CN Assignment

1. Explain in detail about OSI Reference model

The **Open Systems Interconnection (OSI) Reference Model** is a conceptual framework used to standardize the functions of a telecommunication or computing system into seven distinct layers. It was developed by the International Organization for Standardization (ISO) in 1984 to provide a framework for understanding and designing a network architecture that is interoperable across different systems.

OSI Model Layers:

1. **Physical Layer**:
   - This is the lowest layer of the OSI model. It deals with the physical connection between devices and the transmission of raw bitstreams over a physical medium.
   - Key functions: bit-level transmission, electrical/optical signaling, cabling, connectors, and the physical aspects of network hardware.
2. **Data Link Layer**:
   - This layer is responsible for node-to-node data transfer and error detection and correction. It organizes data into frames for transmission.
   - Sub-layers:
     - Logical Link Control (LLC): Error checking and flow control.
     - Media Access Control (MAC): Controls how devices access the medium.
3. **Network Layer**:
   - The network layer is responsible for data routing, packet forwarding, and addressing. It ensures that data reaches its destination across networks.
   - Key functions: logical addressing (IP addresses), routing, path determination.
4. **Transport Layer**:
   - This layer is responsible for delivering data across networks. It ensures error recovery, data flow control, and reliable data transfer between two devices.
   - Key protocols: Transmission Control Protocol (TCP), User Datagram Protocol (UDP).
5. **Session Layer**:
   - The session layer manages sessions or connections between applications. It establishes, maintains, and terminates communication sessions.
   - Key functions: session establishment, synchronization, and dialog control.
6. **Presentation Layer**:
   - The presentation layer translates data between the application layer and the network format. It ensures that data is in a usable format and performs encryption, compression, and translation.

- Key functions: data format conversion, encryption, compression.

7. **Application Layer**:
    - This is the topmost layer that interfaces with the end-user applications. It provides network services to applications such as email, file transfer, and web browsing.
    - Key protocols: HTTP, FTP, SMTP, DNS.

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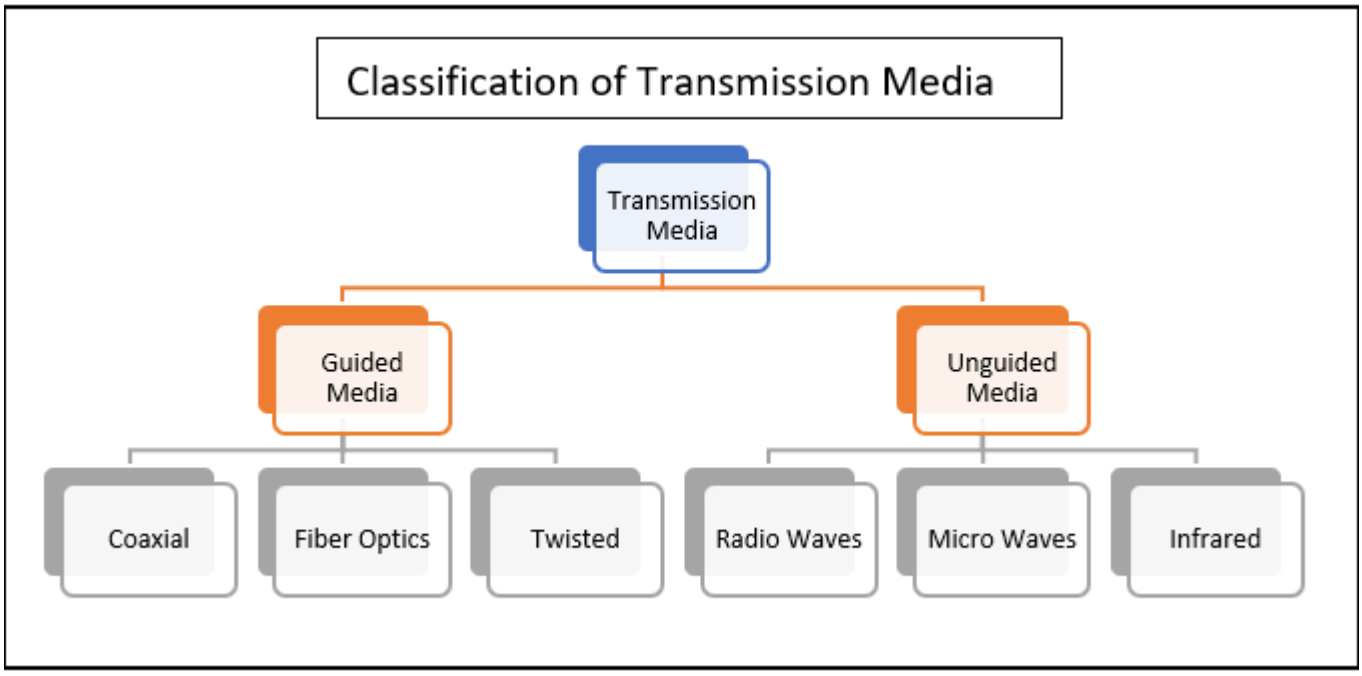
2. Explain about Transmission Medium with neat diagram

A **transmission medium** is the physical path between the sender and the receiver in a data communication system. It is categorized into two main types:

1. **Guided Media (Wired Media)**:
    - Guided media are those that use a physical path to transmit data, such as cables and fibers.
    - Types:
        - **Twisted Pair Cable**: A pair of copper wires twisted together. Commonly used in telecommunication networks (e.g., telephone lines, Ethernet cables).
        - **Coaxial Cable**: Consists of a core conductor, insulation, shielding, and outer insulation. Used in cable TV networks.
        - **Optical Fiber**: Uses light to transmit data. It provides high bandwidth and long-distance transmission. Common in modern telecommunication systems.
2. **Unguided Media (Wireless Media)**:
    - Wireless media transmits data through the air or vacuum without the use of physical cables.
    - Types:
        - **Radio Waves**: Used for radio broadcasting, mobile phones, and Wi-Fi.
        - **Microwaves**: High-frequency waves used in satellite communication.
        - **Infrared**: Used in remote controls and short-range communication.

Diagram: Transmission Media



3a) Explain about hamming, codes with an example

Hamming Codes are used for error detection and correction. They can detect and correct single-bit errors and are commonly used in data transmission and storage systems.

Working of Hamming Code:

1. **Parity bits**: Hamming code adds parity bits to the data to ensure error detection and correction. For a data bit of length `n`, Hamming codes use `k` parity bits, where `2^k >= n + k + 1`.

2. **Positioning of parity bits**: Parity bits are placed at positions that are powers of two (1, 2, 4, 8...).

3. **Error detection and correction**: By recalculating the parity at the receiver's end, errors can be detected and the bit position with an error can be identified and corrected.

Example:

Consider 4 bits of data: `1011`. The Hamming code adds 3 parity bits.

1. **Data with parity bits**:
   - `d4, d3, d2, p3, d1, p2, p1`
   - Data: `1 0 1 1` → Position the data: `_ _ 1 _ 0 1 1`
2. **Calculate parity bits**:
   - `p1`: Covers positions 1, 3, 5, 7 → Covers: `_, 1, 0, 1`. Parity = 1.
   - `p2`: Covers positions 2, 3, 6, 7 → Covers: `_, 1, 1, 1`. Parity = 0.

- `p3`: Covers positions 4, 5, 6, 7 → Covers: `1, 0, 1, 1`. Parity = 1.

3. **Final transmitted code**: `1010111`.

If an error occurs during transmission, the parity checks can determine which bit is incorrect.

3b) Explain about Cyclic Redundancy Check (CRC) with Example

Cyclic Redundancy Check (CRC) is an error-detecting code used to detect accidental changes to raw data. It treats data as a large binary number, divides it by a predetermined divisor, and appends the remainder (CRC bits) to the end of the data.

CRC Calculation:

1. **Dataword**: `11010011101100`
2. **Divisor (Generator Polynomial)**: `1011`
3. **Append zeros** to the dataword (based on the divisor size): `11010011101100000`
4. **Perform binary division** using XOR (similar to long division).

Example:

- Dataword: `11010011101100`
- Generator Polynomial (Divisor): `1011`

Perform the XOR division of `11010011101100` by `1011`, and append the remainder to the data. The resulting codeword will include the data plus CRC bits. This ensures any bit errors can be detected by rechecking the remainder at the receiver's end.