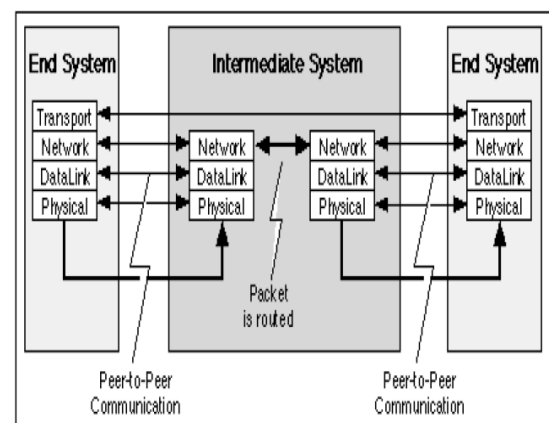
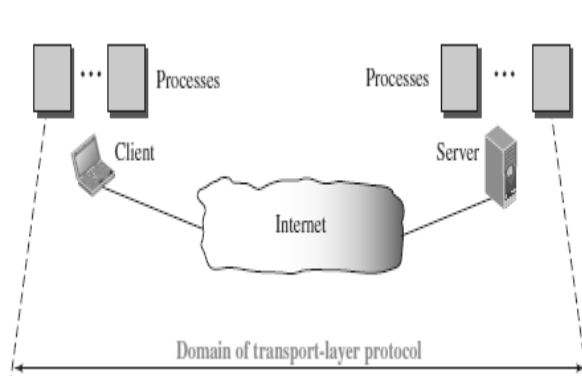


UNIT – IV : TRANSPORT LAYER

Introduction – Transport Layer Protocols – Services – Port Numbers – User Datagram Protocol – Transmission Control Protocol – SCTP.

1. INTRODUCTION

- The transport layer is the fourth layer of the OSI model and is the core of the Internet model.
- It responds to service requests from the session layer and issues service requests to the network Layer.
- The transport layer provides transparent transfer of data between hosts.
- It provides end-to-end control and information transfer with the quality of service needed by the application program.
- It is the first true end-to-end layer, implemented in all End Systems (ES).



TRANSPORT LAYER FUNCTIONS / SERVICES

- The transport layer is located between the network layer and the application layer.
- The transport layer is responsible for providing services to the application layer; it receives services from the network layer.
- The services that can be provided by the transport layer are
 1. Process-to-Process Communication
 2. Addressing : Port Numbers
 3. Encapsulation and Decapsulation
 4. Multiplexing and Demultiplexing
 5. Flow Control
 6. Error Control
 7. Congestion Control

Process-to-Process Communication

- The Transport Layer is responsible for delivering data to the appropriate application process on the host computers.
- This involves multiplexing of data from different application processes, i.e. forming data packets, and adding source and destination port numbers in the header of each Transport Layer data packet.
- Together with the source and destination IP address, the port numbers constitutes a network socket, i.e. an identification address of the process-to-process communication.

Addressing: Port Numbers

- Ports are the essential ways to address multiple entities in the same location.
- Using port addressing it is possible to use more than one network-based application at the same time.
- Three types of Port numbers are used :
 - ✓ **Well-known ports** - These are permanent port numbers. They range between 0 to 1023. These port numbers are used by Server Process.
 - ✓ **Registered ports** - The ports ranging from 1024 to 49,151 are not assigned or controlled.
 - ✓ **Ephemeral ports (Dynamic Ports)** – These are temporary port numbers. They range between 49152–65535. These port numbers are used by Client Process.

Encapsulation and Decapsulation

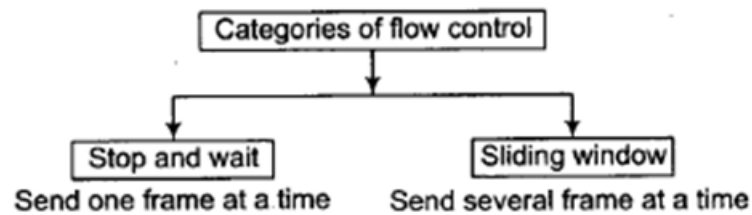
- To send a message from one process to another, the transport-layer protocol encapsulates and decapsulates messages.
- Encapsulation happens at the sender site. The transport layer receives the data and adds the transport-layer header.
- Decapsulation happens at the receiver site. When the message arrives at the destination transport layer, the header is dropped and the transport layer delivers the message to the process running at the application layer.

Multiplexing and Demultiplexing

- Whenever an entity accepts items from more than one source, this is referred to as **multiplexing** (many to one).
- Whenever an entity delivers items to more than one source, this is referred to as **demultiplexing** (one to many).
- The transport layer at the source performs multiplexing
- The transport layer at the destination performs demultiplexing

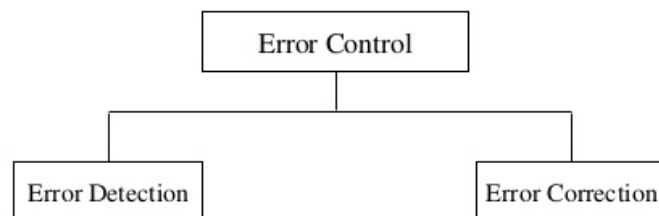
Flow Control

- Flow Control is the process of managing the rate of data transmission between two nodes to prevent a fast sender from overwhelming a slow receiver.
- It provides a mechanism for the receiver to control the transmission speed, so that the receiving node is not overwhelmed with data from transmitting node.



Error Control

- Error control at the transport layer is responsible for
 1. Detecting and discarding corrupted packets.
 2. Keeping track of lost and discarded packets and resending them.
 3. Recognizing duplicate packets and discarding them.
 4. Buffering out-of-order packets until the missing packets arrive.
- Error Control involves Error Detection and Error Correction



Congestion Control

- Congestion in a network may occur if the *load* on the network (the number of packets sent to the network) is greater than the *capacity* of the network (the number of packets a network can handle).
- Congestion control refers to the mechanisms and techniques that control the congestion and keep the load below the capacity.
- Congestion Control refers to techniques and mechanisms that can either prevent congestion, before it happens, or remove congestion, after it has happened
- Congestion control mechanisms are divided into two categories,
 1. Open loop - prevent the congestion before it happens.
 2. Closed loop - remove the congestion after it happens.

2. PORT NUMBERS

- A transport-layer protocol usually has several responsibilities.
- One is to create a process-to-process communication.
- Processes are programs that run on hosts. It could be either *server* or *client*.
- A process on the local host, called a *client*, needs services from a process usually on the remote host, called a *server*.
- Processes are assigned a unique 16-bit *port number* on that host.
- Port numbers provide end-to-end addresses at the transport layer
- They also provide multiplexing and demultiplexing at this layer.