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Module 1

Explain in detail about data transmission and communication.

Ans - Data transmission refers to the process of transferring analog or digital data between two or more devices. The data can be transferred from one device to another device in a point-to point. point-to-multipoint. or in multipoint -to point environment and the data is transferred in the form of the bitstream. It is also known as "Data Transmission" or also called as "Digital Communication" ~~In data Transmission. It provides the communication~~ &.

Types of Data Transmission

(i) Parallel Transmission
(ii) Serial Transmission

(i) Parallel Transmission refers to the process of sending multiple data parallelly at the same time over multiple channels known as "parallel Transmission". In this type of transmission. each node required each channel for the transmission and it is much faster than the Serial transmission.

Advantages of parallel Transmission

(i) Transferring speed of data is fast.
(ii) This type of transmission is suitable for short-distance communication.

(ii) Serial Transmission

In serial Transmission Multiple data can be sent over a single channel one after another known as "serial Transmission" At the the time of transmitting the data from Sender to receiver that time each node doesnot require ~~not~~ multiple channels.

Advantages of Serial Transmission

(i) It is cost-effective transmission where only a single communication channel is required
(ii) It is suitable for short and long - distance communication.

Communication

Communication in the context of data transmission involves the exchange of information between two or more parties. These parties could be computers, devices or even humans. Effective communication involves not only sending data but also receiving, processing and understanding the received data.

-) Data communication process

1) Data encoding - The process of converting data into a suitable format for transmission

2) Transmission - Data is sent over the chosen medium & with consideration for factors like bandwith, speed etc

3) Reception - The receiver picks up the transmitted ~~ting~~ signal and prepares it for ~~decoding~~ decoding

4) Data ~~Encoding~~ Decoding - The process of converting the received signal back into its original format for further processing or display

-) Challenges in Data communication

(1) Noise :- Interference during transmission that can distort the signal

(2) Attenuation - The ~~weaking of~~ weakening of the signal as it travels through a medium leading to loss of data integrity.

3) Data loss - Bits of data can be lost during transmission due to various factors

Q. Explain in detail the guided / wire mode of transmission

Guided media :- It is defined as the physical medium through which the signals are transmitted. It is also known as Bounded media.

Types of guided media :-

(i) Twisted pair
(ii) Coaxial cable
(iii) Fibre optic

(i) Twisted pair :- Twisted pair is a physical media made up of a pair of cables twisted with each other. A twisted pair cable is cheap as compared to other transmission media. Installation of the twisted pair cable is easy. And it is a lightweight cable

- Types of twisted pair
  i) Unshielded twisted pair
  ii) Shielded twisted pair

(ii) Coaxial cable :-
  i) Coaxial cable is very commonly used transmission media, for example TV wire is usually a coaxial cable.
  ii) The name of the cable is coaxial as it contains two conductors parallel to each other.
  iii) It has higher frequency as compared to twisted pair cable.

- Types of coaxial
  i) Baseband transmission
  ii) Broadband transmission

Fibre optic

i) Fibre optic cable is a cable that uses electrical signals for communication.
ii) It holds the optical fibres coated in plastic that are used to send the data by pulses of light
(iii) Fibre optics provide faster data transmission than copper wires.

i) Types of fibre optic
ii) Multimode
Single-mode

c. Explain in detail all the different types of goals in a network.

Ans. The following are some important goals of computer networks:

1. Resource sharing:- Many organization has a substantial number of computers in operations, which are located apart. Ex. A group of office workers can share a common printer, fax, modem, scanner, etc.

2. High Reliability:- If there are alternate sources of supply, all files could be replicated on two or more machines. If one of them is not available due to hardware failure, the other copies could be used.

3. Inter-process communication:- Network users, located geographically apart may converse in an interactive session through the network. In order to permit this the network must provide almost error-free communications.

4. Flexible access - Files can be accessed from any computer in the network. The project can be begun on one computer and finished on another.

5. Security - Computer networks must be secure to protect against unauthorized access, data breaches and other security threats.

6. Performance - Computer networks must provide high performance and low latency to ensure that applications and services are responsive and available when needed.

7. Scalability - Computer networks must be designed to scale up or down as needed to accomodate changes in the number of users, devices, and data traffic. This requires careful planning and management to ensure the network can meet current and future needs.

d. What are the various causes of attenuation in a network?

Attenuation in a network refers to the decrease in signal strength as it travels over a transmission medium or through a network. Attenuation degrade the quality of a signal and limit the distance over which data can be reliably transmitted.

Causes of attenuation:

1) Distance Attenuation:

The most common causes of attenuation is the simple fact that signals weaker as they travel over distance The longer the distance, the more the signal strength diminishes ~~the more the signal strength~~ This effect is especially pronounced in the electrical signal over copper wires and wireless signals.

2) Frequency attenuation:

Highest-frequency signals experience greater attenuation than low-frequency signals over the same distance This is known as frequency dependent attenuation. It can be caused by factors like free space path loss.

3) External ~~interfance~~ Interference:

~~Interfance~~ Interference occurs when unwanted signals from other sources disrupt the transmitted signal Electromagnetic interference (EMI) and Radio frequency Interference (RFI)

4) cable quality

In copper cables attenuation occurs due to resistance in the conductors. The higher the resistance, the greater the attenuation.

optical fibres have lower attenuation compared to copper cables because they transmit data using light signal which experience less signal degradation over distance

e. Explain 6 different types of topologies in a network

Ans: Topology defines the structure of the network of how all the components are interconnected to each other.

Types of network Topology

i) Bus Topology
ii) Ring Topology
iii) Tree Topology
iv) Star Topology
v) Mesh Topology
vi) Hybrid Topology

1) Bus Topology

i) The bus topology is designed in such a way that all the stations are connected through a single cable known as a backbone cable.

ii) Each node is either connected to the backbone cable by drop cable or directly connected to the backbone cable

iii) The configuration of a bus topology is quite simpler as compared to other topologies.

2) Ring Topology

i) Ring Topology is like bus topology, but with connected ends.

ii) The node that receives the message from the previous computer will retransmit to the next node.

iii) The data flows in one direction, i.e, it is uni-directional

3) Tree Topology

i) Tree Topology combines the characteristics of bus topology and star topology.

i) A tree topology is a type of structure in which all the computers are connected with each other in hierarchical fashion.

ii) The top-most node in tree topology is known as a root node, and all other nodes are the descendants of the root node.

4) Star Topology

i) Star topology is an arrangement of the network in which every node is connected to the central hub, switch or a central computer.

ii) The central computer is known as a server, and the peripheral devices attached to the server are known as clients.

iii) Coaxial cable or RJ-45 cables are used to connect the computers.

5) Mesh Topology

i) Mesh Topology is an arrangement of the network in which computers are interconnected with each other through various redudant connections.

ii) There are multiple paths from one computer to another computer.

iii) The internet is an example of the mesh topology.

6) Hybrid Topology

i) The combination of various different topologies known as Hybrid topology.

ii) A Hybrid topology is a connection between different links and nodes to transfer the data.

iii) when two or more different topologies are combined together is termed as Hybrid topology and if similar topologies are connected with each other will not result in Hybrid topology.

Explain OSI & TCP/IP model in network.

Ans. OSI stands for open system interconnection, which was developed in 1980s. It is a conceptual model used for network communication. It is not implemented entirely but it is still referenced today. This OSI model consists of seven layers, and each layer is connected to each other. The data moves down the OSI model, and each layer adds additional information. The data moves down until it reaches the last layer of the OSI model.

① OSI model consists of 7 layers :-
Physical layer - Transmits raw bit stream over the physical medium.

② Data link layer - defines the format of data on the network.

③ Network layer - decides which physical path the data will take

④ Transport layer - Transmits data using transmission protocols including TCP and UDP

⑤ Session layer - Maintains connections and is responsible for controlling ports and sessions

⑥ Presentation layer - ensures that the data is in a usable format and is where data encryption occurs.

⑦ Application layer - Human computer interaction layer, where applications can access the network services.

TCP/IP model

The TCP model stands for Transmission control protocol, whereas IP stands for internet protocol. A number of protocols that make the internet possibly comes under the TCP/IP model. Nowadays, we do not hear the name of the TCP/IP model much, we generally hear the name of the IPV4 or IPV6, but it is still valid.

(i) TCP/IP model consists of 4 layers

→ Application layer

(ii) → Corresponds to the top three layers of the OSI model.

→ Handles user interfaces and application services.

(iii) → example protocols: HTTP, SMTP

→ Transport layer

→ Similar to the transport layer in the OSI model

→ Provides reliable data delivery and flow control.

→ example protocols: TCP (Transmission control protocol)
UDP (User Datagram protocol).

(iv) → Internet layer

→ Equivalent to the network layer in OSI.

→ Responsible for logical addressing and packet forwarding.

→ example protocols: IP, ICMP

(v) TCP/IP → Interface layer

→ combines the Data link and physical layers from OSI.

→ ensures reliable data transfer within a local network.

→ example protocols: ethernet, PPP

Module - 2

Data link layer

1.) Answer the following question.

a) Explain in detail the different types of operations of the Data link layer

→ Data link layer is the second layer of the OSI (open system interconnection) model and it is responsible for reliable data transfer between directly connected nodes over a physical medium.

The Data link layer primarily performs the following operations:

1) Framing:

- Framing is the process of breaking the data into manageable frames or packets. It involves adding start and stop bits, headers, and trailers to identify the beginning and end of each frame.

2) Physical Addressing:

- The Data link layer uses physical (MAC) addresses to identify devices on the same network segment.

3) Flow control:

- Flow control mechanisms ensure that a sender does not overestim overextand a slower receiver with data. It manages the pace of data transmission.

4) Error Detection and correction

- The Data link layer detects and sometimes corrects errors that occur during data transmission

5) Access control:

- In shared network segments, where multiple devices compete for access to the transmission medium, access control mechanisms are essential

6) Acknowledgements:

- Acknowledgements are used to confirm the successful reception of data frames. They are crucial for ensuring data integrity and reliability.

b. i) Please provide definations for the following

Go Back N ARQ.

Go Back N ARQ is an automatic repeat request protocol used in data communication. In this protocol, the sender is allowed to transmit multiple frames before receiving acknowledgements from the receiver. If an error is detected in any frame all unacknowledged frames beyond the one in error are retransmitted. It offers high throughput but can be less efficient when errors occur frequently

ii) Stop-and wait flow control:

Stop-and wait flow control is a simple mechanism used to manage data flow between a sender and a receiver in data communication. The sender sends one data frame and then waits for an acknowledgement (ACK) from the receiver before sending the next frame. This ensures that frames are delivered in the correct order and helps prevent overwhelming the receiver.

iii) Control Buffer

A control Buffer is a data structure or memory space used within a communication system to temporarily store control information or frames before processing or transmission. It plays a crucial role in managing the flow of data and control signals within the data link layer of the OSI model. control Buffers help in organizing and controlling the flow of data within a network by storing and managing data temporarily.

c) A seven bit Hamming code is received as 1111101. what is the correct code. (even no of 1s is represented as 0)

Data Received = 1111101

1	1	1	1	1	0	1
D_7	D_6	D_5	P_4	D_3	P_2	P_1

P_1 = D_3, D_5, D_7

⇒ 1, 1, 1 ⇒ 1 (even parity) original P_1 = 1 (correct)

P_2 = D_3, D_6, D_7

⇒ 1, 1, 1 ⇒ 1 (even parity) original P_2 = 0 (error)

P_4 = D_5, D_6, D_7

⇒ 1, 1, 1 ⇒ 1 (even parity) original P_4 = 1 (correct)

So, the error is in P_2

New: P_1 ⇒ 1, 3, 5, 7 ⇒ 1, 1, 1, 1 ⇒ 0 (even)

P_2 ⇒ 2, 3, 6, 7 ⇒ 0, 1, 1, 1 ⇒ 1 (odd)

P_4 ⇒ 4, 5, 6, 7 ⇒ 1, 1, 1, 1 ⇒ 0 (even)

So, now we have 010. It means the error is in 2nd position as 010 is 2 in ~~decemal~~ decimal.

d. Explain the operation of the CRC error detection method by means of an example show how.

↳ The cyclic Redudancy check (CRC) error detection method is a widely used technique to detect errors in data transmission. It operates by appending a fixed-length check sequence (CRC bits) to the data message. The sender and receiver both have access to a shared generator polynomial, typically represented in binary terms.

↳ The steps for CRC error detection method are

1) The error dectation bits are generated using polynomial = $x^3 + x + 1$

$= x^3 + x^2 + x^1 + x^0$

1 0 1 1

let's ~~asse~~ assume we want to send the data 1101101 Now, let's append 3 zeros at the end of data frame The no of zeroes should be equal to the degree of the generator polynomial

Now, divide the data frame by the generator bit

```
           111101
1011 | 1101101000
        1011
        ----
        x1101
         1011
         ----
         x1100
          1011
          ----
          x1111
           1011
           ----
           x1000
            1011
            ----
            x0110
             0000
             ----
             x1100
              1011
              ----
              x111
```

∴ The remainder is 111 and hence the encoded data sent is 1101101111

2) Receiver's frame :- 1101101111

```
           1111101
1011 | 1101101111
        1011
        ----
        x1101
         1011
         ----
         x1100
          1011
          ----
          x1111
           1011
           ----
           x1001
            1011
            ----
            x0101
             0000
             ----
             x1011
              1011
              ----
              x
```

∴ The remainder has all zeroes, so the data received has no error.

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