Principles of Data Communications

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

Run length Encoding

- Run-length encoding (RLE) is a form of lossless data compression in which runs of data (sequences in which the same data value occurs in many consecutive data elements) are stored as a single data value and count, rather than as the original run.
- "wwwwaaadexxxxxx - "w4a3d1e1x6"
- Reduces Code Length

111111111111111100000000000000000001111

- (15,1), (19,0), (4,1)
- $2^4 = 16, 2^5 = 32$: 5 bits are required for storing 19
- (01111,1), (10011,0), (00100,1)
- (5+1)+(5+1)+(5+1)=18 bits
- Compression Ratio: 18/38
- 1:2.11

IEEE 802.3: Ethernet

- Ethernet is a communication standard (technology) that was developed in the early 80's to network computers and other devices in a local environment such as a home or a building. This local environment is defined as a LAN.
- Ethernet is a wired system and started with coaxial cable and successfully progressed to using twisted pair cable and fiber optic cables.
- In 1983, Ethernet was standardized to IEEE 802.3 by the Institute of Electrical and Electronics Engineers (IEEE).
- IEEE 802.3 defines the
  - Physical Layer and the
  - MAC (Media Access Control) portion of the data link layer of wired Ethernet

Physical Layer consists of the following components:

- Cabling
- Devices

Cabling

- Most Common- Twisted Pair Cable (CAT 5/5e: 100 Mbps, CAT 6: 1 Gbps, CAT 6a etc.)
- Ethernet twisted pair cable uses RJ-45 (Registered Jack) 8 pin connectors at either end of the cable.
- OFC: Ethernet to Fiber Converter
- Inorder to use fiber optics in an ethernet network that uses twisted pair ethernet cabling, we have to use an ethernet to fiber converter.

- Computers
- Printers
- or Any device with a network interface card or external ethernet adapter

DL Layer is divided into

- Logical Link Control (LLC)
- Media Access Control (MAC)

- LLC establishes paths for data on the ethernet to be transmitted between devices.
- MAC uses hardware addresses that are assigned to NIC to identify a specific computer or device to show the source and destination of data transmission.

Traditional Ethernet uses CSMA/CD.

- CSMA/CD (Carrier Sense Multiple Access/ Collision Detection) is a media-access control method that was widely used in Early Ethernet technology/LANs, when there used to be shared Bus Topology and Nodes(Computers) were connected By Coaxial Cables.
- Carrier Sense Multiple Access with Collision Detection (CSMA/CD) is used as a standard in ethernet to reduce data collisions and increase successful data transmission.
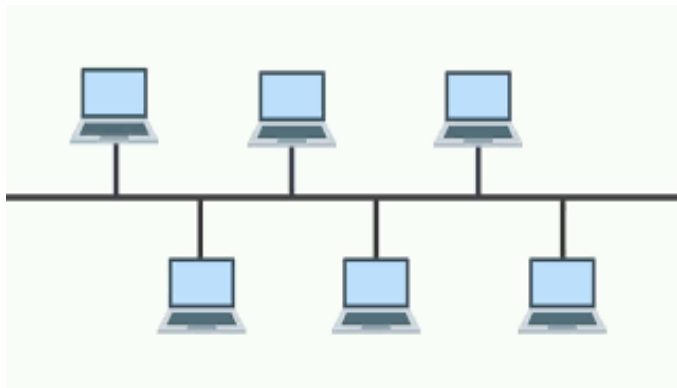
Carrier:

- Refers to transmission medium.
- Media carries data, hence called carrier.

Carrier Sense:

- Each machine has the ability to sense whether data is available in the cable.
- A node on a network has sense: listen and hear.

Multiple Access:

- Every node has access to the cable at the same time.
- Every node has equal right to use and access the shared medium, but they must take turns.

- CSMA means before a node transmits data, it checks or listens to the medium.
- When the medium is not busy, the node sends its data.
- If it detects the medium is used, it will back off and wait for a random amount of time and try again.
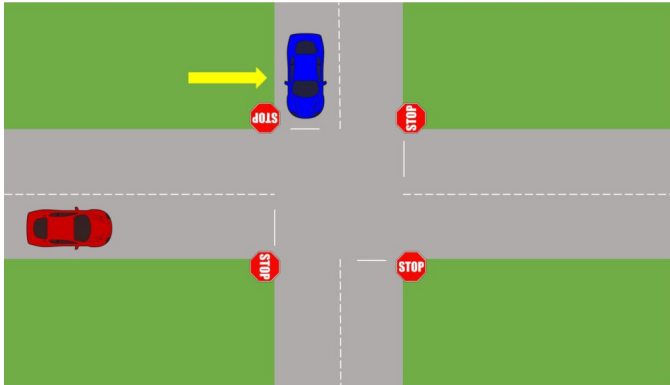
- eg) Traffic- Junction: Check the state at the junction. Every driver can use the junction. Wait and check.
- Collision Detection: If two send data at the same time (no sgl), both will back off and wait.

How CSMA/CD works?

- Check if the sender is ready for transmitting data packets.
- Check if the transmission link is idle?
  Sender has to keep on checking if the transmission link/medium is idle. For this it continuously senses transmissions from other nodes. If it senses that the carrier is free and there are no collisions, it sends the data. Otherwise it refrains from sending data.

- Transmit the data & check for collisions.
  Sender transmits its data on the link. It checks for the
  successful and unsuccessful transmissions through collision
  signals. During transmission, if collision signal is received by
  the node, transmission is stopped. The station then transmits
  a jam signal onto the link and waits for random time interval
  before it resends the frame. After some random time, it again
  attempts to transfer the data and repeats above process.
- If no collision was detected in propagation, the sender
  completes its frame transmission and resets the counters.

THANK YOU