Transmission Techniques

Info 341 Networking and
Distributed Applications

Basic Data Transmission Characteristics

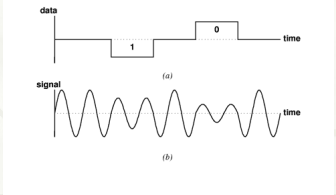
- Prior chapters/lectures mentioned
  - Analog signaling
    - Use analog wave forms to transmit data
  - Digital signaling
    - Use of discrete square waves for transmission
- How are these used?

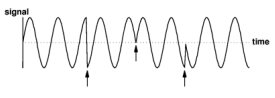
Carrier Transmission

- Long distance transmission uses a carrier
  - Carrier – oscillates at a known rate and amplitude
  - Data is encoded into the carrier wave through modulation of the carrier wave

Basic Carrier Encoding

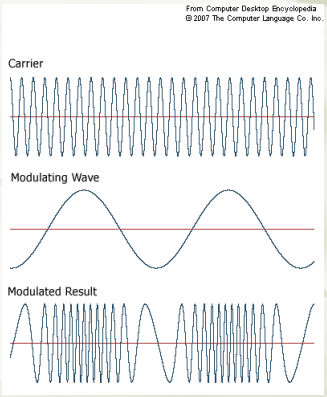
- Three common approaches
  - Frequency Modulation (FM)
  - Amplitude Modulation (AM)
  - Phase Shift





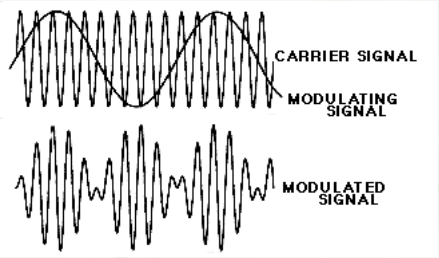
Frequency Modulation

- Frequency of the carrier wave is modulated



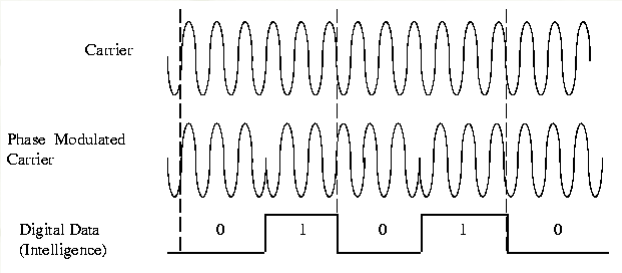
Amplitude Modulation

- Carrier amplitude is modulated



Phase Shift Modulation

- Phase shift determines values

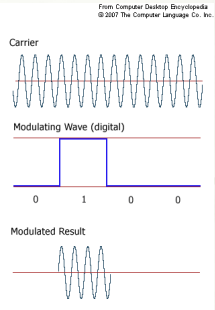


Shift Keying

- When the modulation is digital then the term Shift Keying is used instead of modulation
  - Amplitude Shift Keying (ASK)
  - Frequency Shift Keying (FSK)
  - Phase Shift Keying (PSK)

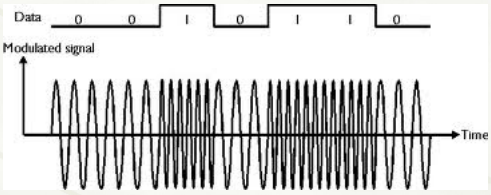
Amplitude Shift Keying

- Digital data directly modifies carrier



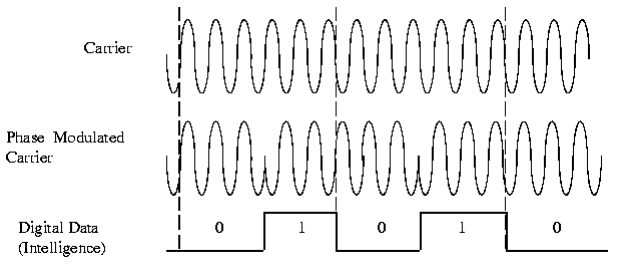
Frequency Shift Keying

- Digital data modifies carrier frequency



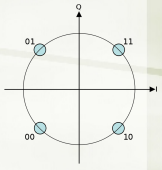
Phase Shift Keying

- You might remember this from earlier
  - Technically it was a 2-PSK encoding

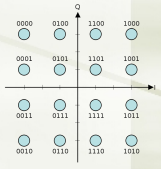


Multiple Encoding

- More phase shifts, more encoding
  - 4 PSK
  - Expressed on a constellation diagram



- Quadrature Amplitude Modulation (QAM)
  - 16-QAM uses both phase shifting and amplitude modulation



Modems

- Traditionally over phone lines
  - Use a limited range of frequencies
  - Baud rates kept increasing
  - V.32 9600 bps 32QAM
  - V.32bis 14,400 bps 128QAM

Multiplexing

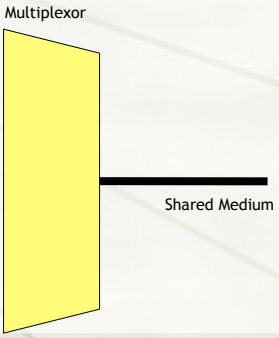
- Four important types
  - Frequency Division Multiplexing
    - Wavelength Division Multiplexing
  - Time Division Multiplexing
  - Code Division Multiplexing

Frequency Division

- Each frequency is a carrier frequency (or frequency range – a band)
  - Often allocate some space between bands
- Use one (or more) bands per sender/ receiver
  - What is the advantage of using more than one?

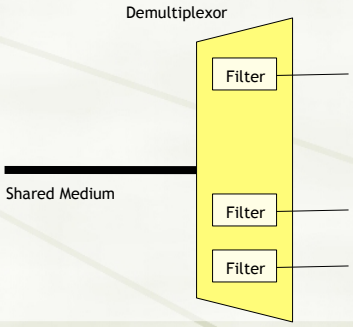
Multiplexor

- Multiplexor combines incoming frequencies



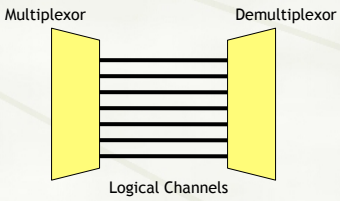
Demultiplexor

- Demultiplexor must separate the individual carrier frequencies (filters)



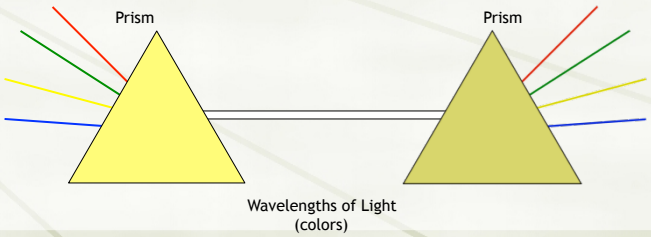
Frequency Division

- Logically each carrier is a separate channel – but all are on one shared medium



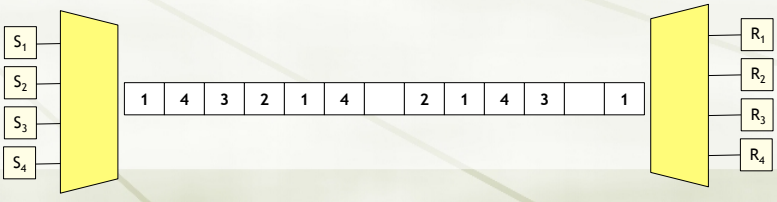
Wavelength Division

- Change medium to light (fiber optics)
- Change Mux/Demux to prisms



Time Division Multiplexing

- Add a clock, with regular ticks
- Allocate a specific time slot to each channel
- Strict round-robin allocation

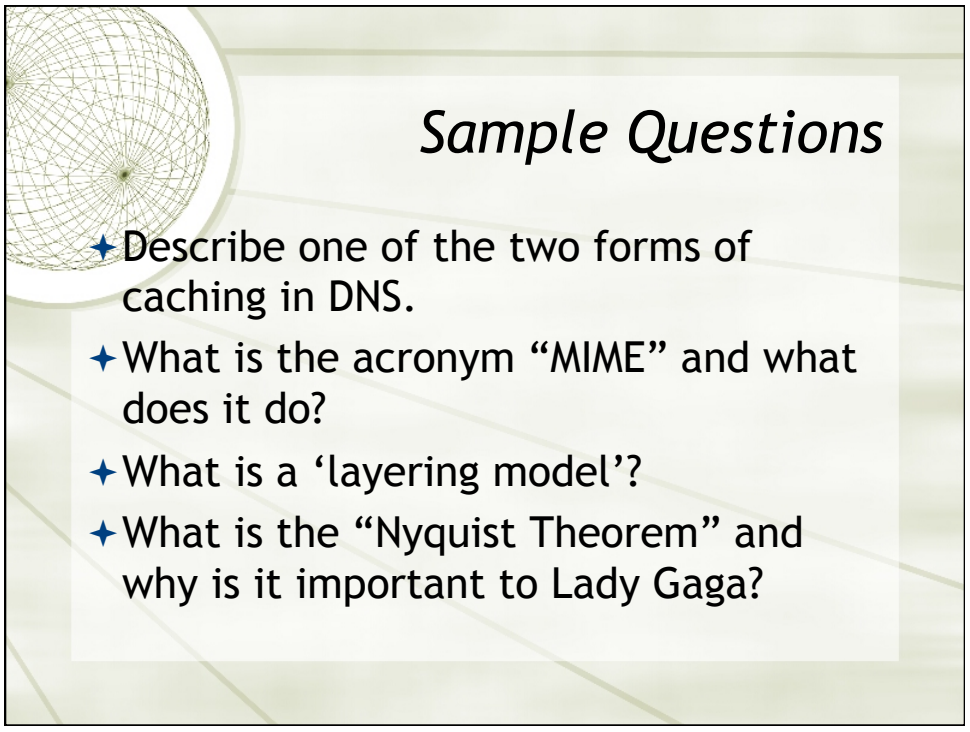


Time Division Multiplexing

- Bandwidth gets wasted when a sender has nothing to send
- Solution is Statistical TDM
  - In round-robin if sender has no data, pick next sender

Code Division Multiplexing

- Math (vector space) solution
- Each sender has a unique ID
  - ID is a vector, each and every vector/ID pair is orthogonal (dot product is zero)
- Senders can send data on the same channel and data can be recovered
- Extremely low latency for sending
- Large IDs computationally expensive


Sample Questions
Describe one of the two forms of caching in DNS.
What is the acronym “MIME” and what does it do?
What is a ‘layering model’?
What is the “Nyquist Theorem” and why is it important to Lady Gaga?