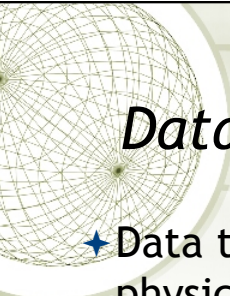


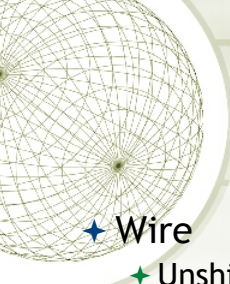
Data Transmission Media and Modes

Info 341 Networking and
Distributed Applications




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
 - ★ Unshielded Twisted Pair (UTP)
 - ★ Shielded Twisted Pair (STP)
 - ★ Coaxial Cable (Coax)
- ★ 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)

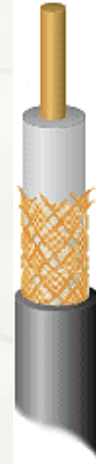
Media Type - UTP/STP Connectors

- ★ 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



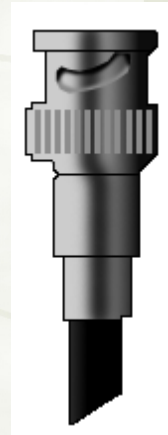
Media Type - Coaxial Cable

- ★ 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



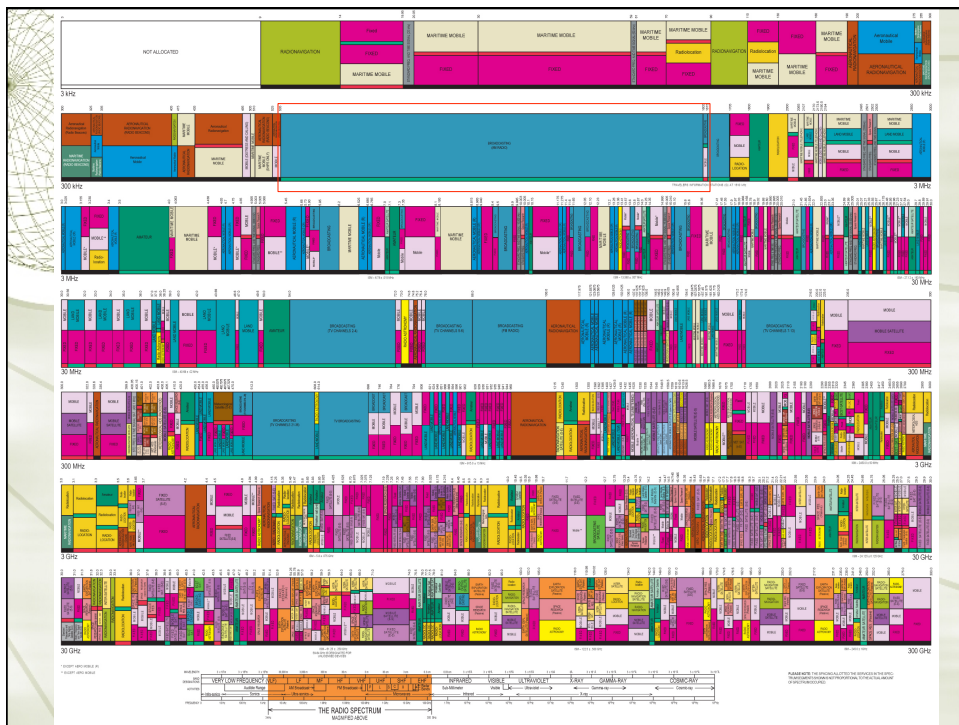
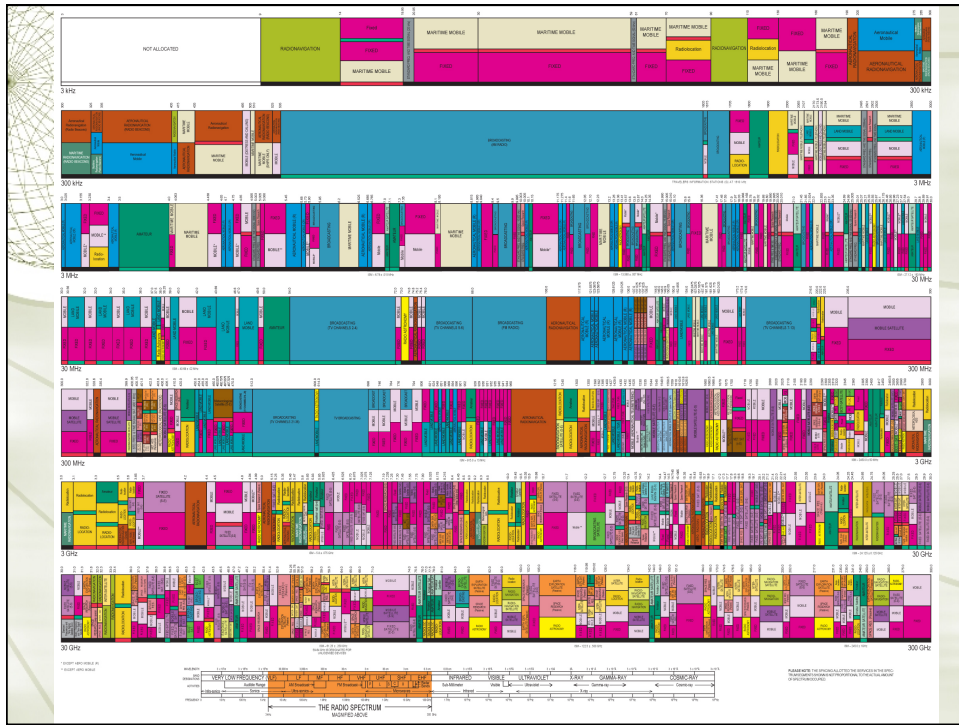
Media Type - Optical Fiber

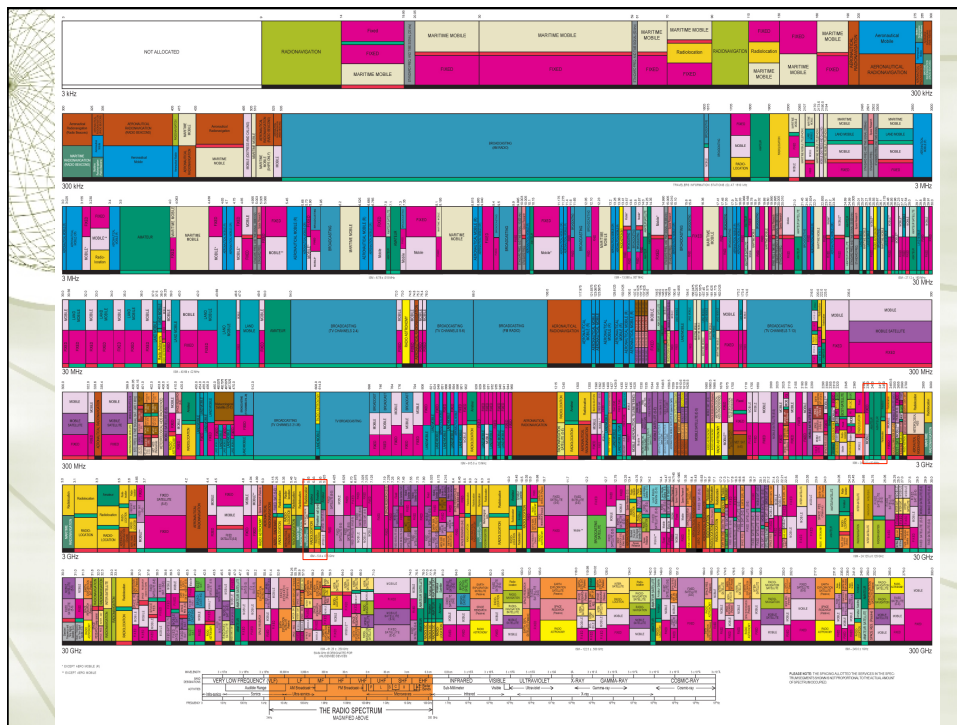
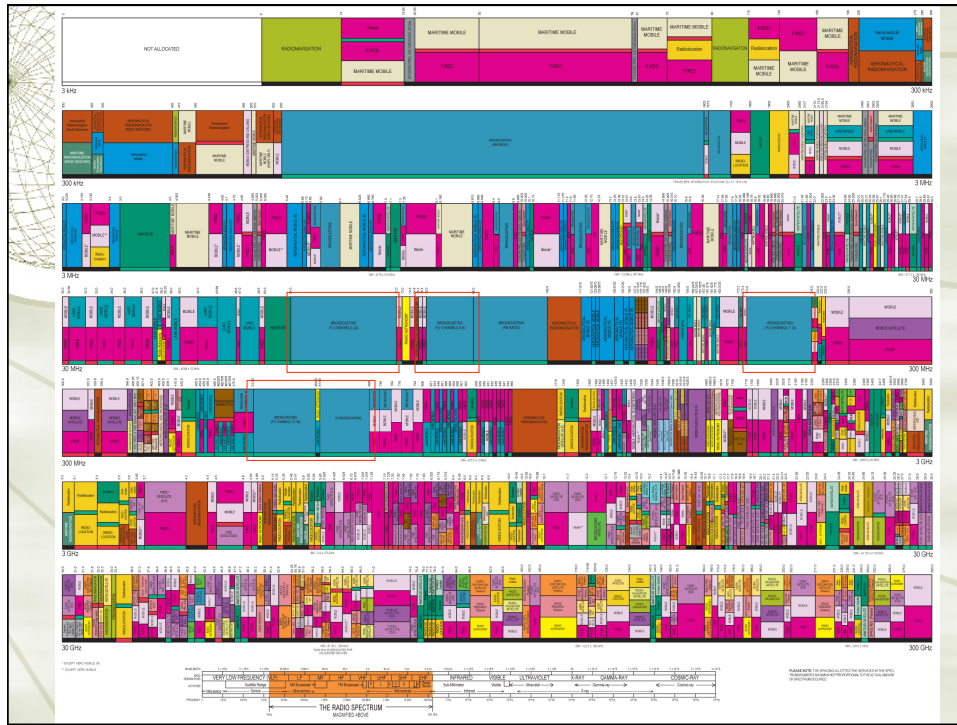
- ★ Construction similar to coax
 - ✦ Glass core, plastic buffer, kevlar cushion, plastic shield
 - ✦ Very high speed, very high capacity
- ★ Connectors
 - ✦ Tons, some like BNC, others like RJ

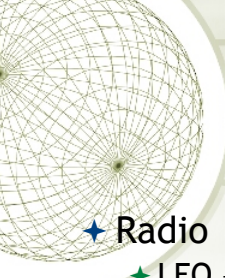


Media Type - Radio

- ★ 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
 - ✦ relatively high latency



Media Type - Radio

- ★ Networking Spectrum
 - ✦ Unlicensed Spectrum
 - ✦ WiFi 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

TRANSMISSION MODES

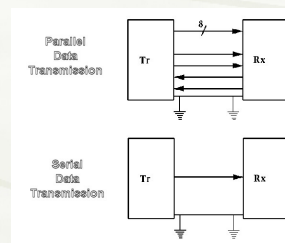
Principle Transmission Modes

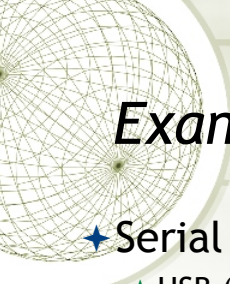
- ★ Serial

- ★ 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), EIDE, 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)



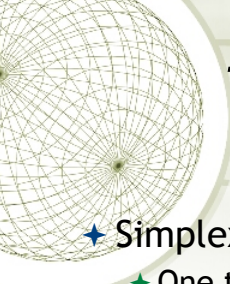
Types of Serial Transmission

- ★ 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

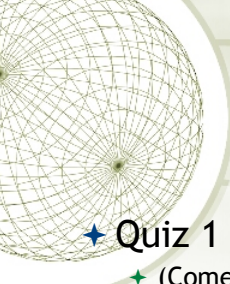
- ★ Start/Stop bits
 - ✦ Asynchronous transmission, signal start and stop of each chunk (byte)
- ★ Framing
 - ✦ Synchronous transmission, define the boundaries of a block (set of bytes)



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 Friday

- ★ (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



Demo Assignment 2