

Concepts of Networking

Definition

- Network: collection of distributed, intelligent machines that share data and information through interconnected lines of communication

Telecommunications

Models of Network

- Used to classify networks by size, distance, and structure
- Local Area Networks
- Wide Area Networks

Network Concepts and Considerations

- Network topology
 - Ring network
 - Bus network
 - Hierarchical
 - Star network
 - Hybrid network
- Network types
 - Local Area Networks
 - Wide Area Networks
 - International networks
 - Home and small business networks

WANs

- LAN of LANs
- Wide Area Networks in the enterprise connect all LANs in the organization – global aspect for multinational
- Internet is global WAN
- WANs may be public or private
- Private WANs may be Intranet

LANs

- Combination of computer hardware and transmission that is small in size
- Typically within a building or business unit
- Typically utilize only one type of cabling
- Distance limited to 10 km or less due to cabling
- Wireless LANs are new addition

Basic Communications Channel Characteristics

- Simplex channel: message travels in one direction only
- Half-duplex: messages travel in both directions but only one direction at a time
- Full-duplex channel: messages can travel in both directions simultaneously

Shannon's Fundamental Law of Information Theory

- The information carrying capacity of a channel is directly proportional to its bandwidth - the broader the bandwidth, the more information that can be carried.

Bandwidth

- The range of frequencies that an electronic signal occupies on a given transmission medium.

Broadband

- Telecommunications in which a wide band of frequencies is available to transmit information, allowing more information to be transmitted in a given amount of time.

Protocols

- Rules which provide foundation of communications
- Standards for syntax
- Covers physical connections, software, hardware specifications

Types of Media

- Twisted-Pair
- Coaxial Cable
- Fiber-Optic Cable
- Microwave Transmission

Transmission Media

- Provides physical path for movement of network data
- May be bounded or unbounded
 - Bound transmission media: central conductor inside of covering providing security, reliability
 - Unbounded transmission media: extends beyond physical cabling, radiated – sent through airwaves

Bound Media

- Unshielded twisted-pair (UTP)
- Coaxial
- Fiber optics

UTP

- Telephone wire
- Two or more insulated copper wires twisted around each other
 - Twists provide reduction of cross-talk
- Data grade utilized for networks
 - 5 categories
 - CAT 5 used for high-speed computer networks, 100 Mbps

COAX

- Center conductor of copper wire
- Outer conductor of wire mesh
- Operates at 10 Mbps

- Variety of standards for usage ranging from LANs, cable tv, etc.
- Lack of security compared to other bound media

Fiber Optics

- Uses properties of light to transmit data
- Not electrical based – immune to Electromagnetic Interference (EMI)
- Can be placed in locations where cabling based upon properties of electricity
- Fibers may be glass or plastic
- 10 Mbps to 2+Gbps – 100 Mbps typical

Advantages & Disadvantages of Fiber

- Advantages:
 - Speed, security, where can be installed due to no sparking, non corrosive due to glass & plastic materials
- Disadvantages:
 - Expensive to install and expand due to special requirements of materials (refractive glass) restriction on angles
 - Expensive to maintain/repair if damaged

Unbound Media

- Radio wave
- Microwave
- Infrared

Radio Wave

- Technology utilizes frequencies
- Suffers from frequencies being regulated and in use
- Suffers from interference and security vulnerability
- Some types are very susceptible to EMI

Microwave

- Transmits beyond radio waves into upper gigahertz band
- 2 types of implementation
 - Terrestrial
 - Satellite

Terrestrial

- Line of sight – typically around 30 miles due to curvature of earth
- Susceptible to atmospheric conditions and EMI
- Good for short distance WANs

Satellite

- Uplink and downlink
- propagation delays due to distance signal must travel – issue and disadvantage of satellite

- Geosynchronous satellite (22,300 miles)
- Low earth satellites –
- Security and weather conditions may be problems (example sun spots) – definite disadvantages

Infrared

- Light emitting diodes (LEDs)
- Most useful in small or open indoor environments
- Can be point-to-point or Broadcast Infrared
- Security & broadcast jamming problems

Bridge, Routers, and Gateways

Definitions

Bridge: network device that provides connection between two or more networks, must use same protocol of communication

Router: network device that operates at network level of OSI model, can determine preferred paths to a final destination of a message/data

Gateway: network device that provides a connection allowing networks with different architectures and using dissimilar protocols to communicate

OSI Model

- Open Systems Interconnection Reference Model
- International Standards Organization developed
- Provides framework for network communications

Seven Layers of OSI

- Physical
- Data Link
- Network
- Transport
- Session
- Presentation
- Application

Physical

- Part of bottom layer of OSI
- Encodes or decodes bits
- Send or receives stream of data
- Standards for this layer defines: electrical properties, transmission media, transmission devices, physical topology, data signaling, data synchronization, data bandwidth
- Physical layer sets rules for the actual connections and transmission of data over networks. Physical devices including cables, modems, network devices must meet these standards.

Data Link

- Part of bottom layer of OSI
- Organizes physical bits into logical groups for intended receiver

- Organizes messages from receiver into physical bits for transmission on outbound

Network

- Part of middle layer of OSI
- Concerned with getting the message where it is going
- 4 tasks: logical addressing, switching, routing, and network control
- Logical address: combines with physical addressing for destination devices
- Switching and Routing determines actual path used to move message
- Network control: handles reassembling message parts

Transport

- Part of middle layer of OSI
- Concerned with getting the message where it is going
- 3 functions: service addressing, segmentation, and transport control
- Service addressing uses connection Ids, ports, and sockets to ensure that message gets to right service
- Segmentation makes certain that message is of correct size for service
- Transport control performs error checking and flow control – **error checking main function of transport layer**

Session

- Part of top layers of OSI
- Provides services
- 3 tasks: establishes connection – transfers data – releases connection
- Opens and controls network dialog
- Ensures reliable communication via accepted transmission type

Presentation

- Part of top layers of OSI
- Provides services
- Transforms message into an acceptable format – translation is primary task
- 2 tasks: translation and encryption

Application

- Part of top layers of OSI
- Provides services
- Uses networking protocols to provide file, print, message, application, and database services

Communications Software

- Network operating systems (NOS)
- Network management software

Communications Protocols

- Open Systems Interconnection (OSI) model
- Transmission Control Protocol/Internet Protocol (TCP/IP)
- Systems Network Architecture (SNA)
- Ethernet
- Asynchronous Transfer Mode (ATM)
- Bluetooth (wireless protocol using radio waves)

Telecommunications and Applications

- Voice mail
- Electronic software distribution
- Telecommuting
- Videoconferencing
- Electronic data interchange (EDI)

Devices

- **Modems:**
 - Analog
 - Digital
- Special-purpose modems
- Multiplexers
- Front-end processors