Networking Media

Computers facilitate information exchange and resource sharing from one location to another through some sort of wiring/cabling or waves that acts a physical path, which carries electrical or electromagnetic signals between a transmitter and a receiver.

Kinds of Networking Media	**Network Design Factors**
• **Wired or Bounded Media:** These networking media use cables and are limited by the physical geography. • **Wireless or Unbounded Media:** In contrast to the wired or bounded media, this networking media doesn't use any cables in transmitting data and is not bounded by physical geography.	• **Bandwidth:** Higher data rate is achieved by means of a greater signal bandwidth. • **Transmission impairments:** These limit the distance travelled by a signal (e. g. attenuation). • **Interference:** Emanations from nearby cables cause frequency bands to overlap and make signal compete. This in turn, distorts or wipes out the signal. • **Number of receivers:** Data rate and distance are limited by multiple attachments for each attachment introduces some attenuation and distortion on the line.
Other Information: • **Attenuation** refers to signal loss due to impedance. • The term **transceiver** is a portmanteau of "transmitter" and "receiver," meaning it could both transmit and receive signals. • This twisted-wire pairs produce a magnetic field cancellation effect, which limits signal degradation caused by interference from nearby twisted pair known as **crosstalk**.	**Network Transmission** • A **serial transmission** is a transmission, in which data with each bit lining up in a series as the bits are sent over a single wire at a time. This type of communication is used over the phone system because it provides one wire for data in each direction. • A **parallel transmission** is a transmission wherein group of bits is sent simultaneously, but each uses a different channel. Though fast because all the bits are travelling at the same time, it is less reliable because bits tend to muddle up and may arrive out of order.

Wired or Bounded Media

- **Serial Cable**
  - The most widely used standards for serial data communications is the which is intended to operate over distances of up to 50 feet and has a communication speed that is equal to or less than 20Kbps.
- **Coaxial Cable**
  - It refers to two (2) conductors, enclosed by insulating protective coating (e. g. rubber, Teflon, or plastic).
  - Kinds of Shielding: *Dual shielded* & *Quad shielded.*
  - The choice of coaxial cable grade: **Polyvinyl chloride (PVC) grade** and **Plenum grade.**
  - **Types of Coaxial Cable**
    - **Thin (Thinnet) Cable** - It is a flexible coaxial cable at about 0.64 centimeters (0.25 inches) thick. It uses British Naval Connector (BNC)-T cable connector attached to the computer's Network Interface Card (NIC).
    - **Thick (Thicknet) Cable** - It is a relatively rigid coaxial cable at about 1.27 centimeters (0.5 inches) in diameter. It uses *vampire tap or piercing tap* as connectors.
- **Twisted Pair Cable** consists of two insulated strands of copper wire that are arranged in a regular spiral pattern.
  - **Unshielded Twisted-Pair (UTP) Cable -** As the name implies, a UTP cable refers to a twisted pair cable that contains no shielding. It has eight (8) individual copper wires (covered by an insulating material), in which pairs of it are twisted around each other to form a four-pair color-coded wire medium that are encased/enclosed in a flexible plastic sheath.
  - **Shielded Twisted-Pair (STP) Cable** - As the name implies, an STP cable refers to a twisted pair cable that combines the techniques of twisting wires, cancellation, and shielding. Each pair of eight (8) individual copper wires is twisted and then wrapped in a metallic foil.

- Additional components are necessary to ensure proper installation of a twisted pair cable network and these are:
  - **RJ – 45 connectors**: It refers to a twisted pair cabling connection plug.
  - **Network Rack:** This serves as an extra room for cables where there isn't much floor space.
  - **Expandable patch panel**: It refers to an array of port mounted in the rack shelves
  - **Jack coupler**: It serves as a connector between single or double RJ-45 jacks.
  - **Wall plate**: It is used to support two (2) or more couplers.

- **Fiber Optic Cable** refers to a bundle of extremely thin and cylindrically shaped glass (or plastic) strands (or fibers) surrounded by a concentric layer of glass (or plastic) coating that is capable of conducting modulated light transmissions. It is more expensive compared to other networking media.
  - Parts of the fiber optics cable:
    - **Core or the center of the fiber:** It refers to the innermost section that consists of one (1) or more very thin strands or fibers made of glass or plastic. It allows light to pass through at very high speeds from the point of origin to the destination, with minimal loss in quality or data.
    - **Cladding:** It refers to an outer optical glass or plastic coating that surrounds and traps the light in the core by the principle of total internal reflection.
    - **Coating (Buffer):** It helps shield the core and cladding from damage.
    - **Jacket:** It refers to an outermost layer that protects a buffer or a bundle of buffer-coated fibers against moisture (solvents), abrasion, crushing, and other environmental dangers.
  - Connectors used with fiber-optic cable are **ST Connector (Straight Tip connector)** and **SC Connector (Subscriber Connector).**
  - Fiber Optic Modes:
    - **Single-mode fiber optic cable** - This fiber optic cable type allows light waves to travel along single path (shown in Figure 3.22) or in only one mode (wavelength = 1,300 to 1,550 nanometers). It is used commonly for high speed transmission over long distances.
    - **Multimode fiber optic cable:** This fiber optic cable type allows light waves to travel into numerous paths (or modes shown in Figure 3.23) through the core of the fiber (wavelength = 850 to 1,300 nm) at various angles. It is often applied to local area networks which encompass a much smaller transmission range.

Wireless or Unbounded Media

Computers also facilitate information exchange and resource sharing from one location to another through waves (aka wireless signals) which act as physical paths that carry current or series of electromagnetic energy pulses at various frequencies (shown in Figure 3.26) between a transmitter and a receiver.

Electromagnetic Spectrum			
Band Name	**Frequency Range**	**Propagation characteristics**	**Description/Uses**
Extremely Low Frequency (ELF)	30 Hz - 300 Hz	Ground Wave (GW) propagation	It involves AC power line frequencies and low frequency telemetry signals.
Voice Frequency (VF)	300 Hz - 3 KHz	GW propagation	It is used by the telephone system for analog Subscriber lines.
Very Low Frequency (VLF)	3 KHz - 30 KHz	GW propagation	It is used in military systems and submarine communication.

Low Frequency (LF)	30 KHz - 300 KHz	GW propagation	It is used for long-range navigation and marine communication.
Medium Frequency (MF)	300 KHz - 3 MHz	Sky-Wave (SW) ionospheric propagation	It is used in commercial AM radio broadcasting.
High Frequency (HF)	3 MHz - 30 MHz	SW ionospheric propagation	It is used in international broadcasting, military communication; long-distance aircraft and ship communication.
Very High Frequency (VHF)	30 MHz - 300 MHz	SW ionospheric and tropospheric propagation;	It is used in VHF television; commercial FM broadcast
		Line-Of-Sight (LOS) Propagation	AM aircraft communication; Aircraft navigational aids.
Ultra High Frequency (UHF)	300 MHz - 3 GHz	LOS Propagation	It is used in UHF television; cellular telephone; radar; microwave links; personal communication systems.
Super High Frequency (SHF)	3 GHz - 30 GHz	LOS Propagation	It is used in satellite communication; radar; terrestrial microwave links; wireless local loop.
Extremely High Frequency (EHF)	30 GHz - 300 GHz	LOS Propagation	It is used in experimental; wireless local loop.
Infrared (IR)	0.3 THz - 300 THz	LOS Propagation	It is used for heating and drying; "night vision" cameras; TV and garage door remotes; satellite remote sensing.
Visible light	0.3 PHz - 3 PHz	LOS Propagation	It is used in Optical communication.

An **antenna,** which is also known as “aerial”, refers to a metallic structure that acts as a *transducer* which converts electrical energy to electromagnetic energy (upon transmission of signal) and vice versa (upon reception of signal).

Types of Antennas

- **Directional antennas** issue wireless signals along a single direction that employs high frequencies at wider distances.
- **Omnidirectional antennas** issue and receive 360-degree horizontal wireless signals that propagates in all directions.

Radio Wave: It refers to a wireless medium that is used for multicast communications (e. g. radio and TV broadcasting, wireless local loop, mobile communications, and amateur radio) and paging systems over long distances. It functions with or without line of sight since it utilizes the different types of propagation method mentioned below:

Types of Wave Propagation

- **Line of Sight Propagation Method** – It is a method by which radio waves travel from the transmitting antenna to the receiving antenna. In lieu of this, the receiving antenna must be located within the radio horizon of the transmitting antenna. In other words, the two (2) antennas mentioned above must "see" each other. The radio horizon is actually about one-third farther than the line-of-sight or natural horizon. This is due to slight refraction that occurs in electromagnetic waves, even when propagated through the troposphere.
- **Ground Wave (Surface) Propagation Method** – It is a method by which radio waves are radiated directly towards the earth's surface. It is used for:
    - Worldwide communications with a frequency that ranges from 3 to 30 KHz and 30 to 300 KHz.
    - Broadcasting with a frequency that ranges from 300 KHz to 3 MHz.
- **Sky Wave (Ionospheric) Propagation Method** – It is a method by which radio waves radiate upwards from the transmitting antenna of the earth into a direction towards the ionosphere. It is used for long distance radio telephony and sound broadcasting with a frequency that ranges from 3 MHz to 30 MHz.
- **Space Wave (Tropospheric) Propagation Method** – It is a method by which radio waves radiation exceeds 30 MHz up to 300 GHz. It is used for sound/television broadcasting for radio relay systems and for various mobile systems that operates in a frequency that ranges from 30 to 300 MHz, 300 MHz to 3 GHz, and 3 to 30 GHz.

Wireless Medium Technologies

- **Microwave**: It refers to a wireless medium that is used for unicast communication such as wireless PAN (Bluetooth), broadband wireless access or wireless MAN (WiMAX), wireless WAN (2G/3G cellular networks), satellite networks and radar, and wireless LANs (Wi-Fi). In contrast to radio wave, it doesn't follow the curvature of the earth and requires line of sight in order to work properly.
- **Infrared:** It refers to a wireless medium that is used for short-range communication (e. g. remote control devices, intruder alarms, infra-red photography, and radiant heaters) in a closed area using line-of-sight propagation. It is achieved using transmitters/receivers (transceivers) that modulate non-coherent infrared light. Transceivers must be within the line of sight of each other either directly or via reflection from a light-colored surface such as the ceiling of a room.
- **Bluetooth:** It is a short-range wireless communication technology that allows devices such as mobile phones, computers, and peripherals to transmit data or voice wirelessly over a short distance. It uses the same 2.4GHz frequency as some other wireless technologies in the home or office, such as cordless phones and WiFi routers. It creates a 10-meter (33-foot) radius wireless network, called a personal area network (PAN) or piconet, which can network between two and eight devices

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