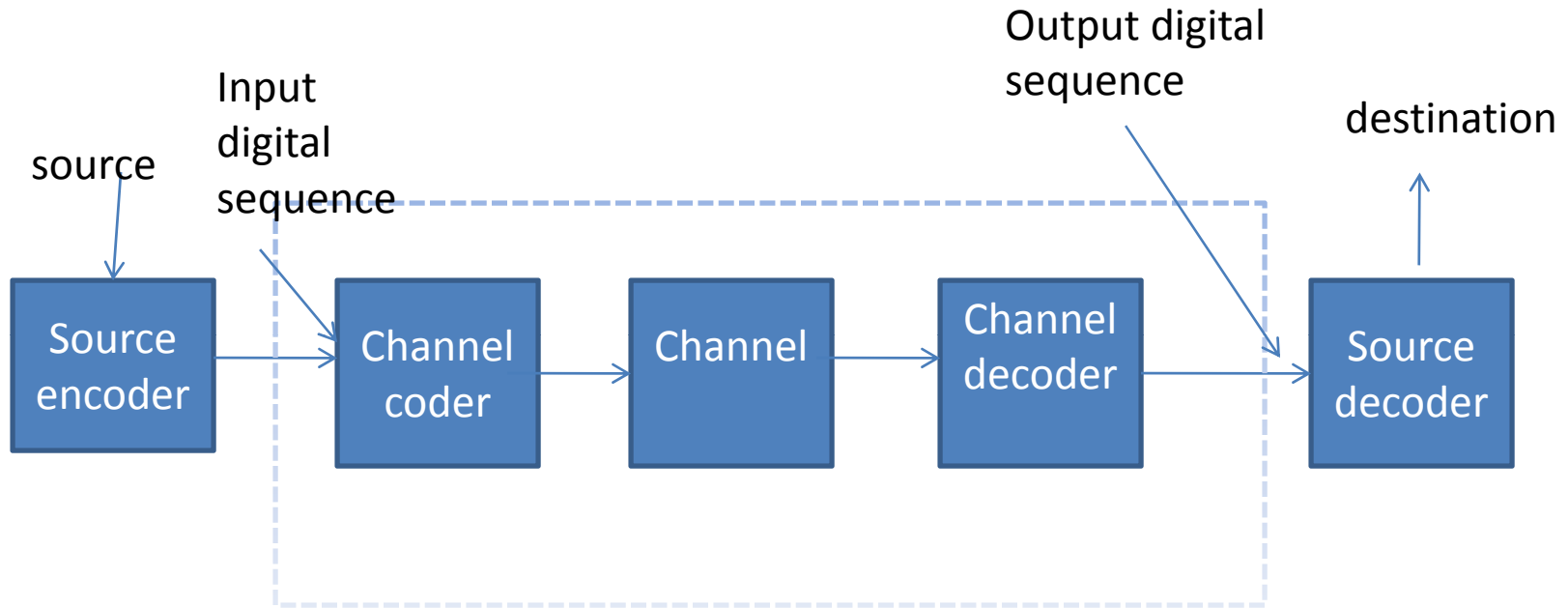


Advantage of digital communication

- Compatibility
- Flexibility
- Economy available
- Reliability
- Operational speed
- Miniaturization
- Operational and maintenance is simple

- Baud : unit of signaling speed
- represents the speed of the communication channel
- No of code elements per seconds

Elements of digital communication



Elements of digital communication system

- simplex
- Half duplex
- Full duplex
- 8000 samples /sec

Digital base band signal

- Digital base band signal are logically transmitted signal (logic ones and zero)
- Two level of voltages or current
- 0 or 1
- Simple to generate ,detect and use

- Let m_n denotes the message signal produced by the source during the n th interval $[nT, (n+1)T]$
- sequences of message to be send to the reciever is $(m_n) = \dots, m_{-1}, m_0, m_1, m_2, \dots$
- If source o/p in the n th interval is K , $m_n = K$
- transmitted signal $s_k(t - nT)$
- single wave form $V(t)$

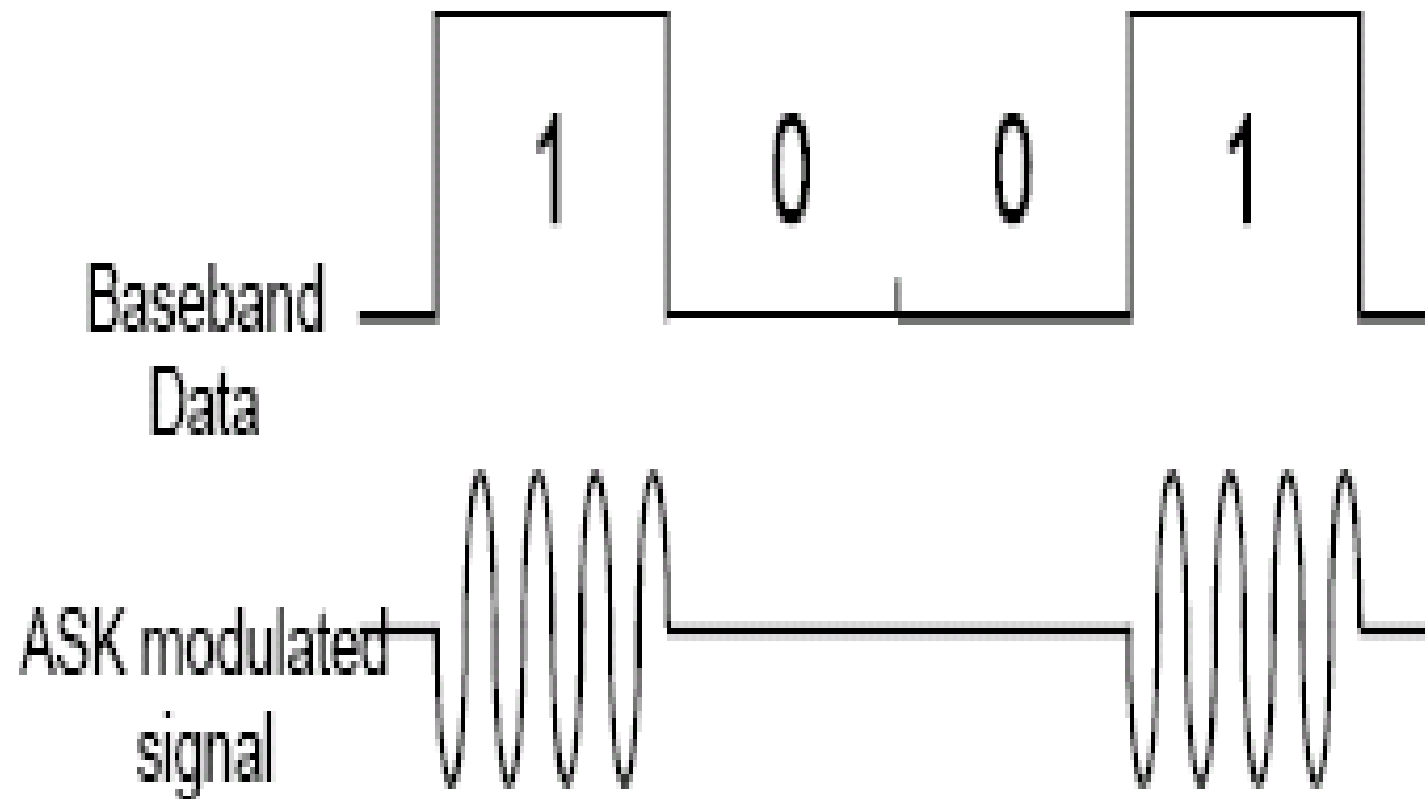
$$s(t) = \sum_{n=-\infty}^{\infty} A b_n v(t - nT)$$

b_n is represented by message sequence of data variables

Digital modulation technique

- Amplitude shift keying(ASK)
- Phase shift keying
- QPSK
- BPSK

Amplitude Shift Keying (ASK)



$$e = E_c \sin(\omega_c t + \phi)$$

then

$$s(t) = a(t) \cdot E_c \sin(\omega_c t + \phi)$$

BAND WIDTH OF THIS TYPE OF SYSTEM IS
TWICE THE HIGHEST FREQUENCY
PRESENT

QUADRATURE ASK

- Two wave form out of phase of 90 degree
- Each of the two component of the signal is an ASK signal with pulse duration T_s

$$s(t) = a_1(t)E_c \sin(\omega_c t + \phi) + a_2(t)E_c \cos(\omega_c t + \phi)$$

PHASE SHIFT KEYING

180Degree phase shift and zero phase shift

Band width is $2fb$

Transmitted wave is a sinusoidal is of amplitude A

Power $P_s = 1/2 A^2$

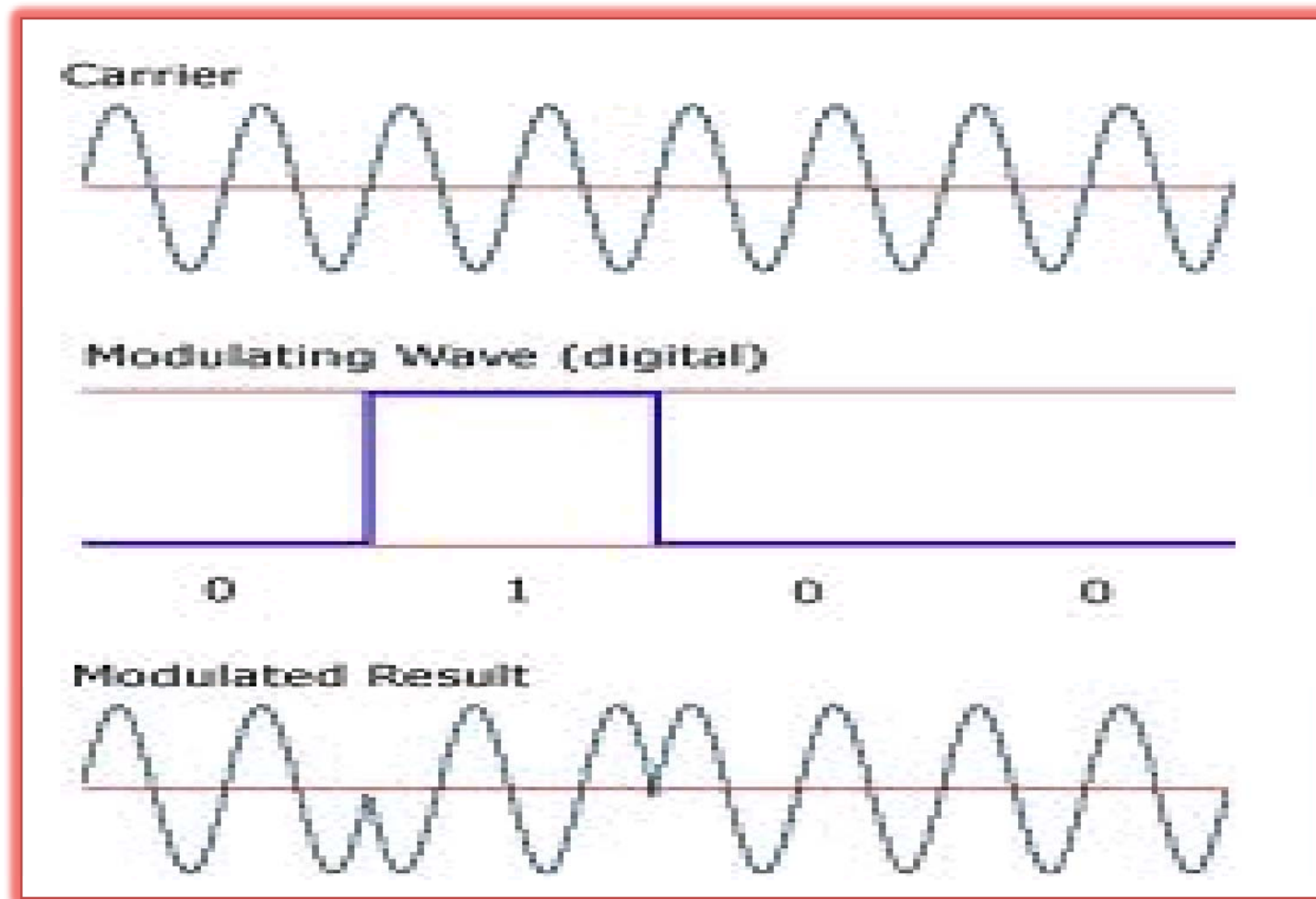
$A = \sqrt{2P_s}$

$S_b^{\text{peak}} = \sqrt{2P_s} \cos(\omega ct)$

$S_b^{\text{peak}} = \sqrt{2P_s} \cos(\omega ct + \pi) = -\sqrt{2P_s} \cos(\omega ct)$

$= b \cos(\omega ct)$

BINARY PHASE SHIFT KEY



System Digital Link Design

- Energy per bit to noise density
- E_b/N_0 is dimensionless
- Figure of merit is bit error rate—bit error probability (BER = SNR)
- Bit error --thermal noise ,external interference, inter-symbolic interference
- In case only thermal noise symbol error rate or symbol error probability is considered

- Energy per symbol / N_0 is measured in the IF bandwidth at the demodulator input
- Higher the value of E_s/N_0 , the lower is SER

- Suppose that during one symbol interval T_b
- Transmitter has the power C watt
- If energy received is E_b
- $E_b = P_t T_b$
- Where, $T_b = 1 / f_b$
- $E_b = P_t / f_b \dots\dots\dots(1)$
- $f_b =$ symbol rate in symbol / sec
- Noise density $N_0 =$ received power N /IF band width B (at demodulator input)
- $N_0 = N / B \dots\dots\dots(2)$
- For Equation 1 & 2 -
- $C/N = (E_b / N_0) (f_b / B)$

- $C/N = (E_b/N_0)(f_b/B)$
- E_b represents the bit energy & f_b represents the bit rate
- Power limited region
- Band limited region
- E_s/N_0 --- ideal error bit performance of various digital modulation scheme

Modulation technique	Idea bit error performance
MSK,BPSK/QPSK	$P = \frac{1}{2} \text{erfc}\sqrt{E_b/N_0}$
DPSK	$P = \frac{1}{2} \exp(-E_b/2N_0)$

TDM

- $T_p < (T_s/M) - \Delta t = 1/2Mf_m - \Delta t$
- T1 24 –channel system
- $1+8*24=193$
- 193 bits ---125 μ s