Principles of Data Communications

Reference Book: Data Communications and Networking by Behrouz A. Forouzan

MAC address

- A media access control address (MAC address) is a unique identifier assigned to a network interface controller (NIC) for use as a network address in communications within a network segment.
- MAC addresses are primarily assigned by device manufacturers, and are therefore often referred to as the burned-in address.
- Also known as Ethernet hardware address, hardware address, and physical address.

IP Address

- An Internet Protocol address (IP address) is a numerical label assigned to each device connected to a computer network that uses the Internet Protocol for communication.
- IP address will be a number, like 172.16.254.1 (IPv4) or 2001:db8:0:1234:0:567:8:1 (IPv6)
- Private IP, Public IP
- IPv4 (IP version 4) Address
    - Here's an example of what an IP address might look like in IPv4: 66.171.248.170
    - An IPv4 address consists of four numbers, each of which contains one to three digits, with a single dot (.) separating each number or set of digits. Each of the four numbers can range from 0 to 255.
    - 32 bits

IPv6

- The rapid exhaustion of IPv4 address space available for assignment to Internet service providers and end-user organizations, prompted the Internet Engineering Task Force (IETF) to explore new technologies to expand the addressing capability on the Internet. The result was a redesign of the Internet Protocol which became eventually known as Internet Protocol Version 6 (IPv6)

- An IPv6 address consists of eight groups of four hexadecimal digits. If a group consists of four zeros, the notation can be shortened using a colon to replace the zeros. Here's an example IPv6 address:
  2001:0db8:85a3:0000:0000:8a2e:0370:7334

- 128 bits

Repeater

- A repeater operates at the physical layer.
- Its job is to regenerate the signal over the same network before the signal becomes too weak or corrupted so as to extend the length to which the signal can be transmitted over the same network.
- An important point to be noted about repeaters is that they do not amplify the signal. When the signal becomes weak, they copy the signal bit by bit and regenerate it at the original strength.
- It is a 2 port device.

- A hub is basically a multiport repeater.
- A hub connects multiple wires coming from different branches, for example, the connector in star topology which connects different stations. Hubs cannot filter data, so data packets are sent to all connected devices.
- Also, they do not have intelligence to find out best path for data packets which leads to inefficiencies and wastage.

Bridge

- A bridge operates at data link layer.
- A bridge is a repeater, with add on the functionality of filtering content by reading the MAC addresses of source and destination.
- It is also used for interconnecting two LANs working on the same protocol.
- It has a single input and single output port, thus making it a 2 port device.

- A switch is a multiport bridge with a buffer and a design that can boost its efficiency and performance.
- A switch is a data link layer device.
- The switch can perform error checking before forwarding data, that makes it very efficient as it does not forward packets that have errors and forward good packets selectively to correct port only.

- A router is a device that routes data packets based on their IP addresses.
- Router is mainly a Network Layer device.
- Routers normally connect LANs and WANs together and have a dynamically updating routing table based on which they make decisions on routing the data packets.

- A gateway, as the name suggests, is a passage to connect two networks together that may work upon different networking models.
- They basically work as the messenger agents that take data from one system, interpret it, and transfer it to another system.
- Gateways are also called protocol converters and can operate at any network layer.
- Gateways are generally more complex than switch or router.

Signals

- Anything that carries information can be called as a signal
- Contains any kind of information
- eg) baby smiles– smile is a signal indicating that the baby is happy
- Can also be defined as a physical quantity that varies with time, temperature, pressure or with any independent varaibles (speech signal, video signal etc.)
- The process of operation in which the characteristics of a signal (amplitude, shape, phase, frequency etc.) undergoes a change is known as signal processing
- Any unwanted signal interfering with the main signal is termed as noise. Noise is also a signal, but unwanted.

Analog Signals

- An analog signal is any continuous signal for which the time-varying feature (variable) of the signal is a representation of some other time-varying quantity, i.e., analogous to another time-varying signal.
- Defined with respect to time
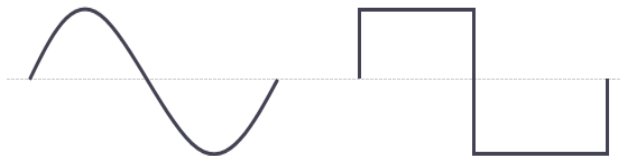- Continuous
- eg) human voice
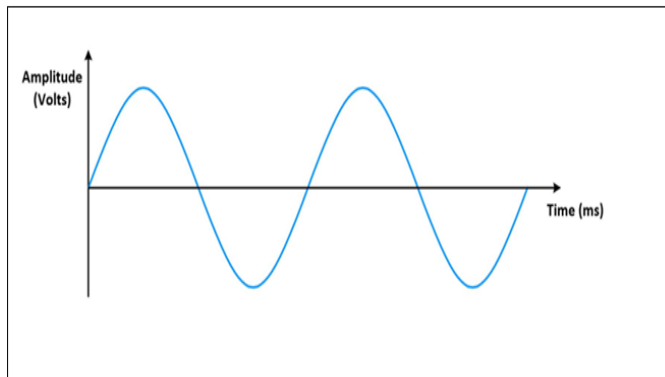
Digital Signals

- A digital signal is a signal that is being used to represent data as a sequence of discrete values; at any given time it can only take on, at most, one of a finite number of values.
- Computer Keyboard- Press or Release (0 or 1)

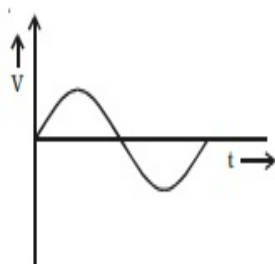Analog Signal   Digital Signal
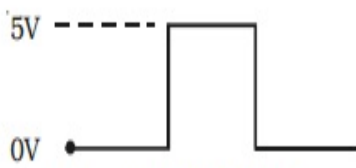
Fig   Analog signal

Fig   Digital Signal

- Computers work on ones and zeros; Ones and Zeros do play a major role on how computers work on the inside
- Inside a computer are electric wires and circuits that carry all the information in a computer
- How do you store or represent information using electricity?
- If you have a single wire with electricity flowing through it, the signal can be either ON or OFF

- With one wire, you can represent a Yes or No.

1	0
True	False
Yes	No
ON	OFF

- This ON-OFF state of a single wire is called as a BIT and is the smallest piece of information a computer can store.

- 1 wire: 0 or 1
- 2 wires: 00, 01, 10, 11
- 3 wires: 000, 001, 010, 011, 100, 101, 110, 111
- With more bits, you can represent more complex information
- Any number can be represented with only 1's and 0's or by a bunch of wires
- The more wires, more numbers can be stored
- With 8 wires, you can store numbers between 0 and 255

- MAC Address
- IP Address
- Networking Devices
- Signals- Analog, Digital

THANK YOU