Topics Covered:

Transport-layer services

Multiplexing and demultiplexing

Connectionless transport: UDP

Principles of reliable data transfer

Connection-oriented transport: TCP

Principles of congestion control

TCP congestion control

Transport Layer Overview

Goal: To be able to explain the different kinds of transport layer services such as:

Multiplexing/Demultiplexing: Directing data to the correct application process.

Reliable Data Transfer: Data delivery must be correct and in order.

Flow Control: Prevention of information overflow beyond the capacity of the receiver.

Congestion Control: No packet losses are caused by overloaded information transmission in a network.

Transport Protocols:

TCP (Transmission Control Protocol): Reliable connection-oriented production with a flow as well as congestion controls.

UDP (User Datagram Protocol): Connectionless, unreliable and light weight.
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Multiplexing and Demultiplexing

Multiplexing: Collection of data from several sockets merging into one's segment at the transport layer.

Demultiplexing: Segment reception based on port numbers and IP addresses is delivered to the respective socket.

UDP Demultiplexing: It uses destination port numbers only.

TCP Demultiplexing: It uses a 4-tuple (source IP, source port, destination IP, destination port) to identify sockets.

Principles of Reliable Data Transfer

Reliable Data Transfer (RDT): Correct and in-sequence delivery of data even when retransmission capability over an unreliable channel exists.

RDT Protocols:

- RDT 1.0: Defines a reliable channel (no errors or lost packets) as if existing.
- RDT 2.0: Deals with error alterations using checksum messages, acknowledgments (ACKs), and negative acknowledgments (NAKs).
- RDT 2.1: Adds sequence numbering to manage duplicate packets.
- RDT 2.2: Eliminates NAK by using ACK with sequence number.
- RDT 3.0: Manages bit errors and loss of packets using timers and retransmissions.

Stop-and-Wait Protocol: Sending a single packet and waiting for an acknowledgment before sending another. Greatly unequal transmission; high latency means decreased efficiency.