## Topologies:

1) Mesh topology -

no. of ports $= n(n-1)$

no. of cables $= \frac{n(n-1)}{2}$

2) Star topology -

no. of ports $= n$

no. of cables $= n$

3) Bus topology -

no. of cables $= 1$ & $n$ (drop lines)

## Data Communication (theoretical)

1) Fourier analysis -

$$g(t) = \frac{1}{2}c + \sum_{n=1}^{\infty} a_n \sin(2\pi n f t) + \sum_{n=1}^{\infty} b_n \cos(2\pi n f t)$$

$$a_n = \frac{2}{T}\int_0^T g(t) \sin(2\pi n f t)\, dt$$

$$b_n = \frac{2}{T}\int_0^T g(t) \cos(2\pi n f t)\, dt$$

$$c = \frac{2}{T}\int_0^T g(t) . dt$$

2) Bandwidth limited signals -

$$ms = \sqrt{a_n^2 + b_n^2}$$

3) Maximum data rate -

Nyquist $\Rightarrow 2H \log_2 V$ bits/sec

Shannon $\Rightarrow B \log_2 (1 + S/N)$

$$\text{Attenuation} = \frac{\text{transmitted}}{\text{received}}$$

## Electromagnetic spectrum:

$$\Delta f = \frac{c\,\Delta\lambda}{\lambda^2}$$

Higher the bandwidth $\Rightarrow$ higher the data rate

$$\frac{\Delta f}{f} \ll 1$$

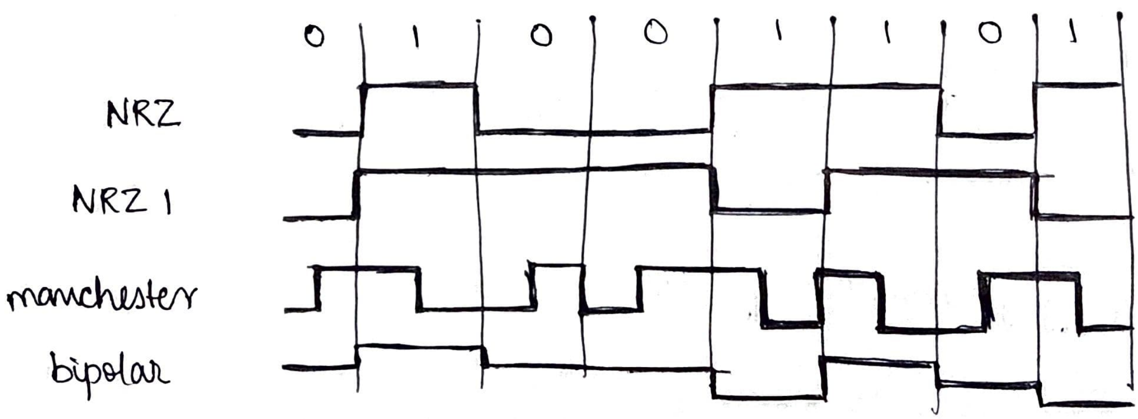
## Modulation & Demodulation:

Baud rate = samples / sec $\Rightarrow$ Baud rate = symbol rate

$$\text{Bit rate} = \frac{\text{symbol}}{\text{sec}} \times \frac{\text{bits}}{\text{symbol}}$$

## Baseband modulation:

Bit stream = 01001101




## Constellation diagrams:

1) QPSK — phase change by 45°
2) QAM-16 — 4 phases changed
   4 bits, 16 symbols
3) QAM-64 — 16 phase change
   6 bits, 64 symbols

Net Attenuation loss = $10 \log_{10} (P_2 / P_1)$ $P_2$ – output power

$$SNR = \frac{\text{avg signal power}}{\text{avg noise power}}$$

Frame size = (no. of slots) × (character size + slot address)

$$\text{Frame duration} = \frac{1}{\text{frame rate}}$$

Framing :

Frame delimited by flag bytes –

| FLAG | Header | Payload Field | Trailer | FLAG |
|---|---|---|---|---|

A – FLAG – B ⇒ A – ESC – FLAG – B

A – ESC – B ⇒ A – ESC – ESC – B

A – ESC – FLAG – B ⇒ A – ESC – ESC – ESC – FLAG – B

A – ESC – ESC – B ⇒ A – ESC – ESC – ESC – ESC – B

If the total no. of bits in a transmittable unit is m+r, then r must be able to indicate at least m+r+1 different states.

$$\boxed{2^r \geq m+r+1}$$

Pure ALOHA :

$G \geq N$

$$Pr(k) = \frac{G^k e^{-G}}{k!} \Rightarrow S = Ge^{-2G}$$

channel utilisation = 18%

## Slotted ALOHA :

$P_0 = e^{-G}$
$S = Ge^{-G}$ } channel utilisation = 37%.
empty slots = 37% & collision = 26%

Transmission time >= 2 * propagation time

p-persistent : $q = 1 - p$

Frame format for ethernet:

DIX ⇒

| 8 | 6 | 6 | 2 | 0–1500 | 0–46 | 4 |
|---|---|---|---|---|---|---|
| Preamble | destination add. | Source add. | Type | Data | Pad | checksum |

IEE 802.3 ⇒

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Preamble | SOF | destination add | source add | length | data | pad | checksum |

Ethernet performance :

1) $A = kp(1-p)^{k-1}$
A is maximum when $p = 1/k$ with $A \rightarrow 1/e$.

2) contention interval has j slots
$A(1-A)^{j-1}$

3) mean number of slot per contention is
$$\sum_{j=0}^{\infty} jA(1-A)^{j-1} = 1/A$$

each slot has duration of $2T$
mean contention interval is $W = 2T/A$.

4) channel efficiency $= \dfrac{P}{P + 2T/A}$

5) channel efficiency $= \dfrac{1}{1 + 2BLe/cF}$

frame length = F

bandwidth = B

cable length = L

speed of signal propagation = c

contention slot per frame = e