even parity) or odd (odd parity) number of ones
- even number of bit errors goes undetected

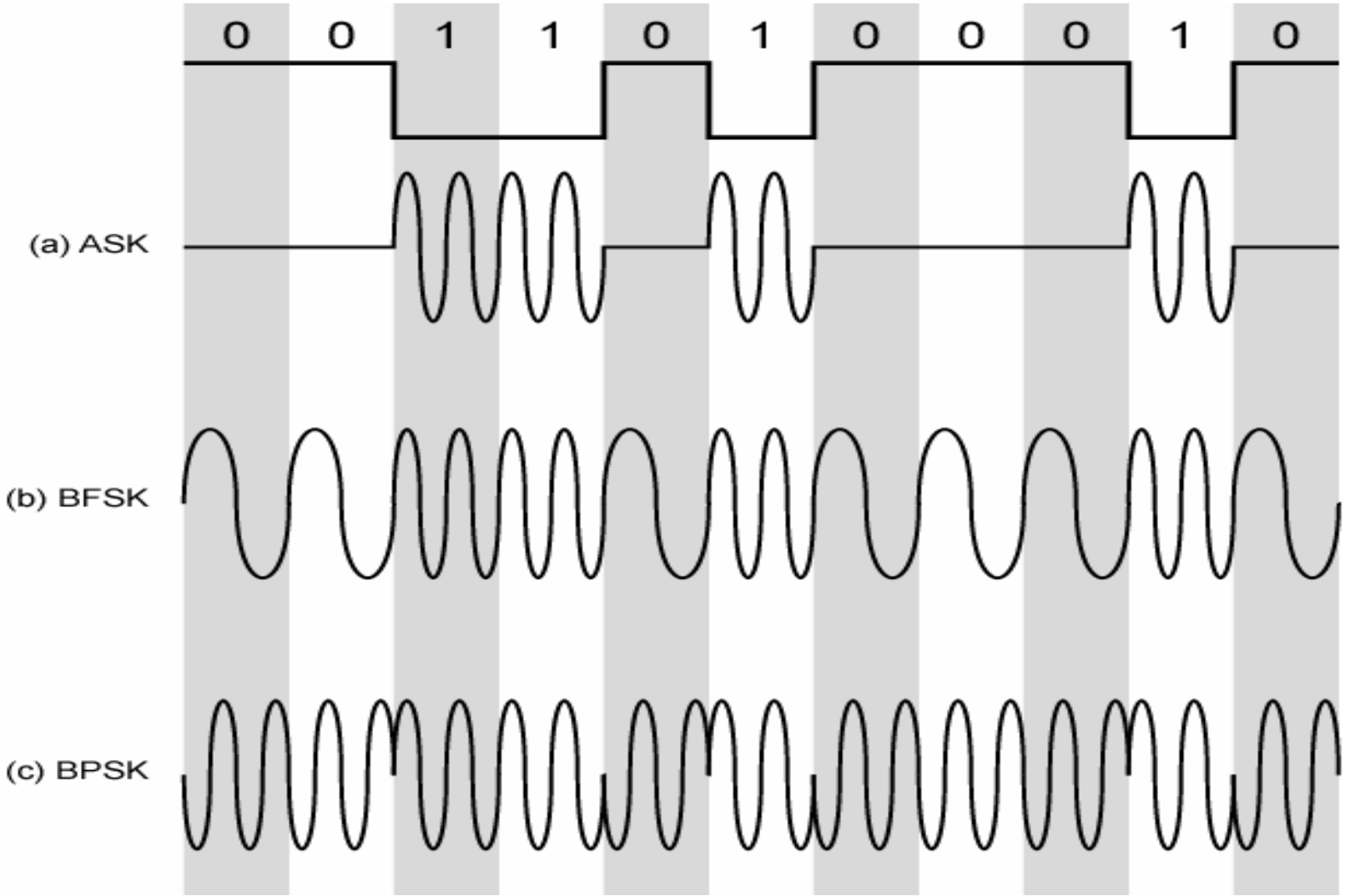
Encoding Schemes



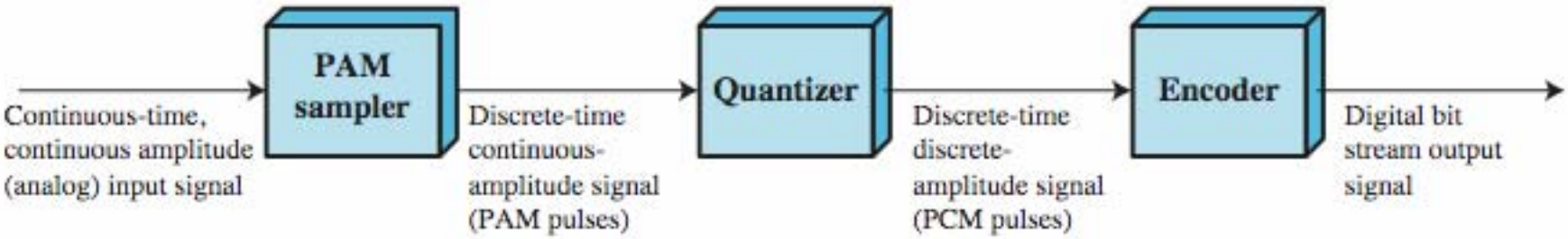
B8ZS and HDB3



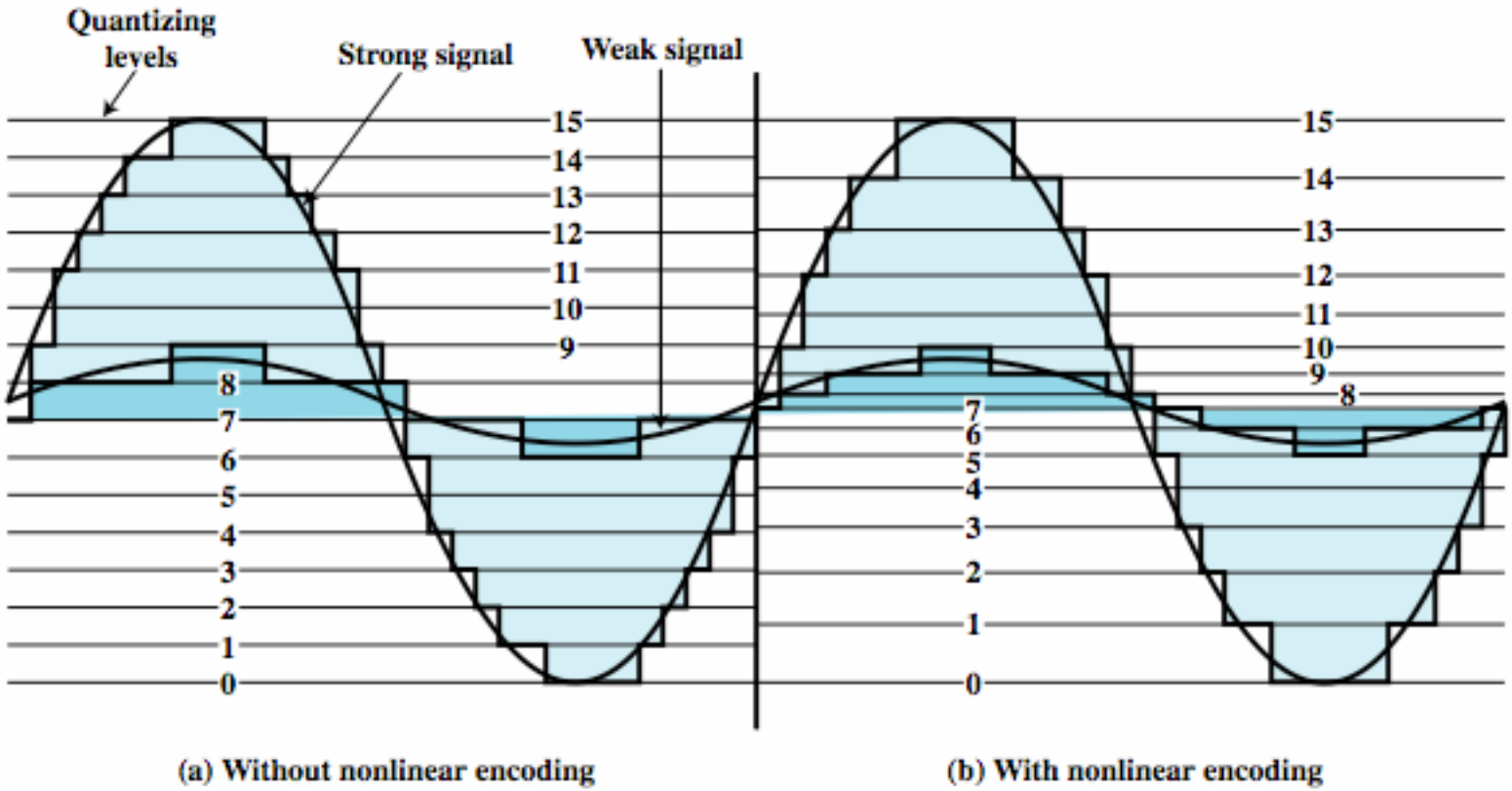
Modulation Techniques



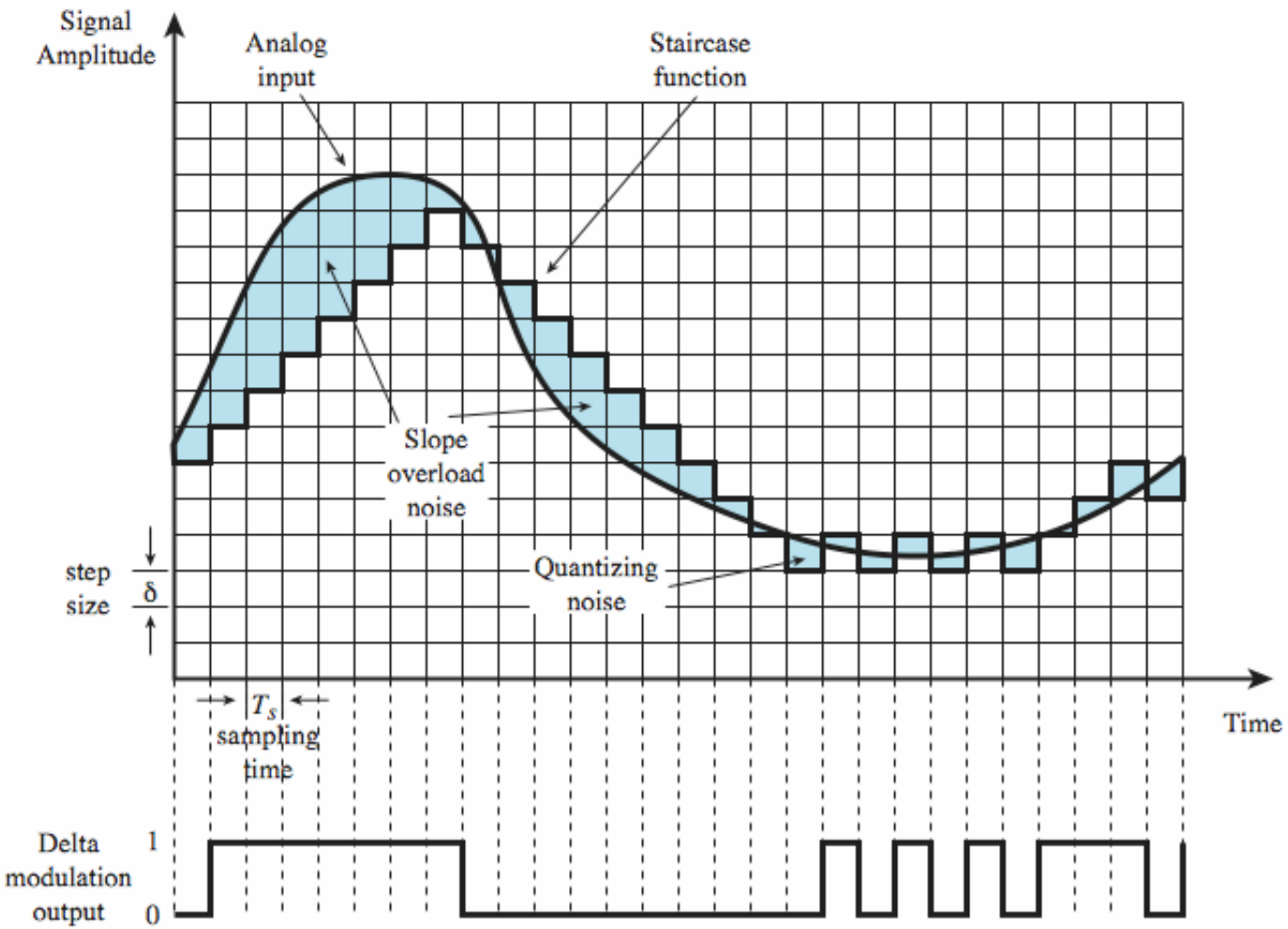
PCM Block Diagram



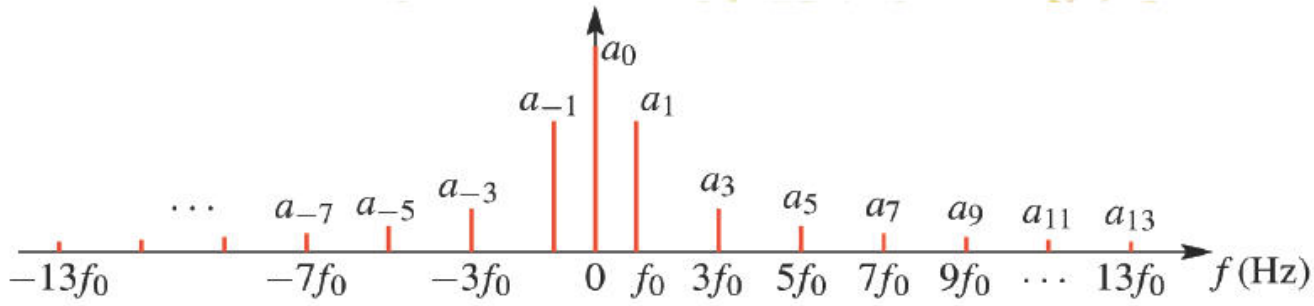
Non-Linear Coding



Delta Modulation Example



Fourier Series Synthesis



Spectrum Plot

(a_k, kf_0) versus f

T_0 = Period

N = Number of Coefficients

Fourier Analysis

Extract Sinusoids

$$a_k = \frac{1}{T_0}\int_0^{T_0} x(t)e^{-j2\pi kf_0 t}\,dt$$

$x(t)$

$\{a_k\}$

$\{kf_0\}$

$f_0 = \frac{1}{T_0}$ Hz

Fourier Synthesis

Approximate the Signal

$$x_N(t) = \sum_{k=-N}^{N} a_k e^{j2\pi kf_0 t}$$

$x_N(t)$