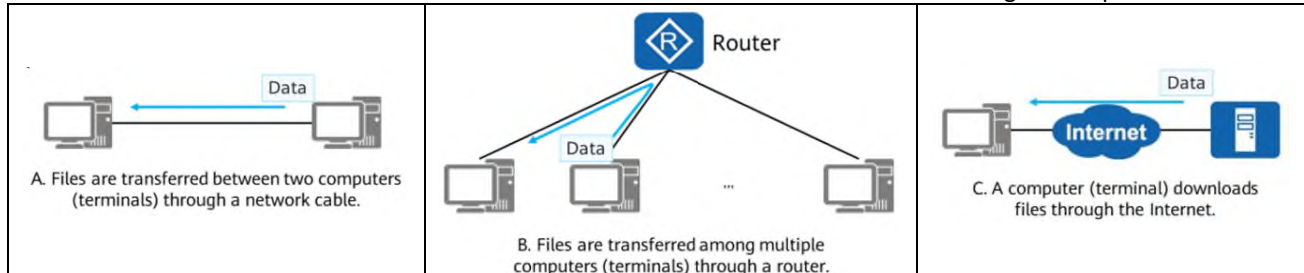


Network Fundamentals

Communication is the act of transmitting and exchanging information between people, people and objects, and objects and objects through various media and actions. The ultimate purpose of communication technology is to help people communicate more efficiently and create better lives from it.

- The **Internet** is the largest computer network in the world. Its predecessor, Advanced Research Projects Agency Network (ARPAnet), was born in 1969.
- **Network communication** refers to communication between terminal devices through a computer network.



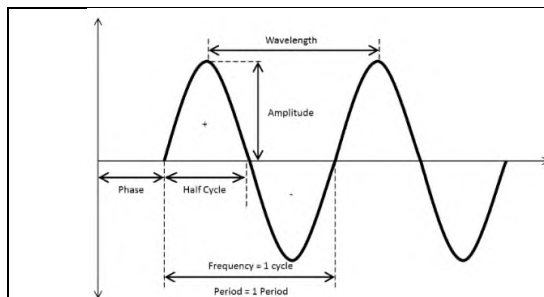
What is a signal?

- **Means of communication:** This refers to a sign or indication that conveys information about something or that tells someone to do something.
- **Communicated information:** This refers to an event or act, which shows that something exists or that gives information about something.
- **Electronics transmitted information:** This refers to a detectable physical quantity or impulse (as a voltage, current, or magnetic field strength) by which messages or information can be transmitted via telegraphy, telephony, radio, radar, or television.

Examples of signals

- **Electrical signals** (voltages and currents in a circuit)
- **Acoustic signals** (audio or speech signals)
- **Video signals** (intensity variations in an image)
- **Biological signals** (sequence of bases in a gene)
- **Noise** (interference – unwanted and undesired form of signal)

The main purpose of the signal is to ensure that the synchronization between the sender and receiver over a physical medium is maintained, as well as support transmission of the data signal in a form that can be interpreted by both the sender and receiver.

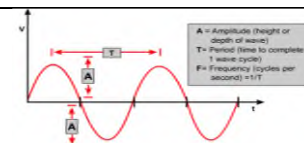


- **Phase** – It describes the position of the waveform relative to time zero; it is a measurement of the delay of the wave relative to some fixed reference point or another sine wave.
- **Frequency** – It refers to the number of waves made per second or as cycles per second. It is the reciprocal of the period to complete one (1) wave cycle. The unit for frequency is in Hertz (Hz); 1 Hz means 1 cycle per second (cps).
- **Period** – This refers to the amount of time (expressed in seconds) required to complete one (1) full cycle.

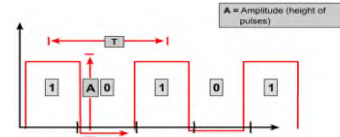
- **Waves** refer to disturbances in that energy to travel through a medium from one location to another.
- **Wavelength** refers to the horizontal distance of a wave from a point to the corresponding point on the next wave. This is measured in meters (m) in SI.
- **Amplitude** – It refers to a vertical distance from a given point on the wave from the horizontal axis. In layman's terms, it is the height above and below the x-axis. This is measured in volts, amperes, or watts, depending on the type of signal.

General Categories of Waves

Analog (short for "analogous") wave – It is a wave in which both the amplitude and time continuously vary over their respective intervals that results in a wavy characteristic. Examples of this wave include the human voice and music.



Digital wave – It is a wave with several discrete (jumpy) states, such as high or low, and on or off. It has fixed amplitude, but its pulse width and frequency can be changed. An example of this signal is the data stored in the memory of a computer in the form of 0s and 1s.



Networking Media

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

- **Wired or Bounded Media:** These networking media use cables and are limited by physical geography.
- **Wireless or Unbounded Media:** In contrast to wired or bounded media, these networking media do not use any cables in transmitting data and is not bounded by physical geography.

Transmission Modes:

- **Simplex Mode** is a connection wherein data flows in one (1) direction only (unidirectional). This type is either transmit-only or receive-only
- **Half-duplex Mode** is a connection wherein data can flow in both directions, but not simultaneously (both at the same time) over a shared physical medium.
- **Full-duplex Mode** is a connection wherein data simultaneously flows in both directions

Transmission Types:

- **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.
- **Parallel transmission** is a transmission wherein a group of bits is sent simultaneously, but each uses a different channel.

Wired or Bounded Media

- **Serial Cable** - The most widely used standard for serial data communications is 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** refers to two (2) conductors enclosed by an insulating protective coating.
 - **Types of Coaxial Cable**
 - **Thin (Thinnet) Cable** - It is a flexible coaxial cable about 0.25 inches thick. It uses British Naval Connector (BNC)-T cable connector attached to LAN Card (NIC).
 - **Thick (Thicknet) Cable** - It is a relatively rigid coaxial cable about 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, in which pairs of them are twisted around each other to form a four-pair color-coded wire medium that is encased in a flexible plastic sheath.
 - **Attenuation** refers to signal loss due to impedance. **Crosstalk** refers to the twisted-wire pairs producing a magnetic field cancellation effect, which limits signal degradation caused by interference from nearby twisted pairs.
 - **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.
- **Fiber Optic Cable** refers to a bundle of extremely thin and cylindrically shaped glass fibers surrounded by a concentric layer of glass coating that can conduct modulated light transmissions.
 - **Parts of the fiber optics cable**
 - **Core** refers to the innermost section that consists of one (1) or more very thin strands or fibers made of glass or plastic.
 - **Cladding** 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** is made from plastic that helps to shield the core and cladding from damage.
- **Strengthening Fibers** stand as protection for the core against compressive forces or crushing and tension or excessive pulling.
- **Cable Jacket (Sheath)** refers to an outermost layer that protects a buffer or a bundle of buffer-coated fibers against moisture, abrasion, crushing, and other environmental dangers.
- **Fiber Optic Modes:**
 - **Single-mode fiber optic cable** - This fiber optic cable type allows light waves to travel along a single path or in only one mode. It is used for high-speed transmission over long distances.
 - **Multimode fiber optic cable:** This fiber optic cable type allows light waves to travel into numerous paths through the core of the fiber 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 which act as physical paths that carry current or series of electromagnetic energy pulses at various frequencies.

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

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.
 - 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.
- **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
- **SkyWave (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 radiotelephony 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 operate at a frequency that ranges from 30 to 300 MHz, 300 MHz to 3 GHz, and 3 to 30 GHz.

Electromagnetic Spectrum			
Band Name	Frequency Range	Propagation characteristics	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	Telephone system for analog subscriber lines
Very Low Frequency (VLF)	3 KHz - 30 KHz	GW propagation	Military systems and submarine communication
Low Frequency (LF)	30 KHz - 300 KHz	GW propagation	Long-range navigation and marine communication
Medium Frequency (MF)	300 KHz - 3 MHz	Sky-Wave (SW) ionospheric propagation	Commercial AM radio broadcasting

High Frequency (HF)	3 MHz - 30 MHz	SW ionospheric propagation	International broadcasting, military communication, long-distance aircraft, ship communication
Very High Frequency (VHF)	30 MHz - 300 MHz	SW ionospheric and tropospheric propagation;	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	UHF television, cellular telephone, radar, microwave links, personal communication systems
Super High Frequency (SHF)	3 GHz - 30 GHz	LOS Propagation	Satellite communication, radar, terrestrial microwave links, wireless local loops
Extremely High Frequency (EHF)	30 GHz - 300 GHz	LOS Propagation	Experimental, wireless local loop
Infrared (IR)	0.3 THz - 300 THz	LOS Propagation	Heating and drying, night vision cameras, TV and garage door remotes, satellite, remote sensing
Visible light	0.3 PHz - 3 PHz	LOS Propagation	Optical communication

Other Wireless Medium Technologies

- **Infrared** 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.
- **Microwave** 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).
- **Bluetooth** 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.

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