Sistem Komunikasi 1

BAB 9

ADC-MUX

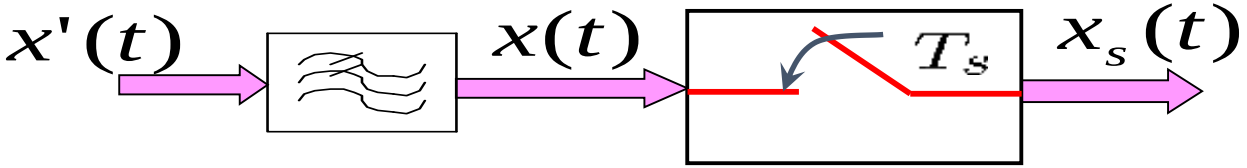
ADC (ANALOG TO DIGITAL CONVERTER) / PCM (PULSE CODE MODULATION)

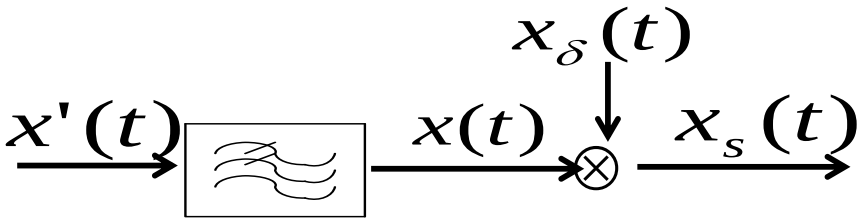
Mengubah sinyal voice analog menjadi sinyal digital

Proses yang terjadi dalam PCM :

Sampling (pencuplikan)
Quantizing (kuantiasasi)
Encoding (pengkodean)

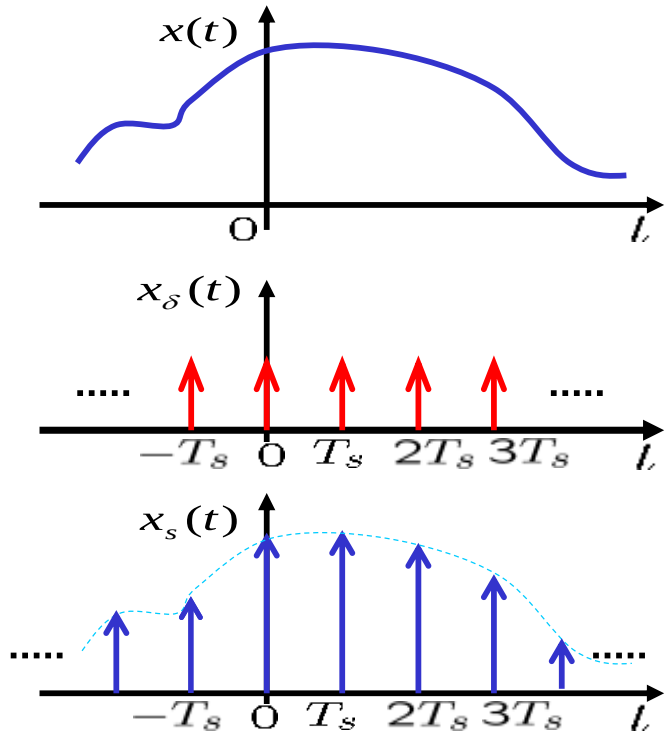
PROSES PENCUPLIKAN (SAMPLING)





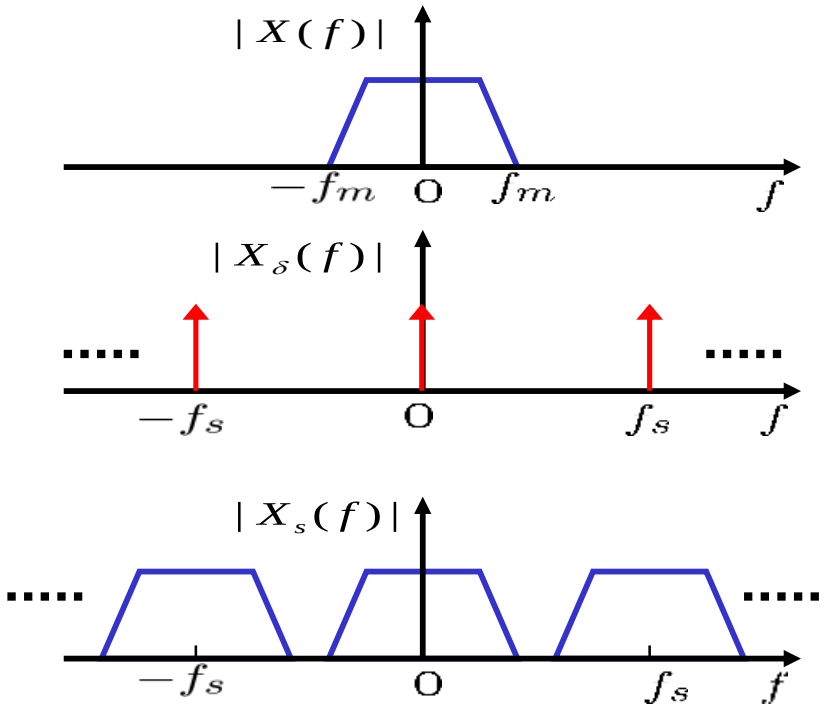
Time domain

$$x_s(t) = x_\delta(t) \times x(t)$$

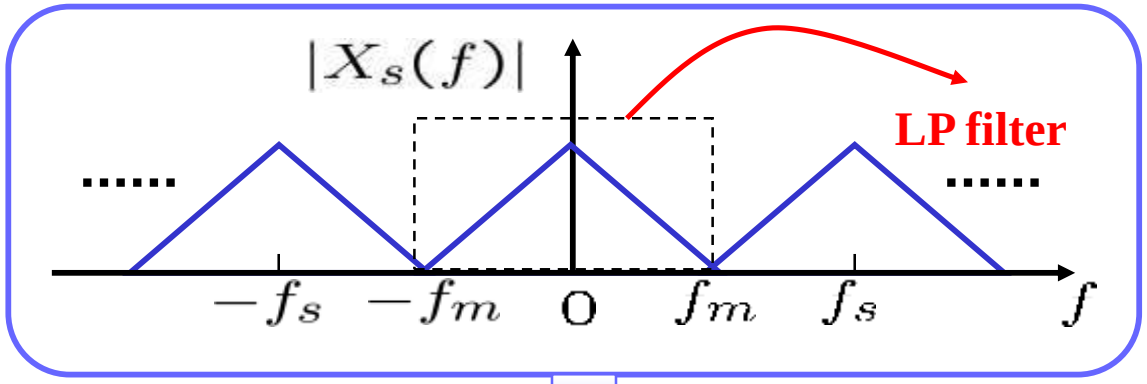


Frequency domain

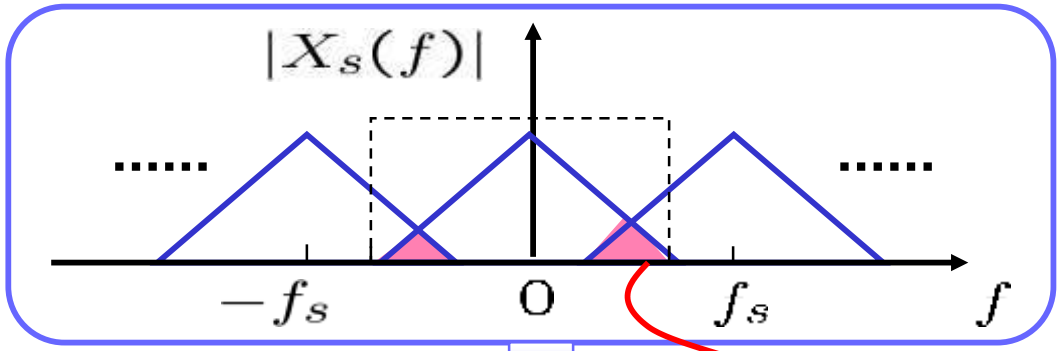
$$X_s(f) = X_\delta(f) * X(f)$$



Aliasing effect

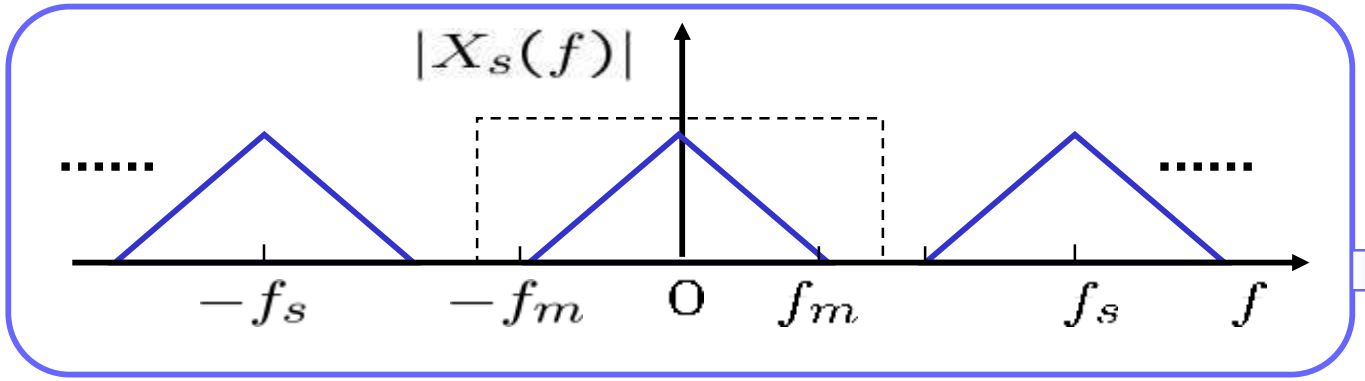


$f_s = 2f_m$



$f_s < 2f_m$

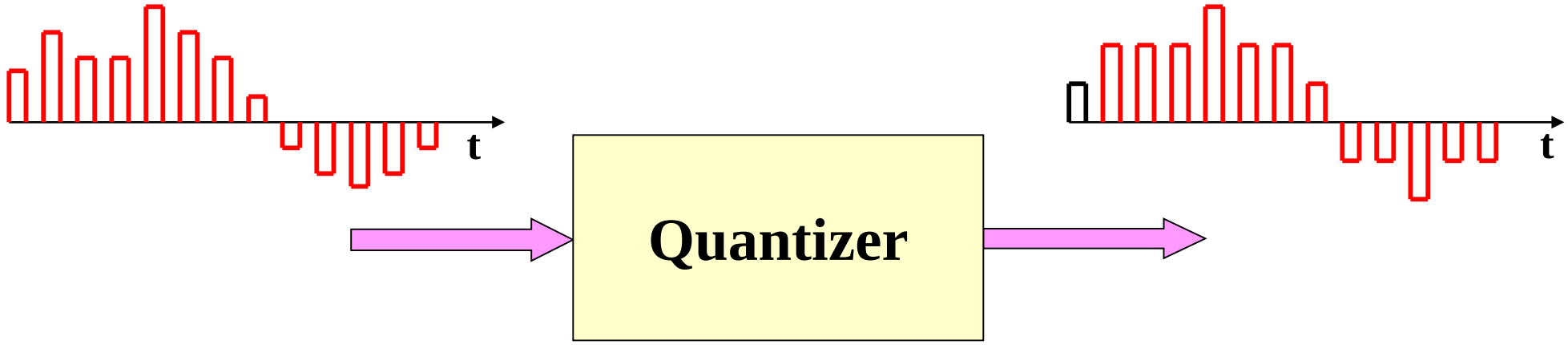
aliasing



$f_s > 2f_m$

Nyquist criteria

PROSES KUANTISASI (QUANTIZATION)



Kuantisasi : mengubah level amplituda menjadi diskret dengan jumlah terbatas.

Jumlah level kuantisasi $M = 2^N$ N = jumlah bit pengkodean

Terdapat 2 jenis kuantiser yaitu :

Kuantiser Uniform (lebar selang kuantisasi seragam)

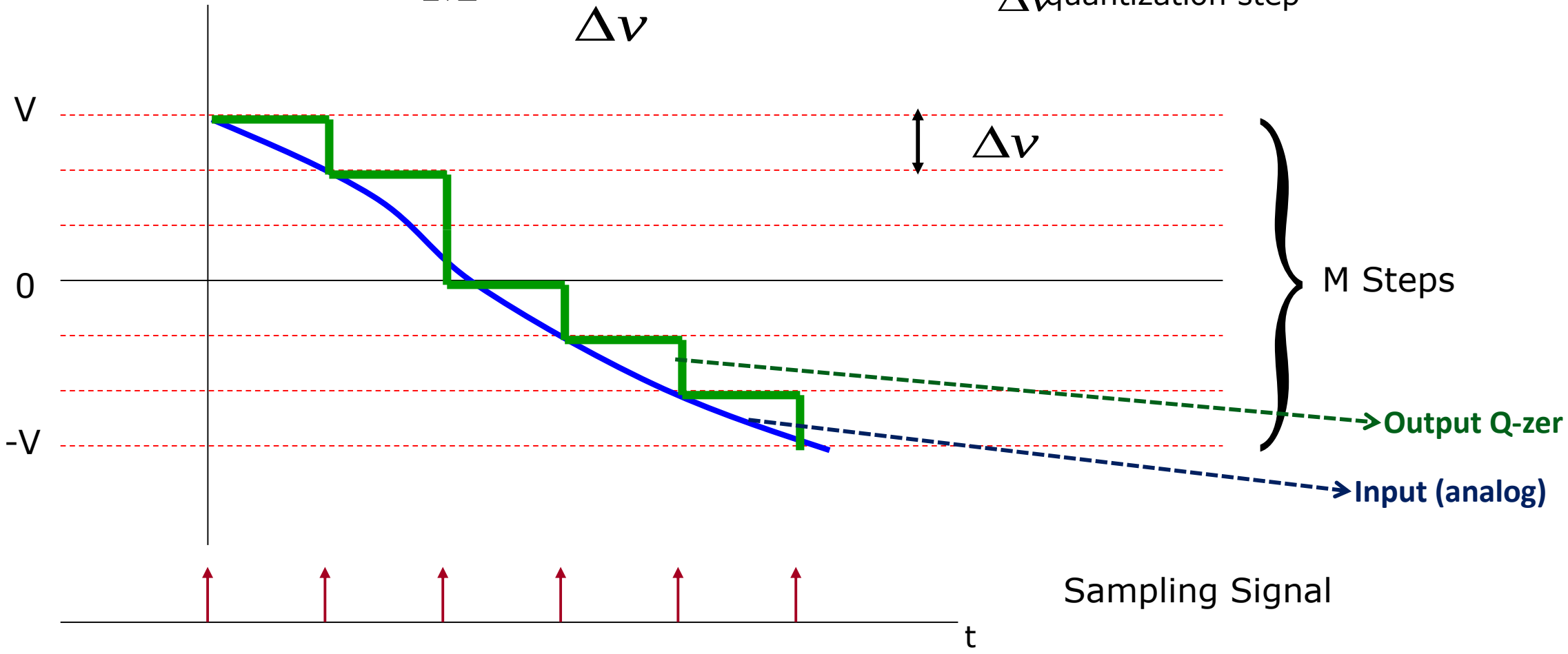
Kuantiser Non-Uniform (lebar selang kuantisasi tidak seragam)

Quantization

$$M = \frac{2V}{\Delta v}$$

Where M = no. of steps

Δv = quantization step



QUANTISER UNIFORM

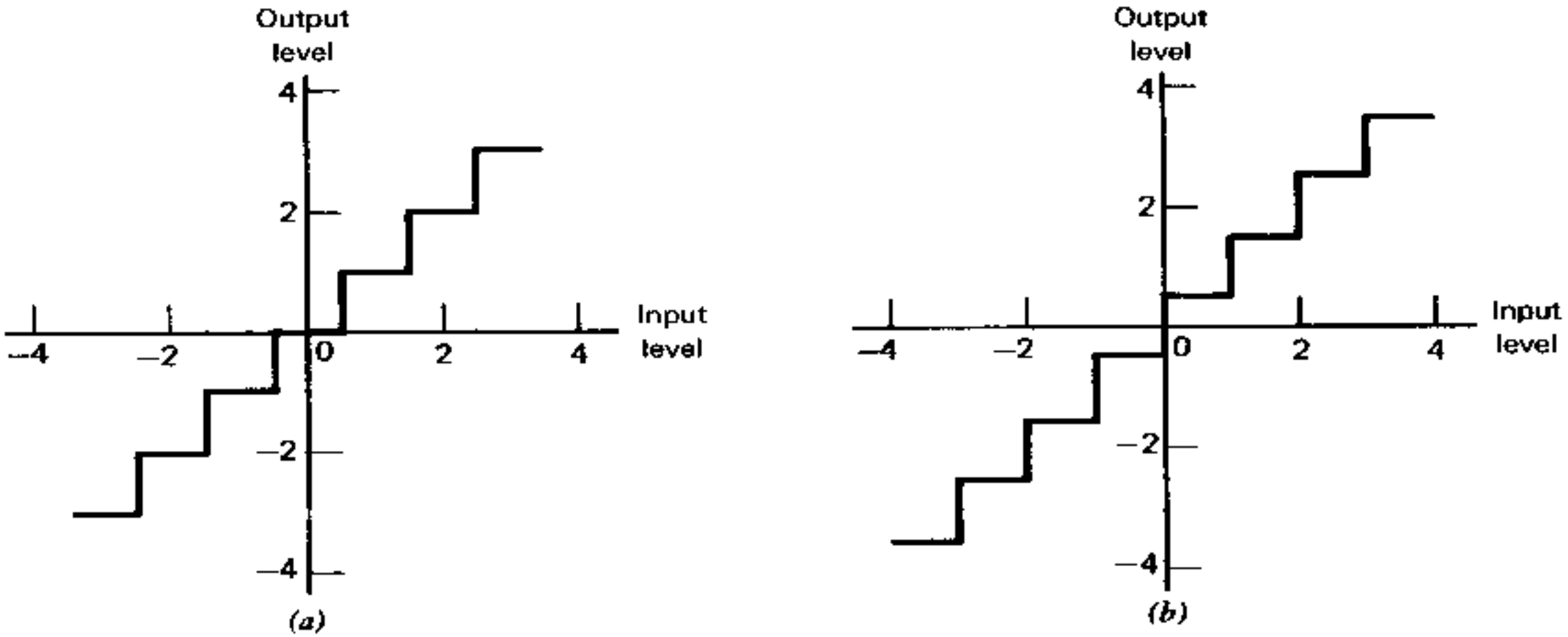
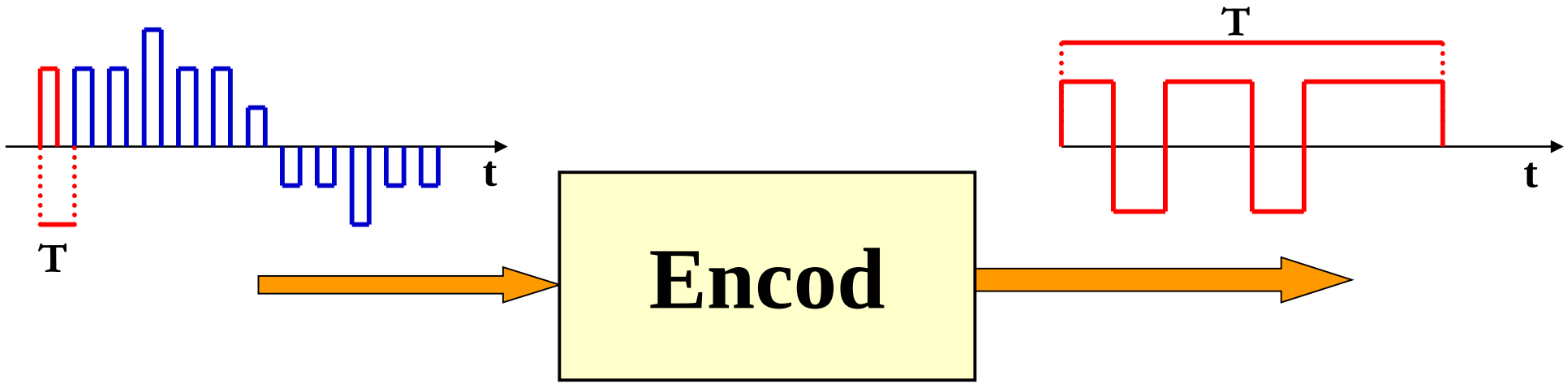


Figure 6.17 Two types of quantization: (*a*) midtread and (*b*) midrise.

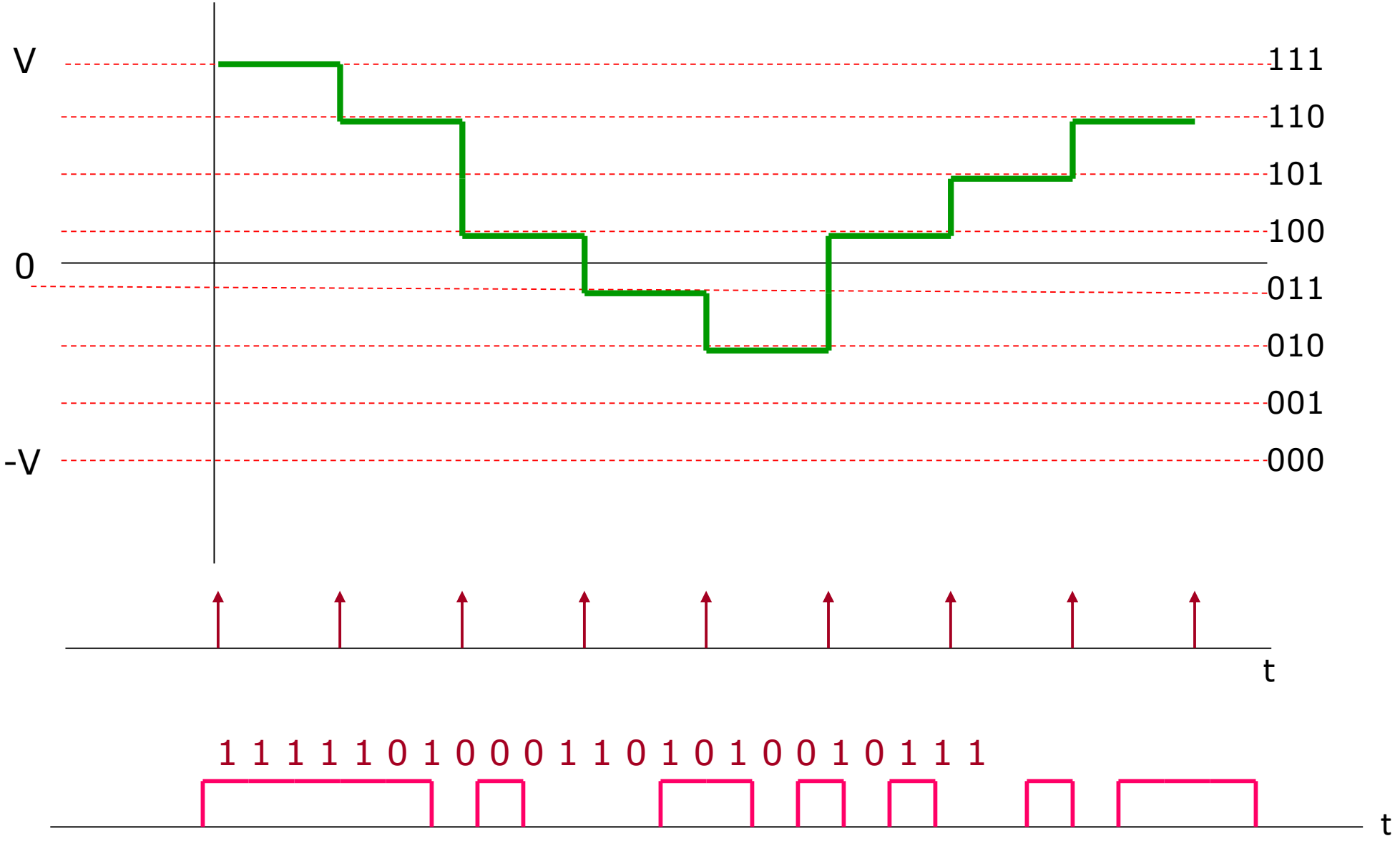
PROSES PENGKODEAN (ENCODING)



Contoh di atas menunjukkan proses encoding,
1 simbol masukan dikodekan menjadi 8 bit

Jumlah bit untuk mengkodekan tiap simbol ditentukan oleh perangkat ADC (Analog to Digital Converter)

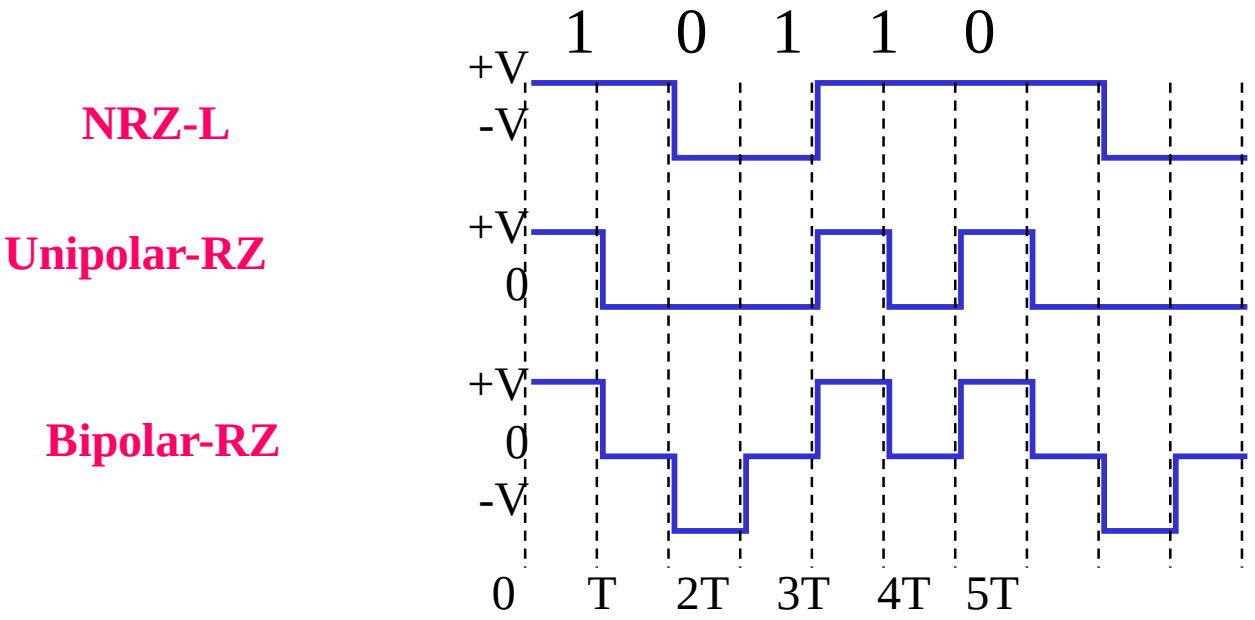
Encoding



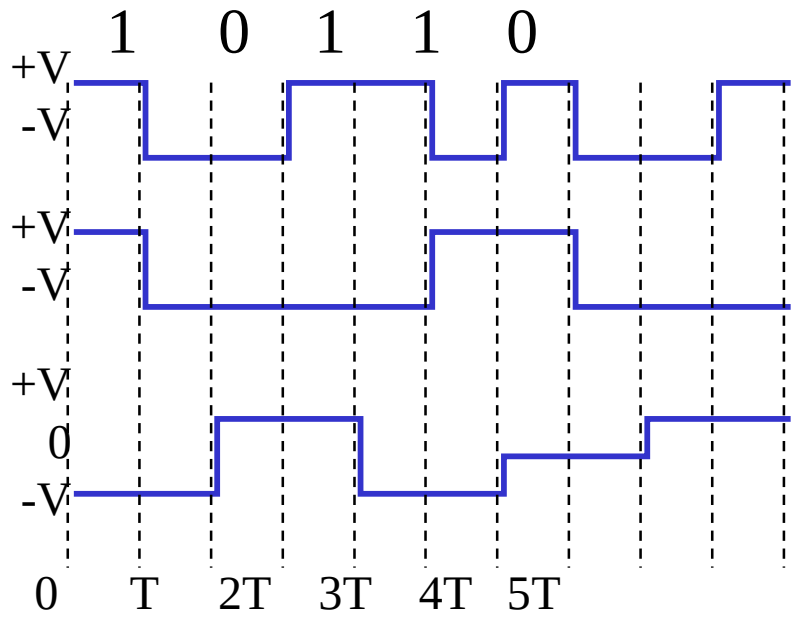
$$M = 2^N$$

Bentuk gelombang/sinyal PCM

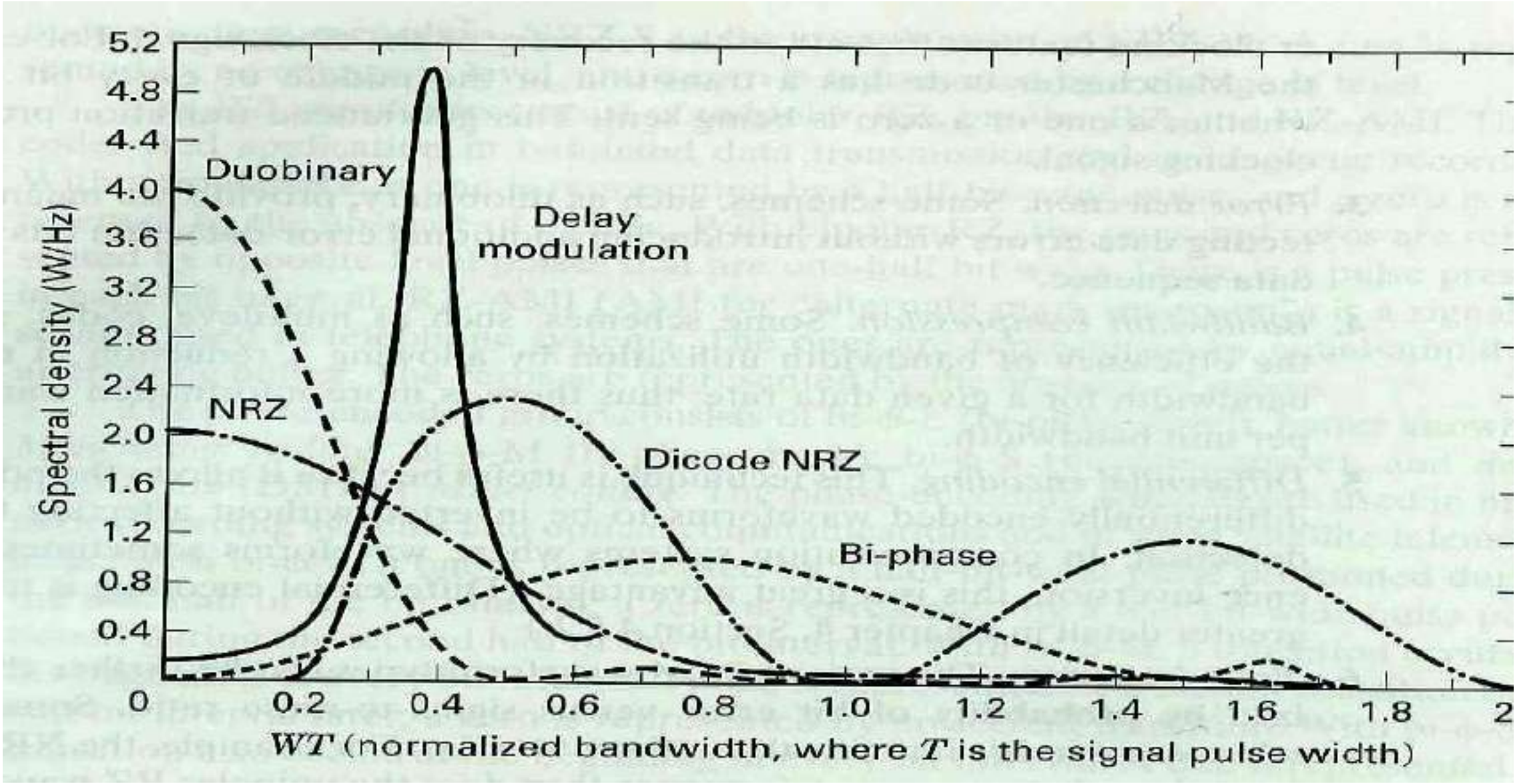
- NonReturn-to-Zero (NRZ)
- Return-to-Zero (RZ)



- Phase encoded
- Multilevel binary



Spectrum sinyal PCM



BIT RATE KANAL VOICE

Frekuensi sampling (f_s) > 2 . BW

> 2 . frekuensi informasi maksimum

(berdasarkan kriteria Nyquist)

BW kanal suara ~ 4 kHz (300 – 3400 Hz)

Kecepatan sampling untuk tiap kanal suara = 2 x 4000 = 8000 sample/s

1 sample dikodekan menjadi 8 bit

Bit rate 1 kanal voice :

$$BR = 8000 \text{ sample/detik} \times 8 \text{ bit/sample}$$
$$= 64 \text{ kbps}$$

Quantization Error

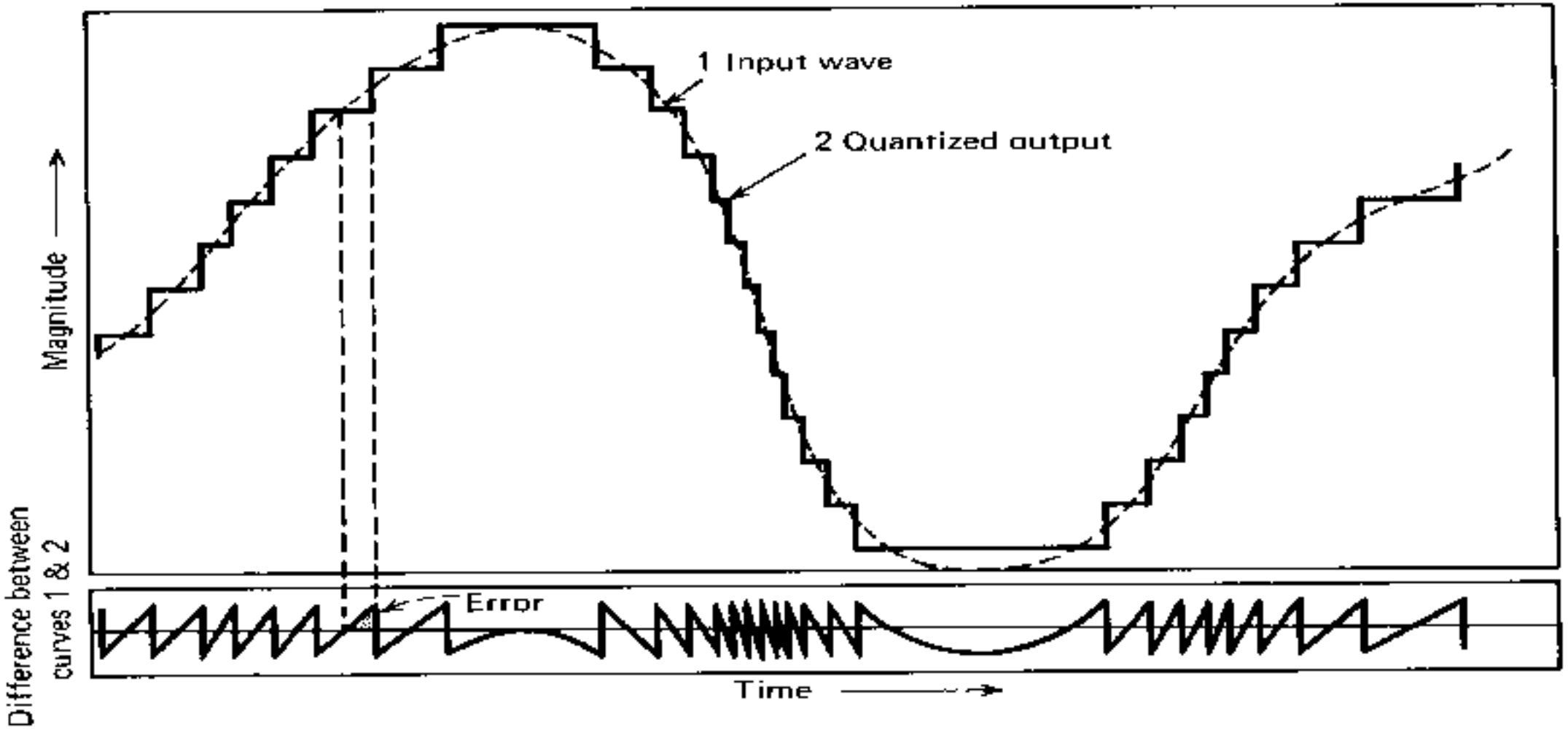
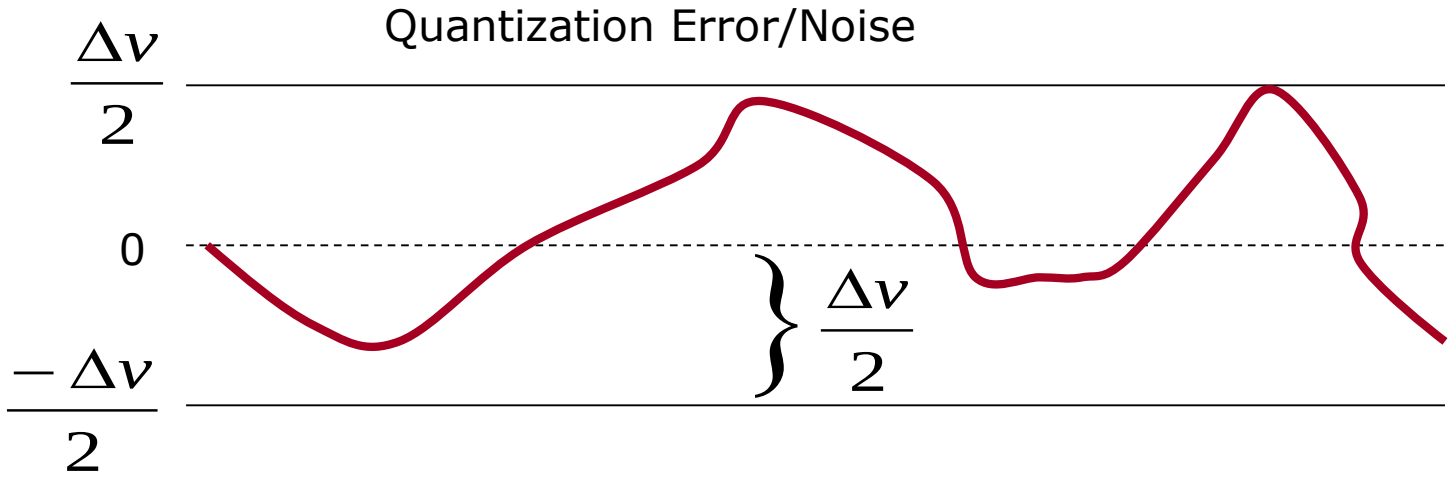
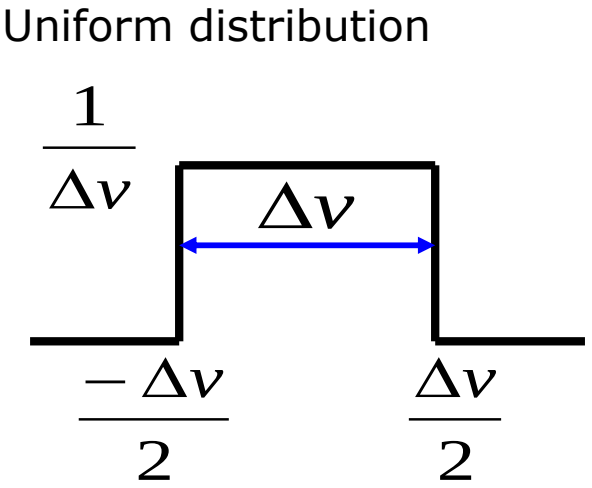


Figure 6.18 Illustration of the quantization process. (Adapted from Bennett, 1948, with permission of AT&T.)

Quantization Error





$$e(t) = f(t) - f_Q(t)$$

$$\frac{-\Delta v}{2} \leq e(t) \leq \frac{\Delta v}{2}$$

Signal to Noise Ratio

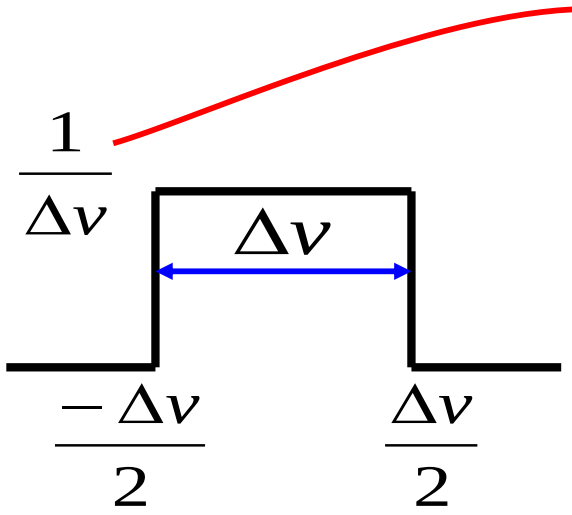
$$SNR|_Q = \frac{SignalPower}{ErrorSignalPower}$$

The average power

$$\overline{P} = \lim_{T\to\infty} \frac{1}{T} \int_{-\infty}^{\infty} f^2(t)dt$$

$$\overline{e^2}(t) = \frac{1}{T} \int_{-T/2}^{T/2} e^2(t)dt$$

Time average Noise



$$= \int_{-\infty}^{\infty} v^2 p(v)dv$$

Continuous Random Variable