**Data Transmission**

**Media and Modes**

Info 341 Networking and Distributed Applications

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**Data Transmission Principles**

- Data transmission is governed by physics
  - The properties of the physical medium
  - Forms of physical media
  - Transmission characteristics
  - Data encoding
Media Types

- Wire
  - Coaxial Cable (Coax)
  - Unshielded Twisted Pair (UTP)
  - Shielded Twisted Pair (STP)
- Optical Fiber
- Radio
  - LEO (Satellite)
  - GEO (Satellite)
  - Cellular
  - WiFi

Media Type - Twisted Pair

- Unshielded Twisted Pair (UTP)
  - Like telephone wire
  - Each cable has four pairs of color coded wires
  - Each pair is twisted with a different number of twists per inch to help mitigate interference
  - Prone to interference (noise)
- Shielded Twisted Pair (STP)
Media Type - Twisted Pair

- UTP is standardized and graded to meet specific performance criteria.
  - Cat 3: Freq 16 Mhz (Ethernet 10 Mbps)
  - Cat 4: Freq 20 Mhz (Token Ring 16 Mbps)
  - Cat 5/5e: Freq 100 Mhz (Gigabit Ethernet 1000 Mbps)
  - Cat 6: Freq 250 Mhz (10 Gigabit Ethernet 10 Gbps - limited)
  - Cat 6a: Freq 500 Mhz (10 Gigabit Ethernet 10 Gbps)
  - Cat 7: Freq 600 Mhz - Shielded Twisted Pair (STP)

Media Type - UTP/STP Connectors

- A modular RJ45 sized connector
  - RJ = registered jack
  - Specifies which wires connect to which pins on the connector
  - Pin out is not actually an RJ45
**Media Type - Coaxial Cable**

- Coaxial Cable (Coax)
  - Copper wire, insulation, mesh wire shielding, insulating cover
  - High capacitance - propagates signals very well
  - Minimize interference (low noise)
  - Stiff hard to bend, bulky

**Media Type - Coaxial Connectors**

- BNC Connectors
  - bayonet Neill-Concelman Connector
  - Minimize signal reflection at the end of coax cable/joints
Media Type - Optical Fiber

- Construction similar to coax
  - Glass core, plastic buffer, kevlar cushion, plastic shield
  - Very high speed, very high capacity
- Connectors
  - Tons, some like BNC, others like RJ

Media Type - Radio

- Radio Spectrum
  - Allocation is a complex problem
  - FCC current strategy is to dedicate frequency range (bandwidth)
Media Type - Radio

- Radio

- LEO - Low Earth Orbit (Satellite)
  - Low orbit - lower latency for communication, need more satellites

- GEO - Geostationary Earth Orbit (Satellite)
  - High orbit - higher latency
  - need fewer satellites - as few as 3
Media Type - Radio

- Networking Spectrum
  - Unlicensed Spectrum
    - Wi-Fi 802.11 2400 MHz, 5000 MHz
  - Licensed Spectrum
    - Cellular Networks
      - US GSM: 824.0-849.0 MHz, 869.0-894.0 MHz
      - US GSM: 1850.0-1910.0 MHz, 1930.0-1990.0 MHz

Principle Transmission Modes

- Serial
  - One bit at a time
- Parallel
  - Multiple bits at a time
Example Transmission Modes

- Serial Connectors
  - USB (Universal Serial Bus)
  - SATA (Serial Advanced Technology Attachment)
- Parallel
  - ATA (AT Attachment), IDE, ATAPI, ATA-1, ATA-2

Serial Transmission - Order

- Which bit to send first?
  - Little-endian - sends the ‘smallest’ place value first (Least Significant Bit - LSB)
  - Big-endian - sends the ‘largest’ place value first (Most Significant Bit - MSB)
Types of Serial Transmission

- **Asynchronous**
  - Transmit at any time, arbitrary delay
  - Overhead of signaling bits (start/stop)

- **Synchronous**
  - Transmission is specifically timed
  - Overhead of “frame” and “idle” bytes

- **Isocronous**
  - Transmission at specified regular intervals

Transmission Overhead

- **Start/Stop bits**
  - Asynchronous transmission, signal start and stop of each chunk (byte)

- **Framing**
  - Synchronous transmission, define the boundaries of a block (set of bytes)
Transmission Connection Types

- **Simplex**
  - One transmission channel, one way only

- **Full Duplex**
  - Two transmission channels, one way each

- **Half-Duplex**
  - One shared transmission channel, bi-directional
QUIZ 1

+ Quiz 1 on Tuesday 10/11

  + (Comer) Chapter 1 Introduction and Overview
  + (Comer) Chapter 2 Internet Trends
  + (Comer) Chapter 4 Traditional Internet Applications
  + (Comer) Chapter 5 Overview of Data Communications
  + (Comer) Chapter 6 Information Sources and Signals
  + (Comer) Chapter 7 Transmission Media
  + (Comer) Chapter 9 Transmission Modes
  + That’s the material through today Thurs 10/6.