Computer Communication Networks - Detailed Notes

Network Topologies

- Definitions of topologies (Mesh, Bus, Star, Ring).

- Characteristics, advantages, and disadvantages of each topology.

- Calculation of full-duplex links for given devices in Mesh topology.

  Formula: Number of links = n(n-1)/2, where n = number of devices.

Switching Techniques

- Circuit Switching: Establishes a dedicated path before data transfer; suitable for real-time communication.

- Packet Switching: Data divided into packets; packets can take independent paths to the destination.

- Message Switching: Entire message stored and forwarded; requires significant storage.

- Comparison of advantages and drawbacks for each.

Protocols

- TCP (Transmission Control Protocol):

  * Connection-oriented.

  * Includes sequence numbers, acknowledgment, and error-checking fields.

- UDP (User Datagram Protocol):

  * Connectionless, lightweight, and suitable for real-time applications.

- HTTP, SMTP, and FTP:

* HTTP: Hypertext Transfer Protocol for web communication.

* SMTP: Simple Mail Transfer Protocol for email.

* FTP: File Transfer Protocol for file uploads/downloads.

Error Control

- CRC (Cyclic Redundancy Check): Detects errors in transmitted data using polynomial division.

- Hamming Distance: Minimum number of bit changes required to convert one binary code to another.

- Stop-and-Wait ARQ: Sender waits for an acknowledgment before sending the next frame.

- Go-Back-N ARQ: Allows a window of frames to be sent; retransmits on error.

- Selective Repeat ARQ: Only erroneous frames are retransmitted.

Routing

- Distance Vector Routing (DVR):

  * Shares routing tables with neighbors.

  * Count-to-Infinity problem resolved using techniques like split horizon.

- Link State Routing (LSR):

  * Uses Dijkstra's algorithm for shortest path calculation.

- Subnetting:

  * Dividing IP address ranges into smaller subnets.

  * Calculating first/last address and subnet masks.

Congestion Control

- Leaky Bucket Algorithm:

* Controls data flow by regulating the rate at which packets are sent.

- Token Bucket Algorithm:

  * Allows bursty traffic while maintaining overall rate control.

- Hybrid models combine features of both for efficient traffic shaping.

Security

- RSA Algorithm:

  * Asymmetric encryption using public and private keys.

  * Encryption: C = P^e mod n, Decryption: P = C^d mod n.

- DES (Data Encryption Standard):

  * Symmetric encryption, converting 64-bit plaintext into 64-bit ciphertext using a 56-bit key.

Data Link Layer Protocols

- HDLC (High-Level Data Link Control):

  * Frame types: I-frame, S-frame, U-frame.

  * Used for error and flow control.

- Ethernet Frame Format:

  * Preamble, Source/Destination MAC, Data, CRC.

- Token Ring (IEEE 802.5):

  * Frame structure includes Start/End Delimiters and Token fields.

Compression Techniques

- Data Compression Methods:

  * Lossy: Removes non-essential data (e.g., JPEG).

  * Lossless: Retains all original data (e.g., Huffman coding).

- JPEG Compression Process:

 * Converts image data into frequency domain using DCT (Discrete Cosine Transform).

OSI and TCP/IP Models

- OSI Model Layers:

 * Physical, Data Link, Network, Transport, Session, Presentation, Application.

- TCP/IP Model:

 * Combines OSI layers into four: Link, Internet, Transport, Application.

- Synchronous vs. Asynchronous Data Transfer:

 * Synchronous: Data synchronized with a clock signal.

 * Asynchronous: Data sent with start/stop bits to indicate transmission.