Computer Fundamentals

Dr. Safdar Nawaz Khan Marwat
DCSE, UET Peshawar

Lecture 13

safdar@uetpeshawar.edu.pk

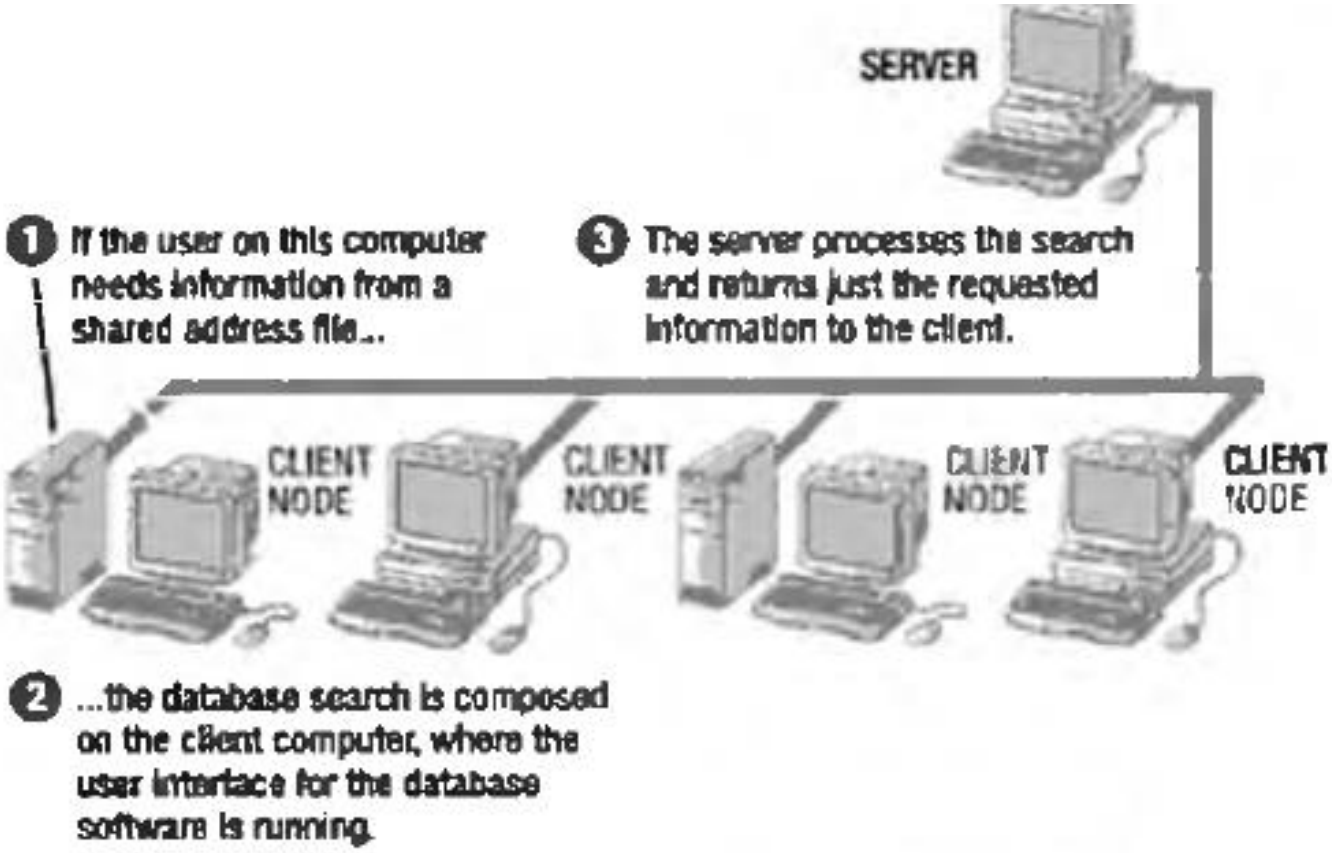
How Networks are Structured

- Server based network
  - Node is any network device
  - Servers **control** what the node **accesses**
  - Users gain access by logging in
  - Server is the most important computer
  - E.g. file server, application server, web server, network server

How Networks are Structured (cont.)

- Client/Server network
  - *Type of server-based network*
  - Nodes and servers **share processing and storage workloads**
  - Nodes are called clients
  - Servers are used to control access
  - Database software
    - Access to data controlled by server
  - Server is the most important computer

How Networks are Structured (cont.)



How Networks are Structured (cont.)

- Peer to peer networks (P2PN)
  - All nodes are equal
  - Nodes connected and share resources without going through server
    - E.g. ad-hoc network
  - Nodes access resources on other nodes
  - Each node controls its own resources
  - Most modern OS allow P2PN
  - Distributed computing is a form
    - Use processing power of other computers

Network Topologies

- Topology
  - Layout of wires and equipment
  - Choice affects
    - Network performance
    - Network size
    - Network collision detection
  - Several different types
    - Logical
    - Physical

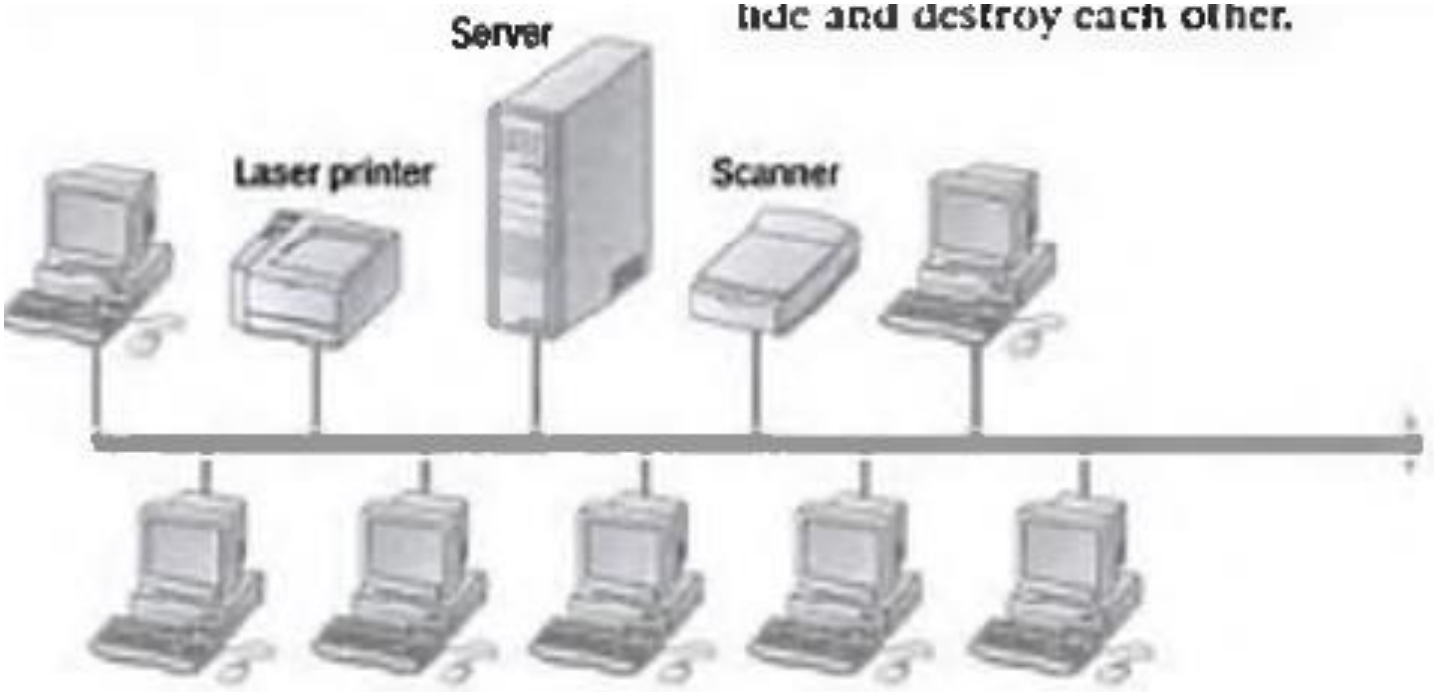
Network Topologies (cont.)

- Packets
  - Pieces of data transmitted over a network
    - Packets are created by sending node
    - Data is reassembled by receiving node
  - Packet header
    - Sending and receiving address
  - Packet payload
    - Number and size of data
    - Actual data
  - Packet error control
    - Optional

Network Topologies (cont.)

- Bus topology
  - Also called linear bus
  - One wire connects all nodes
  - Terminator ends the wires
  - Advantages
    - Easy to setup
    - Small amount of wire
  - Disadvantages
    - Slow
    - Easy to crash

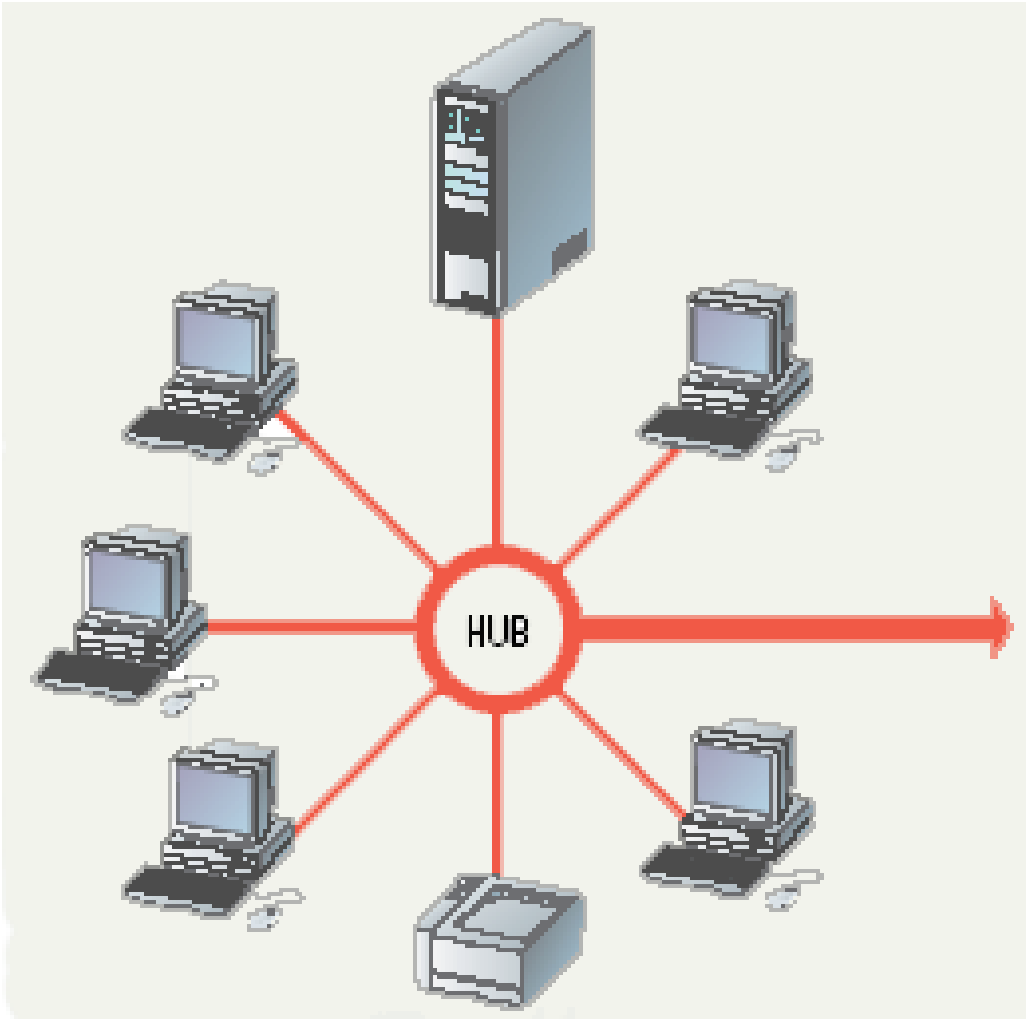
Network Topologies (cont.)



Network Topologies (cont.)

- Star topology
  - All nodes connect to a hub
    - Packets sent to hub
    - Hub sends packet to destination
  - Advantages
    - Easy to setup
    - One cable can not crash network
  - Disadvantages
    - One hub crashing downs entire network
  - Most common topology

Network Topologies (cont.)



Network Topologies (cont.)

- Ring topology
  - Nodes connected in a circle
  - Tokens used to transmit data
    - Nodes must wait for token to send
  - Advantages
    - Time to send data is known
    - No data collisions
  - Disadvantages
    - Slow
    - Lots of cable

Network Topologies (cont.)

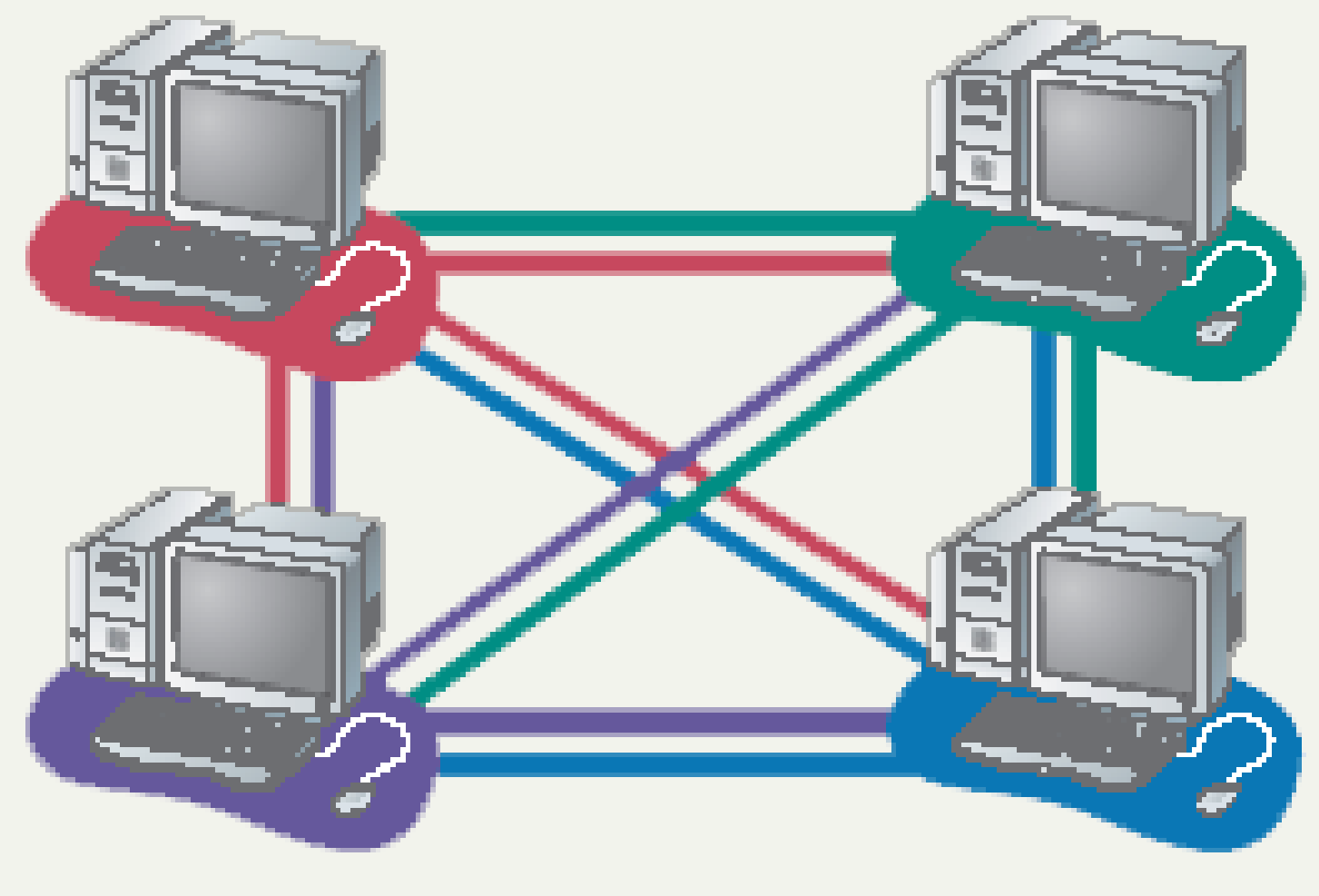
Network Topologies (cont.)

- Mesh topology
  - All computers connected together
    - $n\,(n-1)\,/\,2$ full duplex links required[1]
  - Advantage
    - Data will always be delivered
  - Disadvantages
    - Lots of cable
    - Hard to setup

Source: Shehzad, Batch 19, DCSE, UET Peshawar

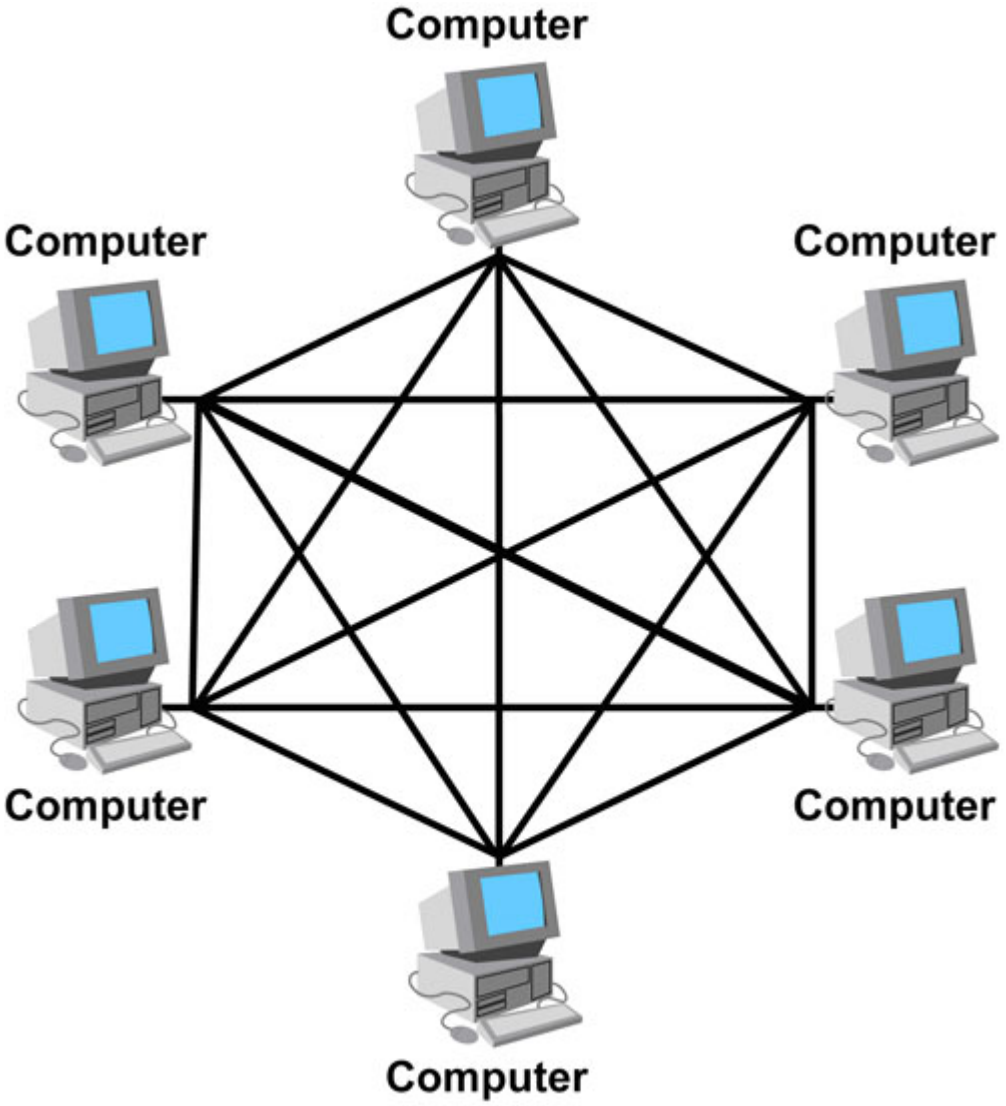
Network Topologies (cont.)

- Half duplex



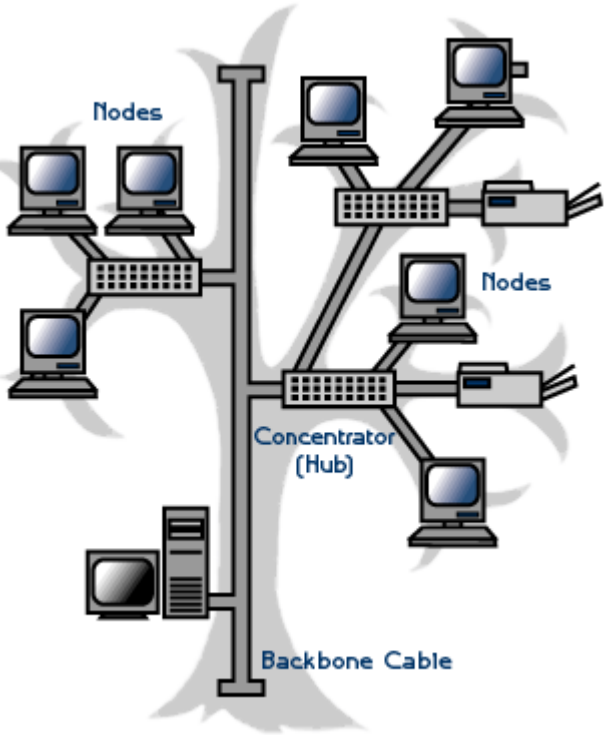
Network Topologies (cont.)

- Full duplex



Network Topologies (cont.)

- Tree topology
  - Combination of characteristics of star and bus topology

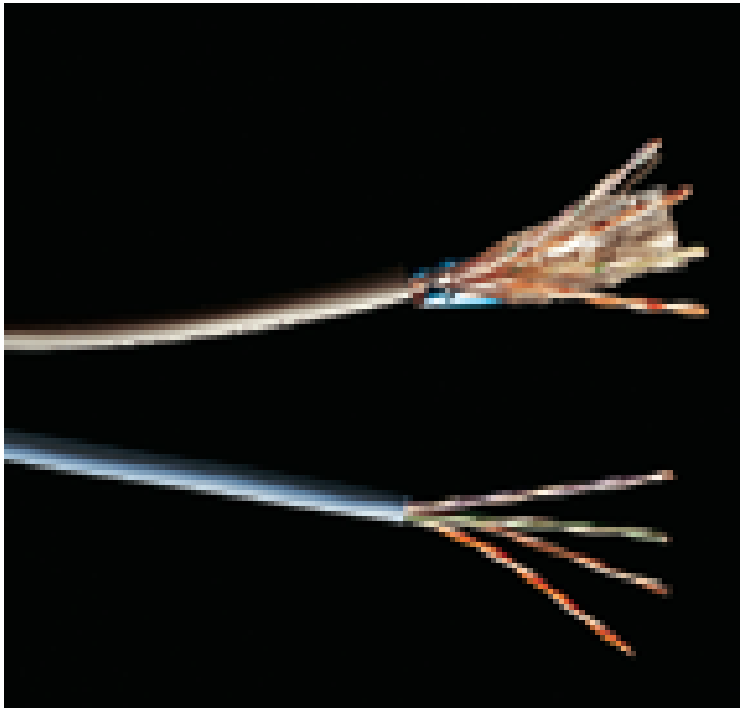


Network Media

- Network links
  - Connect network nodes
- Choice of media impacts
  - Speed
  - Security
  - Size

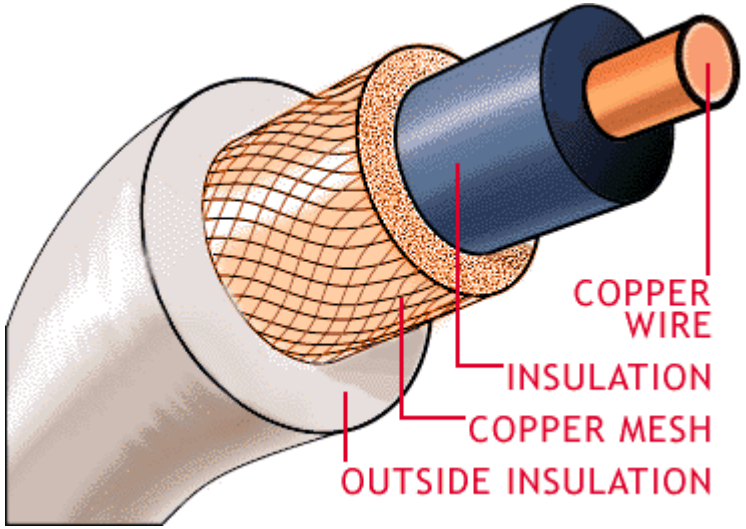
Wire Based Media

- Twisted-pair cabling
  - Most common LAN cable
  - Called Cat5 or 100BaseT
  - Four pairs of copper cable twisted
  - May be shielded from interference
  - Speeds range
    - 1 Mbps to 1,000 Mbps



Wire Based Media (cont.)

- Coaxial cable
  - Similar to cable TV wire
  - One wire runs through cable
  - Shielded from interference
  - Speeds up to 10 Mbps
  - Nearly obsolete

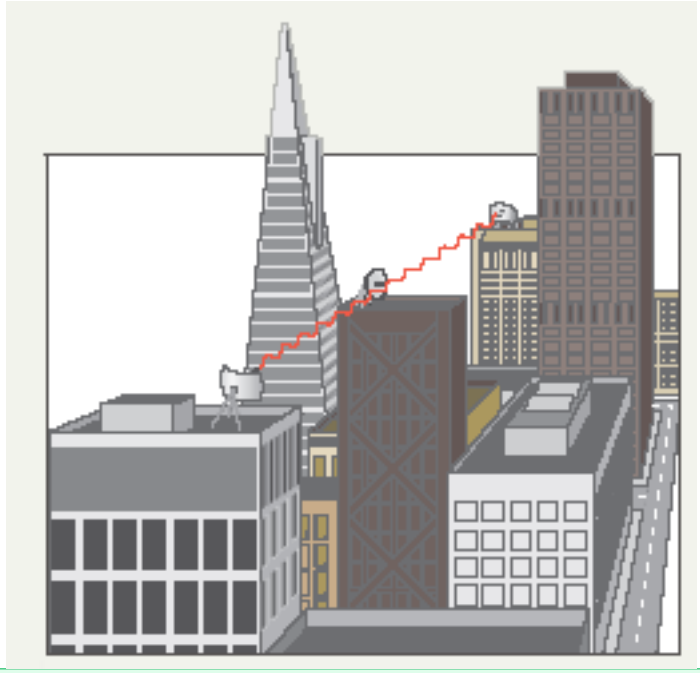


Wire Based Media (cont.)

- Fiber-optic cable
  - Data is transmitted with light pulses
  - Glass strand instead of cable
  - Immune to interference
  - Very secure
  - Hard to work with
  - Speeds up to 100 Gbps

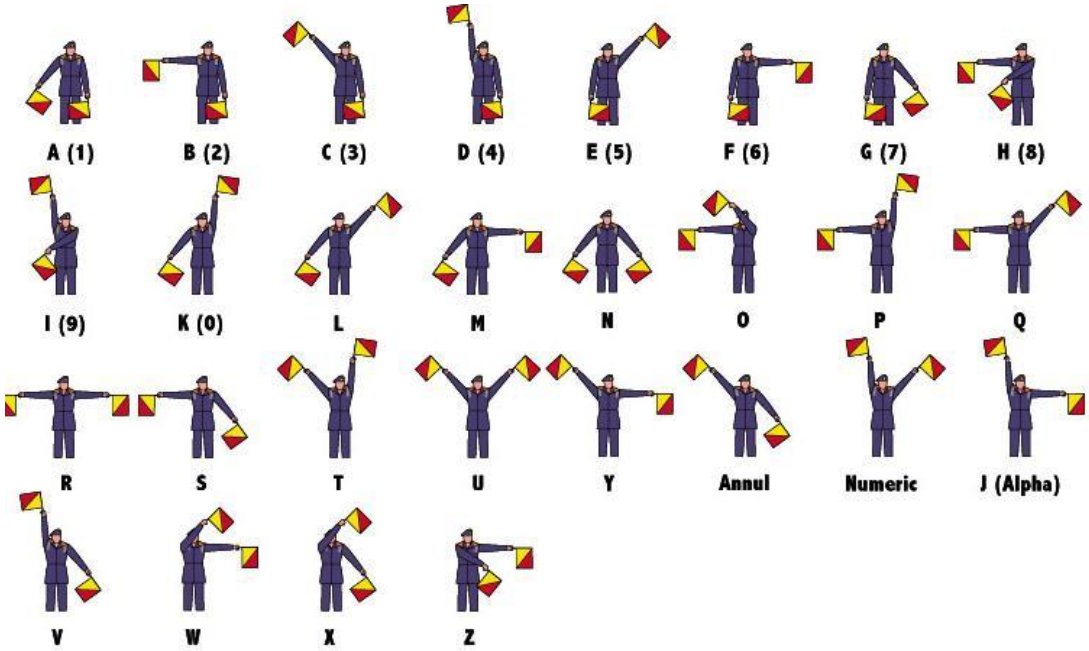
Wireless Media

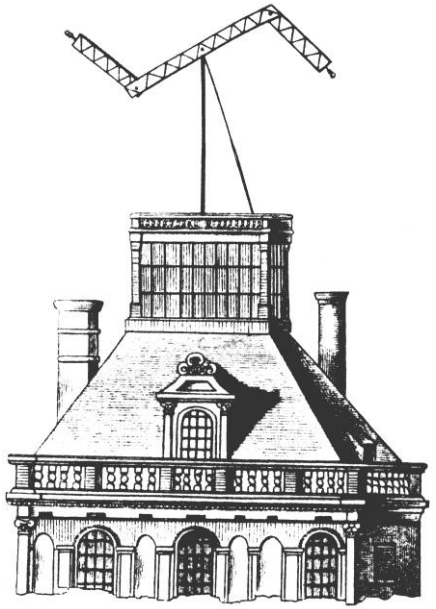
- Data transmitted through air
- LANs use radio waves
- WANs use satellites and microwave signals
- Easy to setup
- Difficult to secure



History

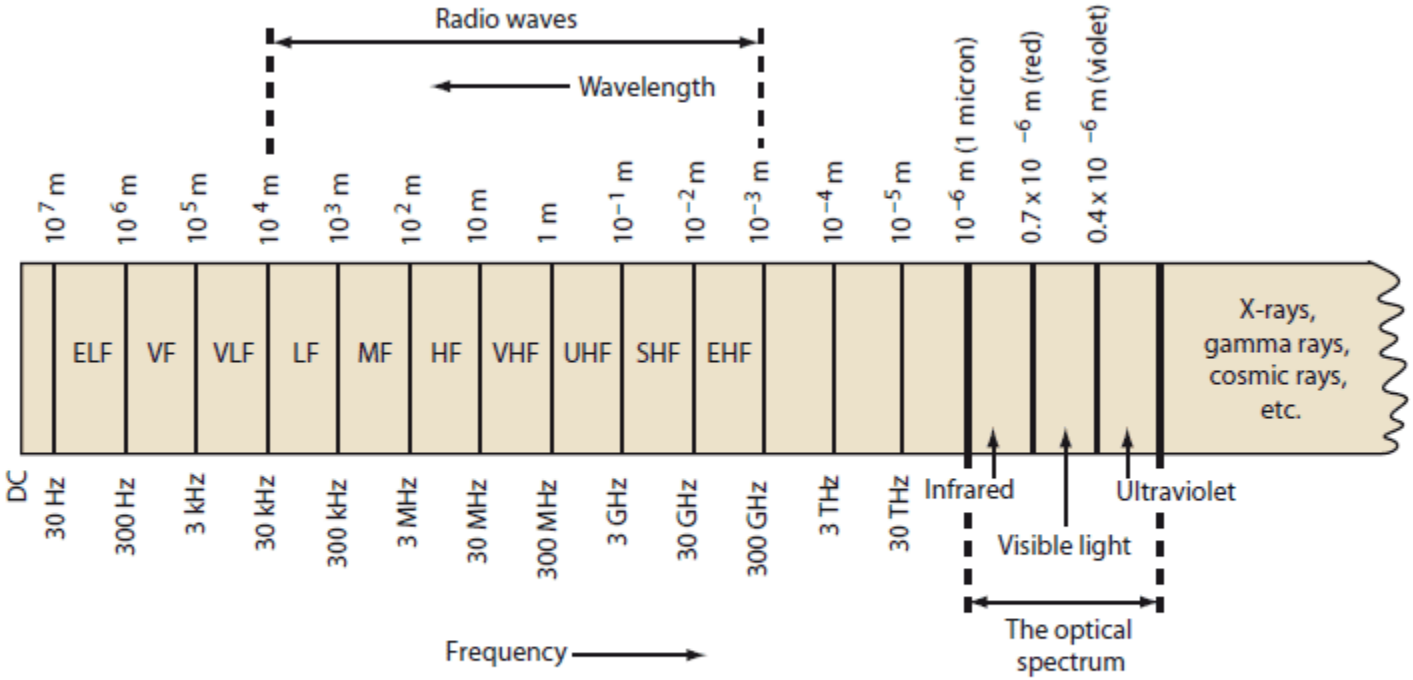
- Light for communication
  - Torches, flags (semaphore), …
  - Signaling towers of Han-Dynasty in China (206 BC – 24 AD)
  - Smoke signals for communication in Greece (150 BC)
  - Optical telegraph of Claude Chappe (1794 esp. French Revolution)





Source: *https://cflagexpressions.wordpress.com/2010/03/23/history-behind-semaphore-flags*

Frequency Spectrum



1. The electromagnetic frequency spectrum ranges from dc to light. The lower radio frequencies are designated mainly by frequency. The optical ranges are referred to by wavelength.

ELF = Extremely Low Frequency, VF = Voice Frequency, VLF = Very Low Frequency, LF = Low Frequency, MF = Medium Frequency, HF = High Frequency, VHF = Very High Frequency, UHF = Ultra High Frequency, SHF = Super High Frequency, EHF = Extremely High Frequency

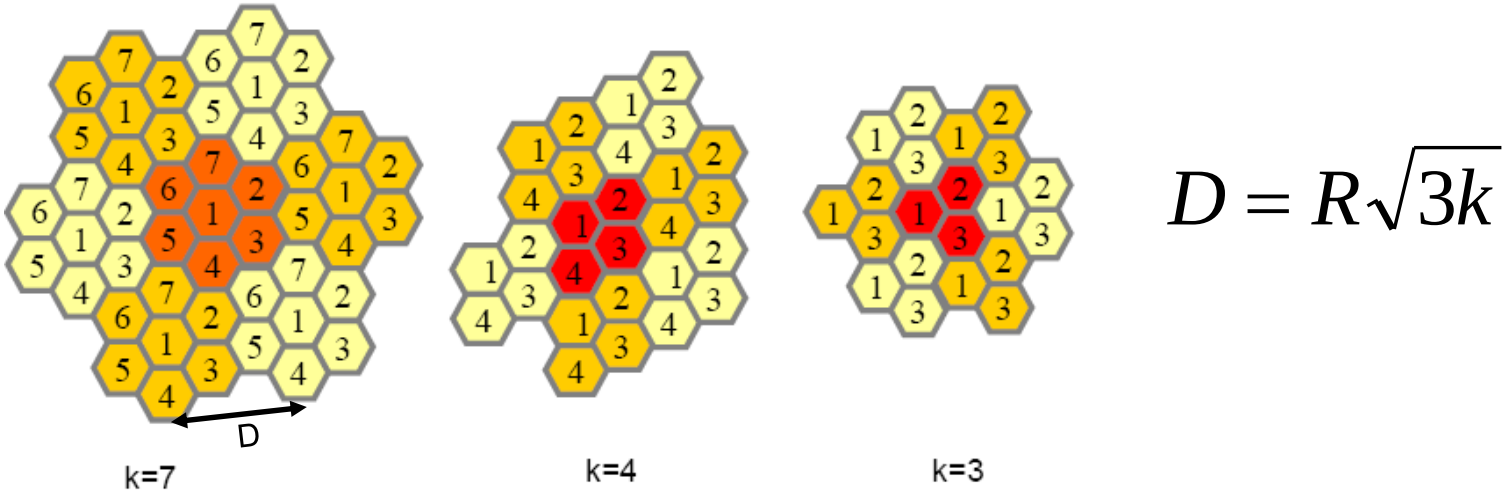
Frequency and wavelength: $\lambda = c/f$

With wavelength λ, speed of light c = 3x10^{8}m/s, frequency f

Source: *http://electronicdesign.com/communications/understanding-solutions-crowded-electromagnetic-frequency-spectrum*

Mobile Networks

- Cellular principle
  - Segmentation of coverage area in smaller areas (Bell Labs patent 1972)
- Spatial frequency reuse
  - Modelling of cells as hexagons
  - Every cell uses a particular frequency
  - Frequency reuse factor, k (also called cluster size)
  - Adjacent cells should use a different frequency
  - Frequency reuse separation, D

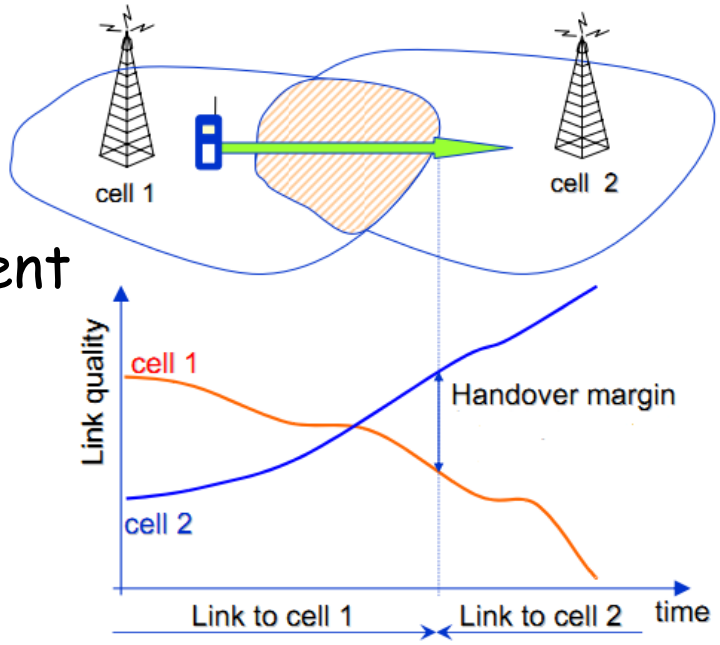


$$D = R\sqrt{3k}$$

Source: Dr. U. Türke, *UMTS-3G Mobile Communication Systems*, University of Bremen

Mobile Networks (cont.)

- Handover
  - Handoff to another base station
- Mandatory handover
  - Distance too large
  - Receive level too low
- Handover for performance improvement
  - Better receive level of adjacent cell
  - High traffic load
- Threshold for handover
  - Avoid ping-pong effect



Source: *http://telecommunicationengineeringconcepts.blogspot.com/2012/05/gsm-handoverhandoff.html*