IS2111
Computer Networks

Physical Layer

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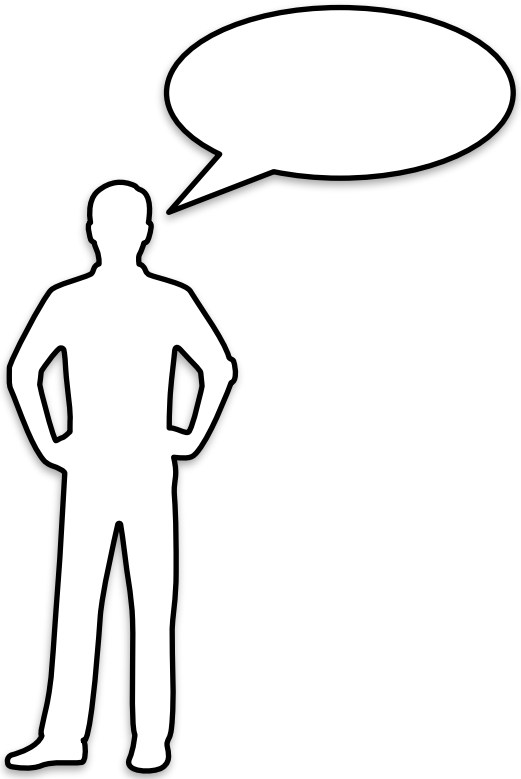
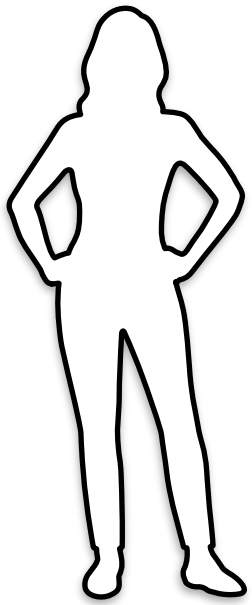
UNIVERSITY OF COLOMBO SCHOOL OF COMPUTING

Topic to be Covered

- Protocols
- Layered Model
- Physical Connection
- Cables
- Wireless media

Communication





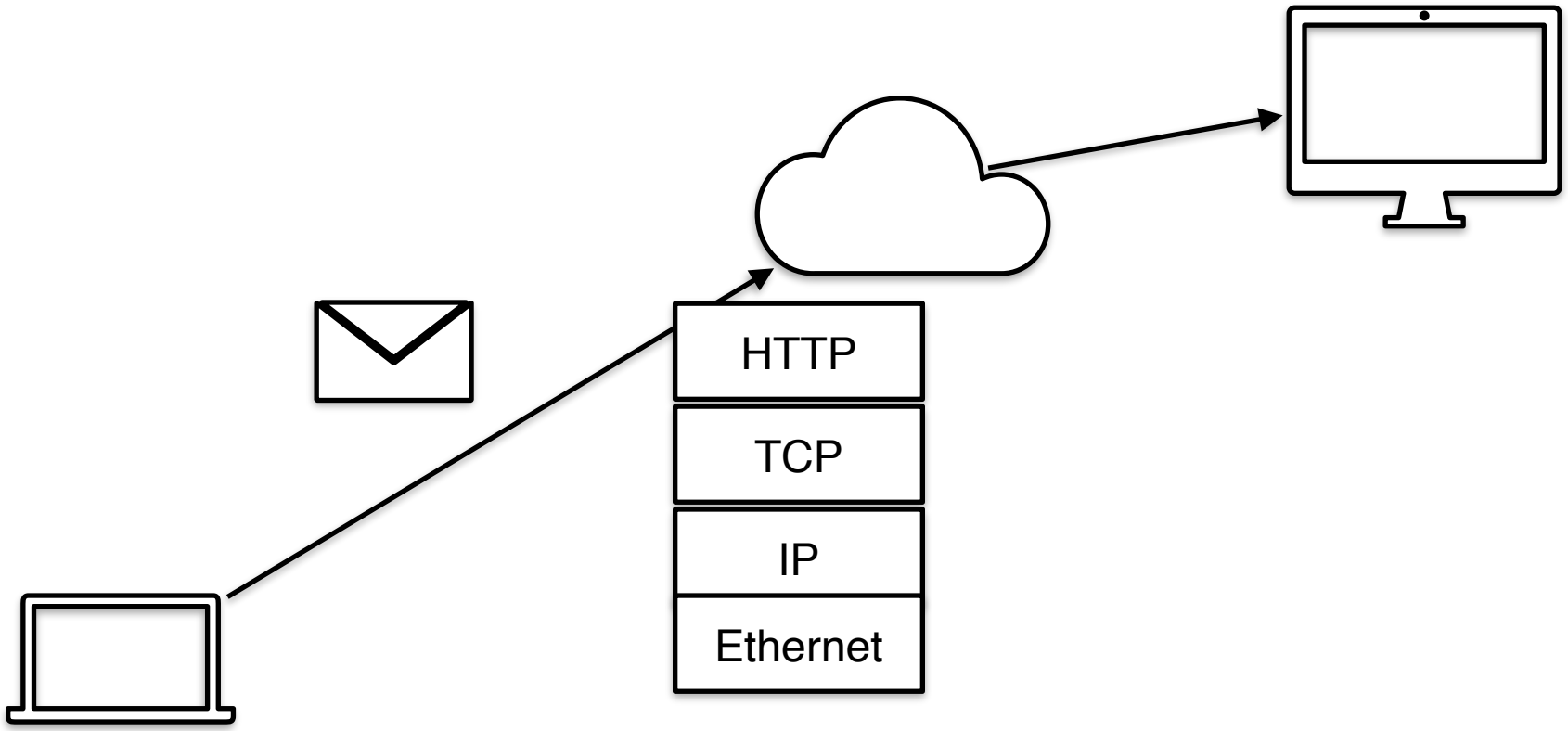
Protocols

- Protocols defines how the a message is transmitted over a network
  - Message encoding
  - Message encapsulation
  - Message size
  - Message timing (Flow control, Response time out, Access methods)
  - Message delivery methods (Unicast, multicast, broadcast)

Protocols Types

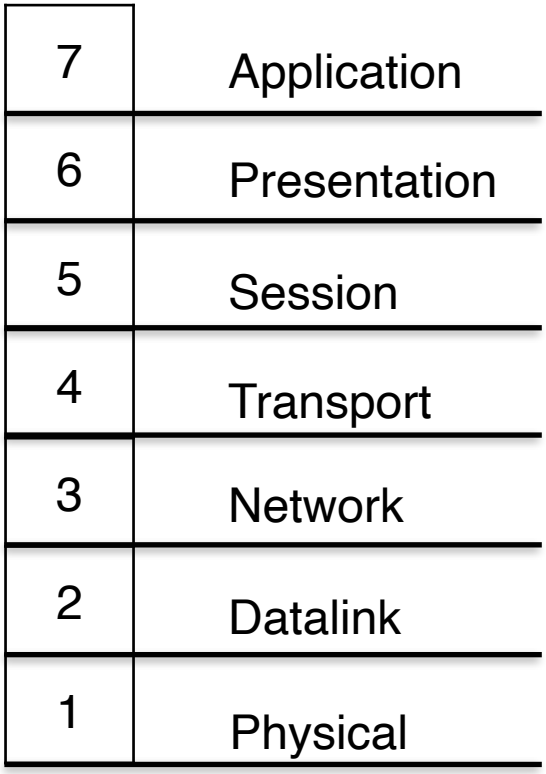
- Network Communication Protocols
- Network Security Protocols
- Routing Protocols
- Service Discovery Protocols

Protocols Interactions

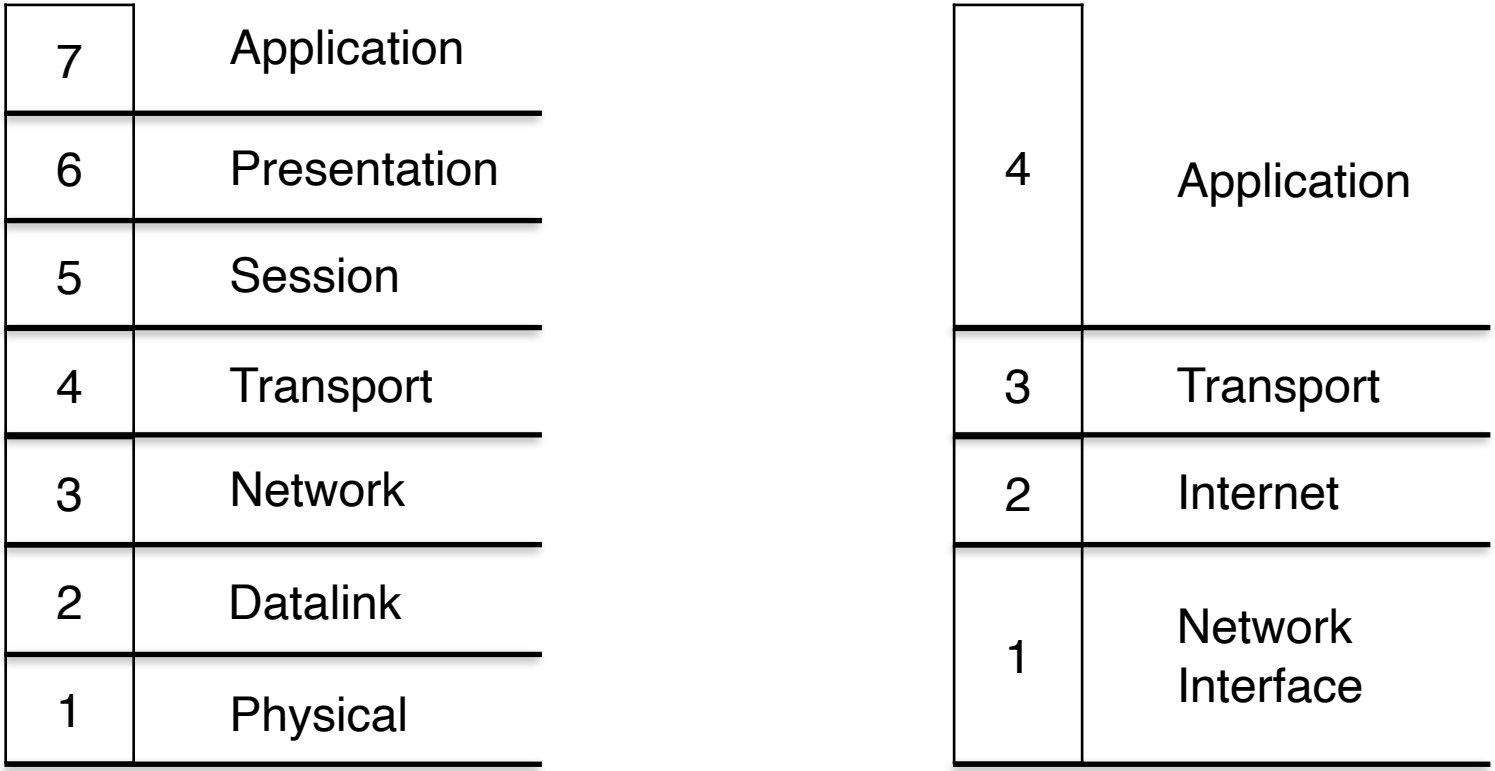


Layered Model

Protocol suites - OSI Layers



OSI Layers Vs TCP/IP

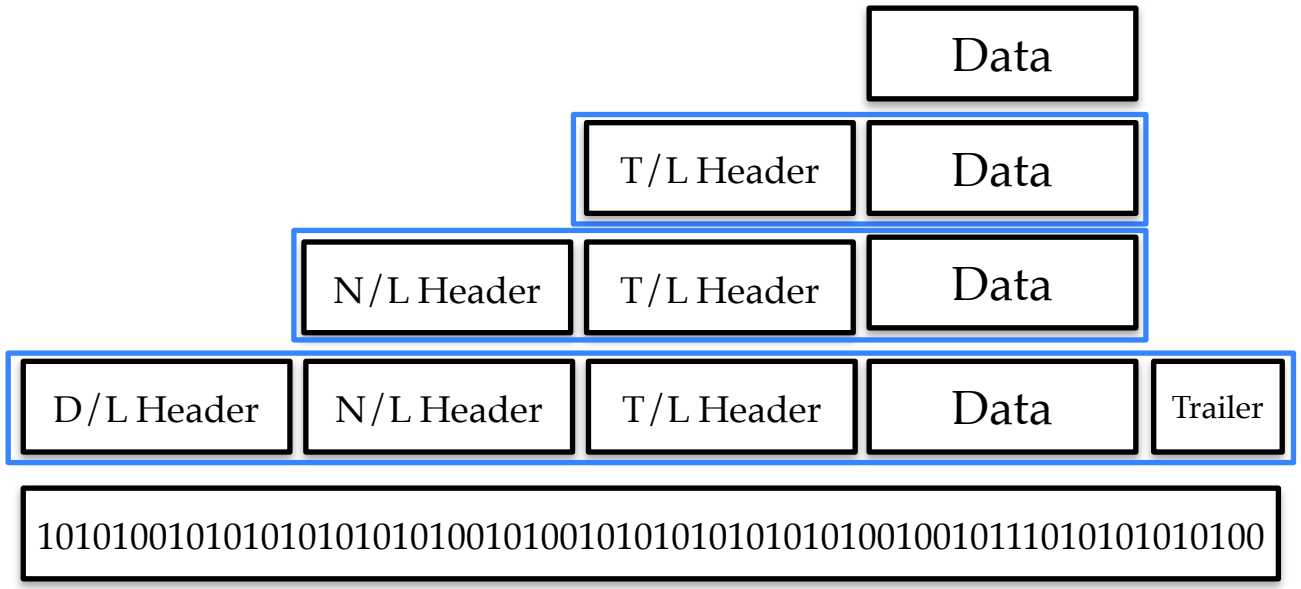


Data Encapsulation

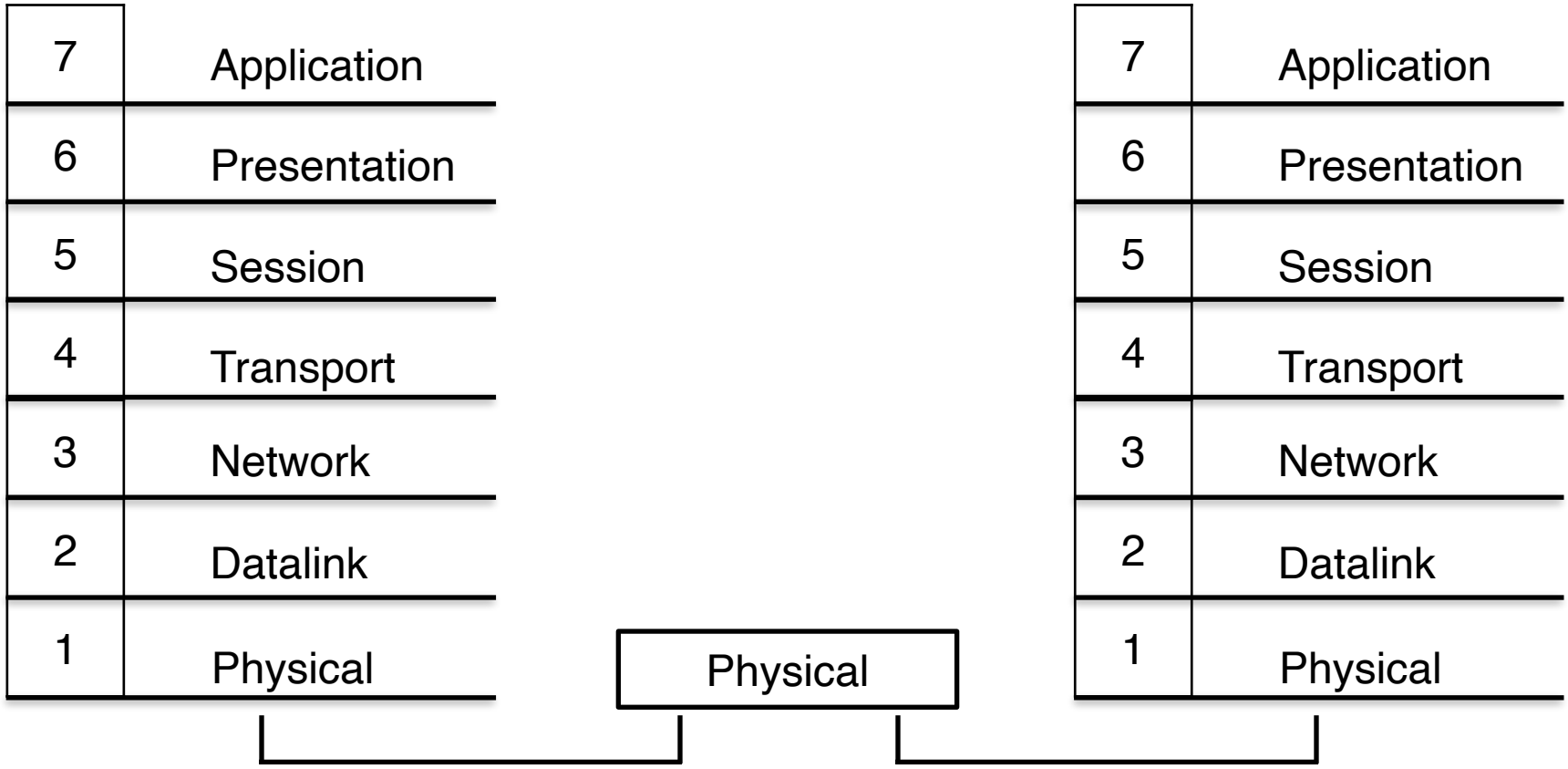
- Segmentation
- Sequencing

Protocol Data Units

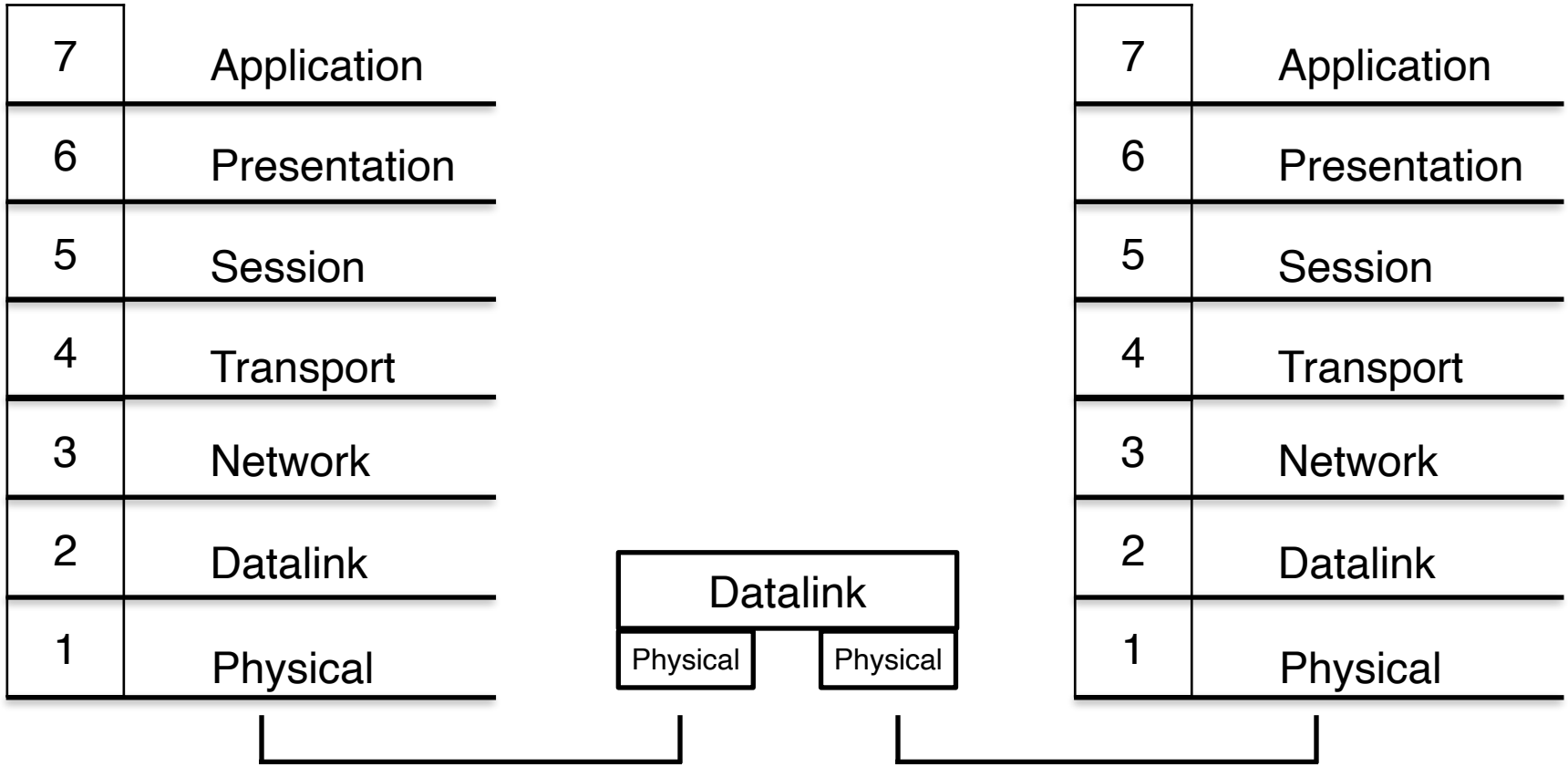
- Data
- Segment
- Packet
- Data frame
- Bits



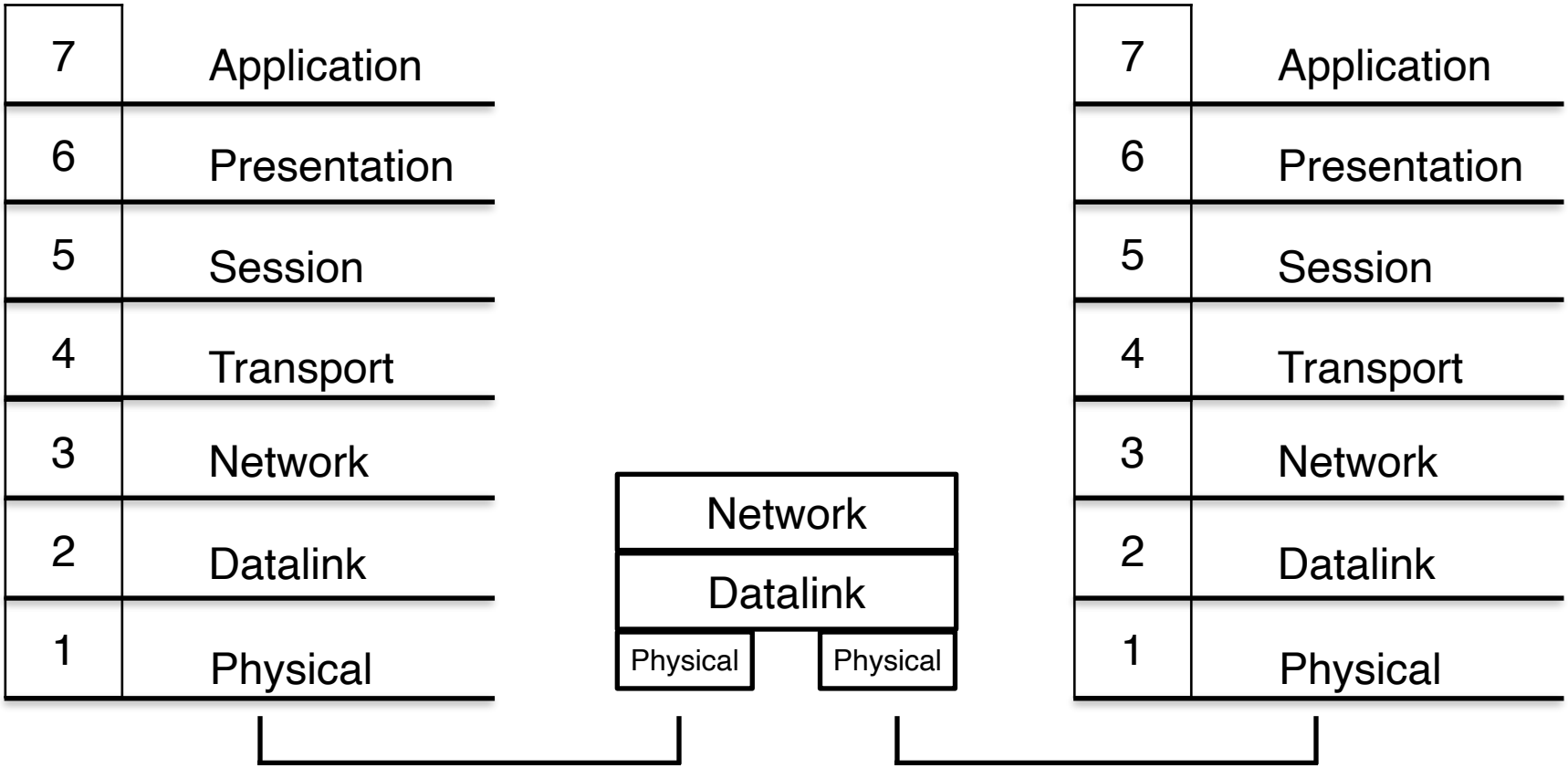
Network Devices with OSI layers



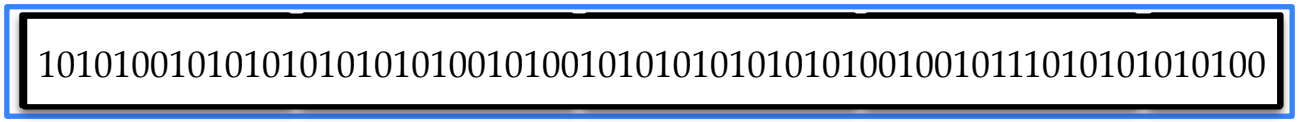
Network Devices with OSI layers



Network Devices with OSI layers



Physical Layer



Physical Connection

- Wired connection
- Wireless connection

Physical Connection

- Network Interface Card (NIC)

Image : https://www.deskdecode.com/lan-card-or-wifi-card-nic/

Physical Connection

- Network Interface Card (NIC)

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Physical Layer

- Standards
  - Why do we need standards?

- International Organization for Standardization (ISO)
- Institute of Electrical and Electronics Engineers (IEEE)

Encoding

- Pattern to represent digital information.

- Encoding mechanisms
  - Manchester encoding

Signals

- Electrical Signals
- Light signals
- Microwave signals

Bandwidth

- Transfer rate
  - Bits per second (bps)
  - Kilobits per second (kbps)
  - Megabits per second (Mbps)
  - Gigabits per second (Gbps)
- Latency
- Throughput

Cables

- Why copper cables,
  - Inexpensive
  - Easy to use
  - Low resistance

- Problems
  - Signal attenuation
  - Electromagnetic interference (EMI)
  - Crosstalk

- Solutions - Metallic shielding, Require proper grounding connections

Cables

- Unshielded twisted-pair (UTP)

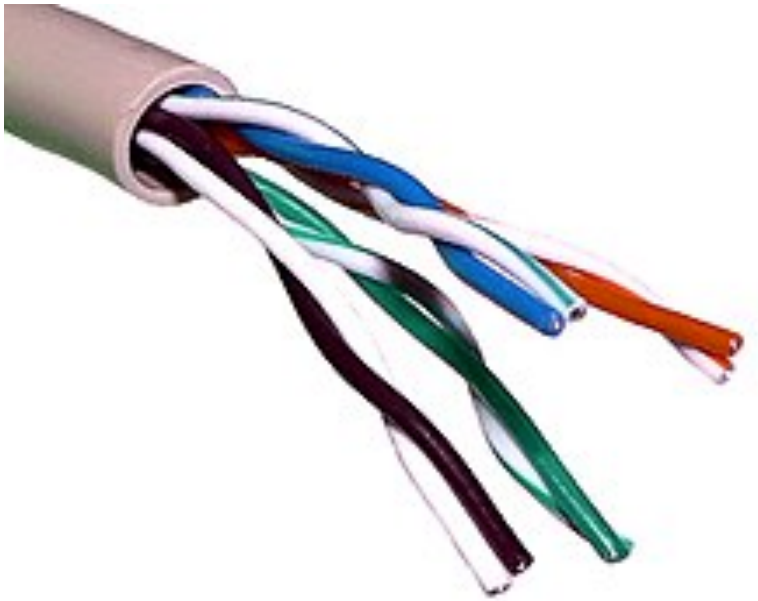


Image: https://en.wikipedia.org/wiki/Twisted_pair

Cables

- Unshielded twisted-pair (UTP)
  - Properties
    - Cancellation
    - Number of twists

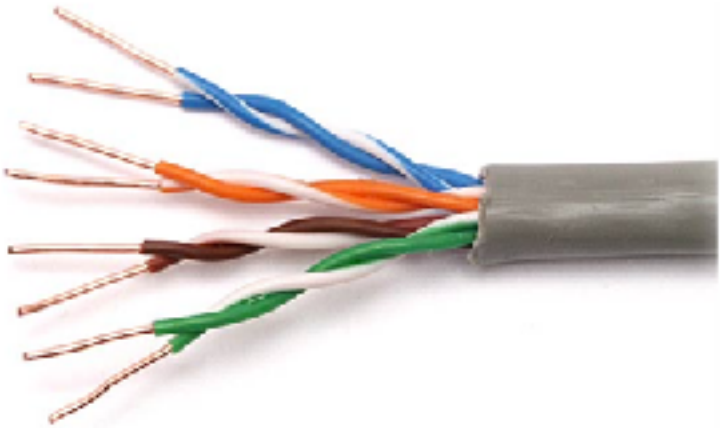
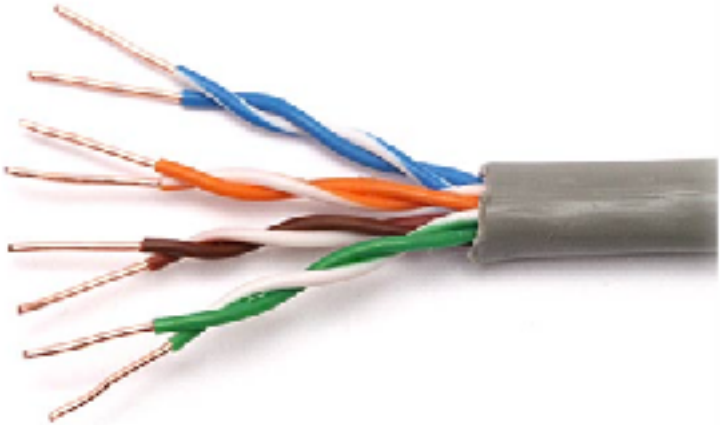


Image : https://www.indiamart.com/proddetail/d-link-cat-6-utp-cable-12706079648.html

Cables

- Unshielded twisted-pair (UTP)
  - Categories
    - Category 3 (10Mbps)
    - Category 5 (100Mbps - 1000 Mbps)
    - Category 6 (10 Gbps)
    - Category 7 (10 Gbps)
    - Category 8 (40 Gbps)



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Cables

- Unshielded twisted-pair (UTP)
  - RJ45

Image : https://www.indiamart.com/proddetail/amp-rj45-jack-connector-20977789430.html

Cables

- Unshielded twisted-pair (UTP)
  - Straight through
  - Crossover

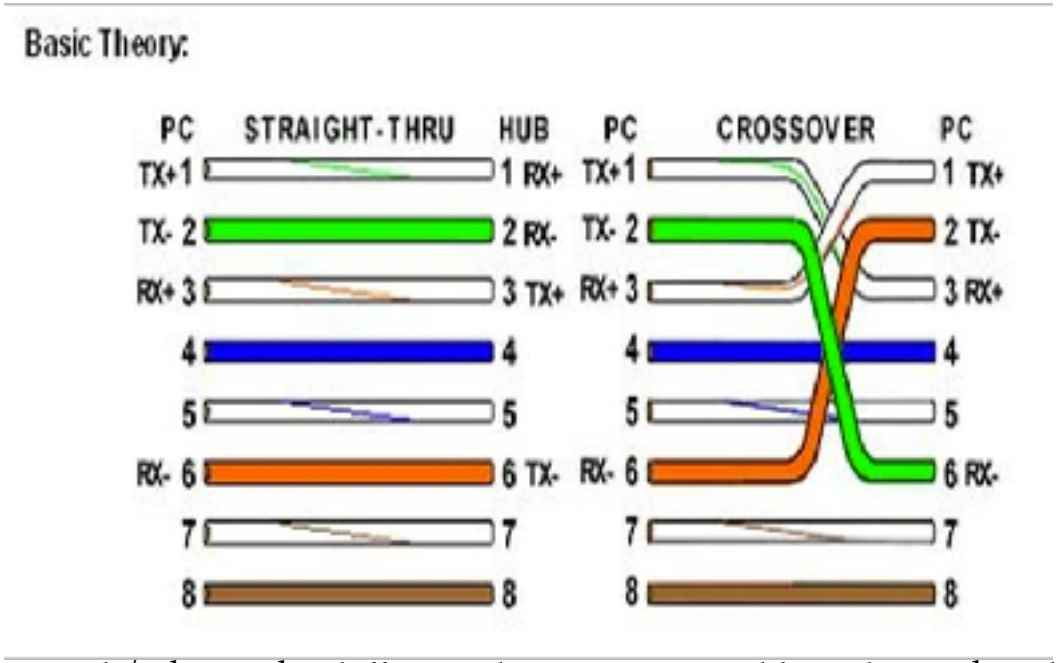


Image : https://sites.google.com/site/mullais/network/what-is-the-defference-between-cross-cable-and-straight-cable

Cables

- Shielded twisted-pair (STP)

Image: https://en.wikipedia.org/wiki/Twisted_pair

Cables

- Coaxial cable

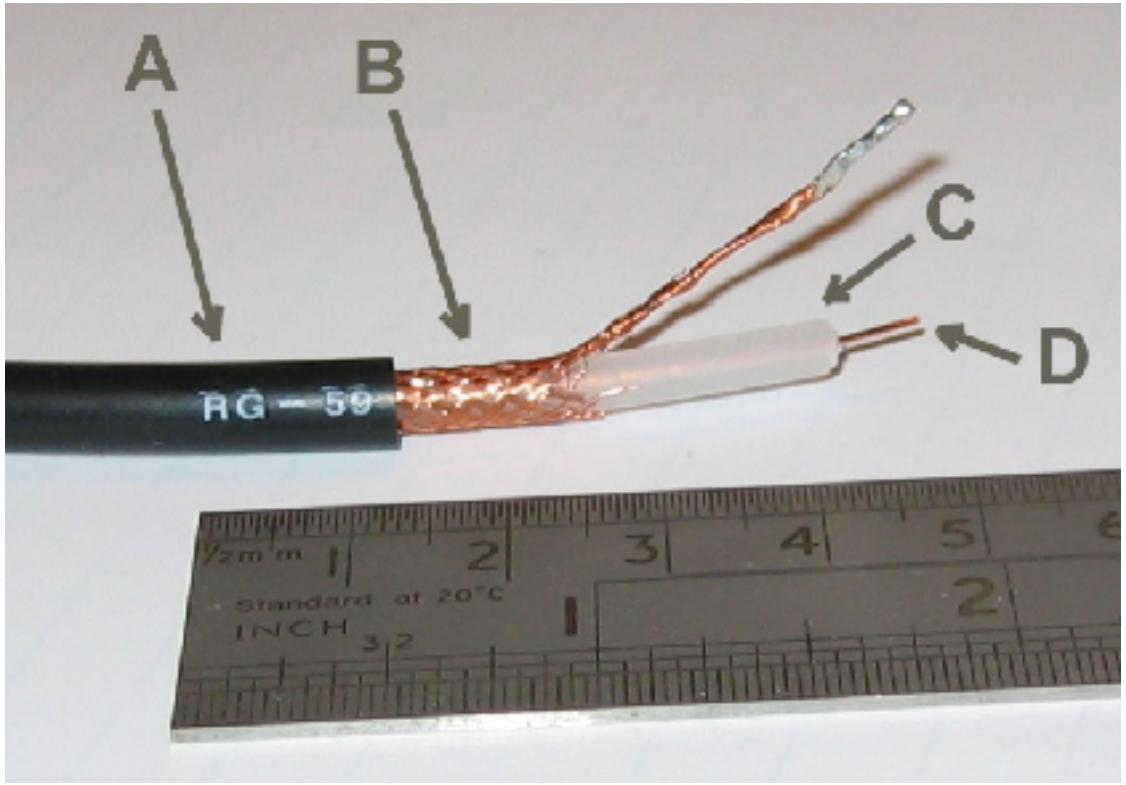
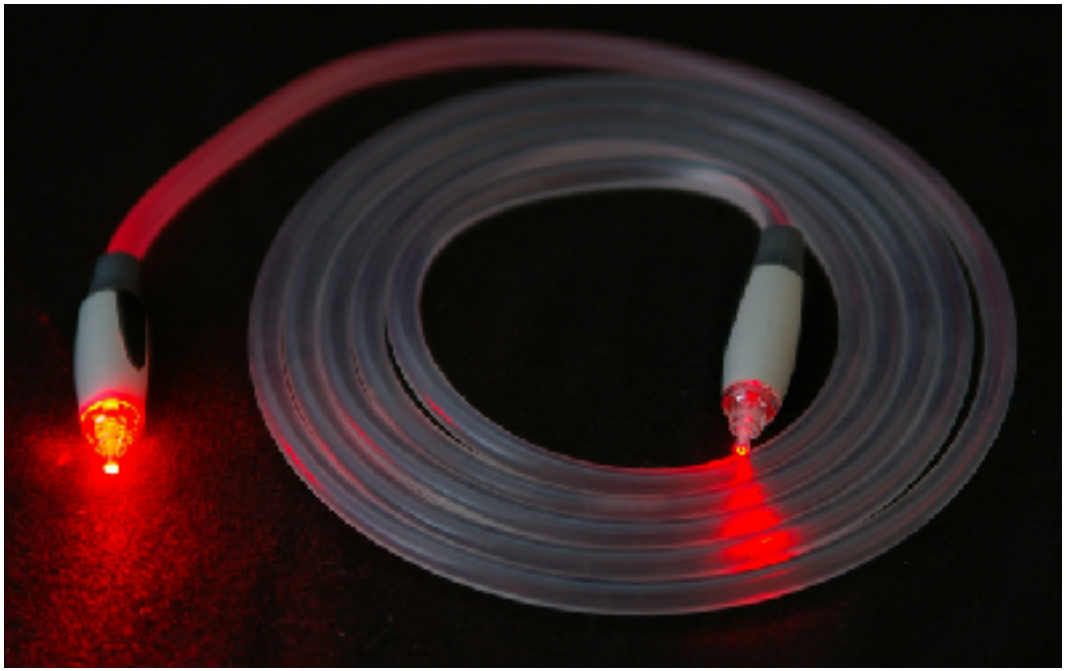


Image: https://en.wikipedia.org/wiki/Coaxial_cable

Fiber Optic

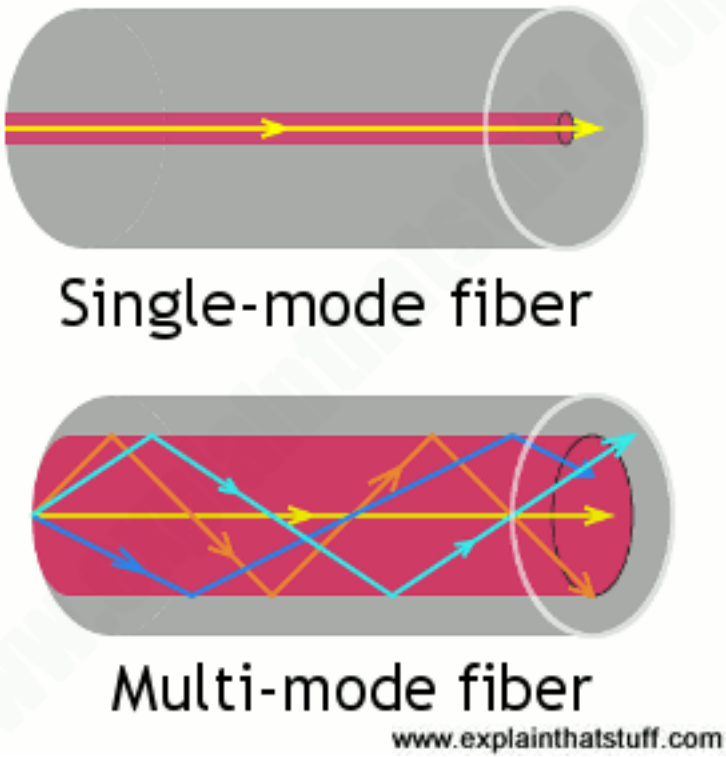
- What are fiber optic?



https://en.wikipedia.org/wiki/Fiber-optic_cable

Fiber Optic

- Types of fiber media.
  - Single mode fiber
  - Multimode fiber



https://www.explainthatstuff.com/fiberoptics.html

UTP and Fiber-optic Cable

UTP and Fiber-Optic Cabling Comparison

Implementation Issues	UTP Cabling	Fiber-Optic Cabling
Bandwidth supported	10 Mb/s - 10 Gb/s	10 Mb/s - 100 Gb/s
Distance	Relatively short (1 - 100 meters)	Relatively long (1 - 100,000 meters)
Immunity to EMI and RFI	Low	High (Completely immune)
Immunity to electrical hazards	Low	High (Completely immune)
Media and connector costs	Lowest	Highest
Installation skills required	Lowest	Highest
Safety precautions	Lowest	Highest

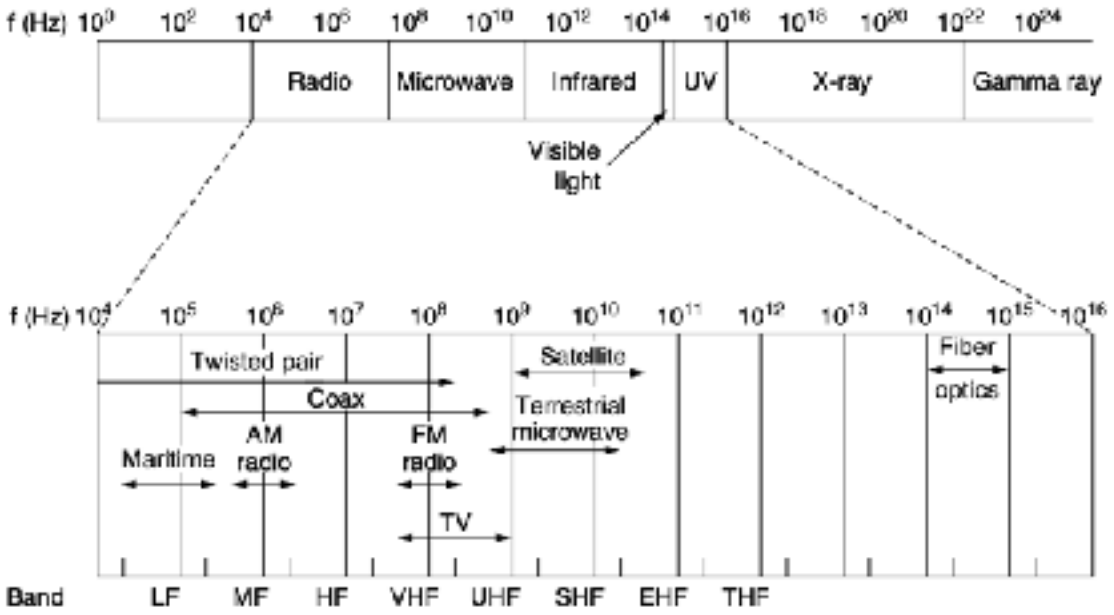
Wireless media

- What are wireless media

- Coverage area
- Interference
- Shared medium
- Security

Wireless media

- Electromagnetic spectrum
  - Frequency
  - Wavelength



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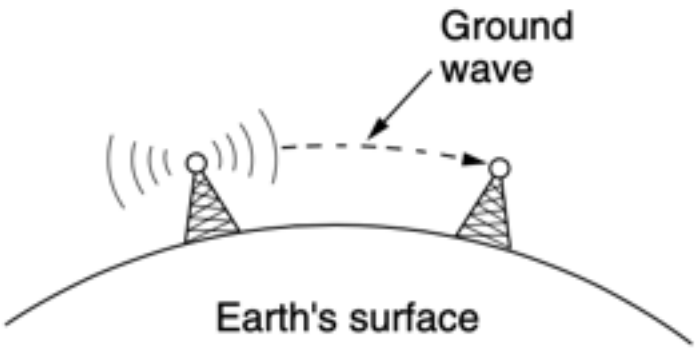
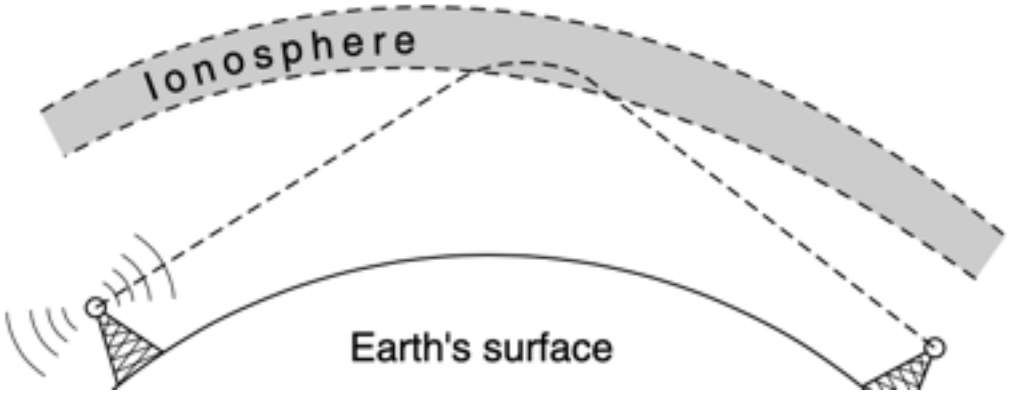
Wireless media - Radio transmission

- Radio transmission
  - 3Hz to 3000 GHz
  - Easy to generate
  - Travel long distances
  - Penetrate buildings easily
  - Omnidirectional

Wireless media - Radio transmission

- VLF, LF, MF radio waves follows the curve of the earth
- HF bounce off from Ionosphere





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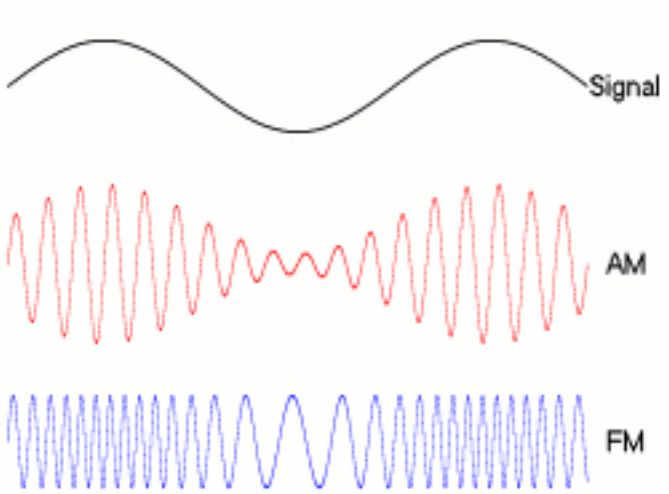
Wireless media - Radio transmission

- Amplitude Modulation (AM) and Frequency Modulation (FM)



https://en.wikipedia.org/wiki/FM_broadcasting

https://en.wikipedia.org/wiki/AM_broadcasting

Wireless media - Microwave transmission

- Waves travel in nearly straight lines
- Transmitting and receiving antennas must be accurately aligned
- Much higher signal-to-noise ratio
- Do not pass through buildings well

Wireless media - Infrared transmission

- Short-range communication
- Do not pass through solid objects
- No government license is needed to operate an infrared system

Wireless media - Light transmission

- Use laser beams

- Li-Fi
  - Li-Fi is a technology for wireless communication between devices using light to transmit data and position.
  - In its present state only LED lamps can be used for the transmission of visible light.
  - Visible light communications (VLC) works by switching the current to the LEDs off and on at a very high rate (Too quick to be noticed by the human eye).

Wireless media

- Types
  - WiFi
  - Bluetooth
  - WiMAX
  - Zigbee