Previously

- OSI – Open Systems Interconnection – Refence Model Specification
- TCP/IP – Protocol Specification
- Critique – OSI vs. TCP/IP

Theoretical Basis

Fourier
Bandwidth
Data Rate

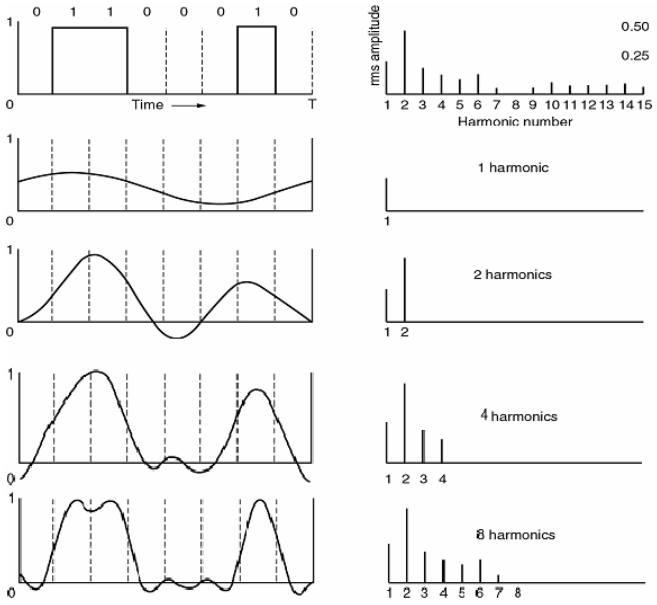
- Fourier Analysis
- Bandwidth-limited signals
- Maximum Data Rate

Fourier Analysis

- Sinusoids
  - Electromagnetic signals are _____
    _____
  - Any (Data) signal can therefore be represented as _____

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

Successive Approximation



Bandwidth limitations

- Power
  - Attenuation: _____
  - Distortion: _____
- Bandwidth
  - Quoted as the range of frequencies _____
  - Further restrictions imposed _____
- Telephone lines
  - Voice signal band-limited to _____
  - What's being lost? _____

Max Data Rate

- Nyquist's Formula: _____
  _____
- Complete Reconstruction
  - If a signal is band-limited (by _____)
  - Then it can be _____ from _____
    _____
  - Only applies to _____
  - Example: Telephone limited to _____
- $C = 2 H \log_2 V$
  - C _____
  - H _____
  - V _____

Shannon-Hartley's Law

- How many signal levels?
  - The more signal levels the _____ and the greater the susceptibility _____
- $C = H \log_2 (1 + S/N)$
  - C: _____
  - H: _____
  - S/N: _____
    - Generally expressed in _____
    - $S/NdB = 10 \text{ Log}_{10} (S/N)$

Question

- Given a voice-grade telephone line with a 20dB signal to noise ratio. What is max theoretical data rate and how many signal levels would be required to achieve this ?