# The Transport and Application Layer

# Transport Layer

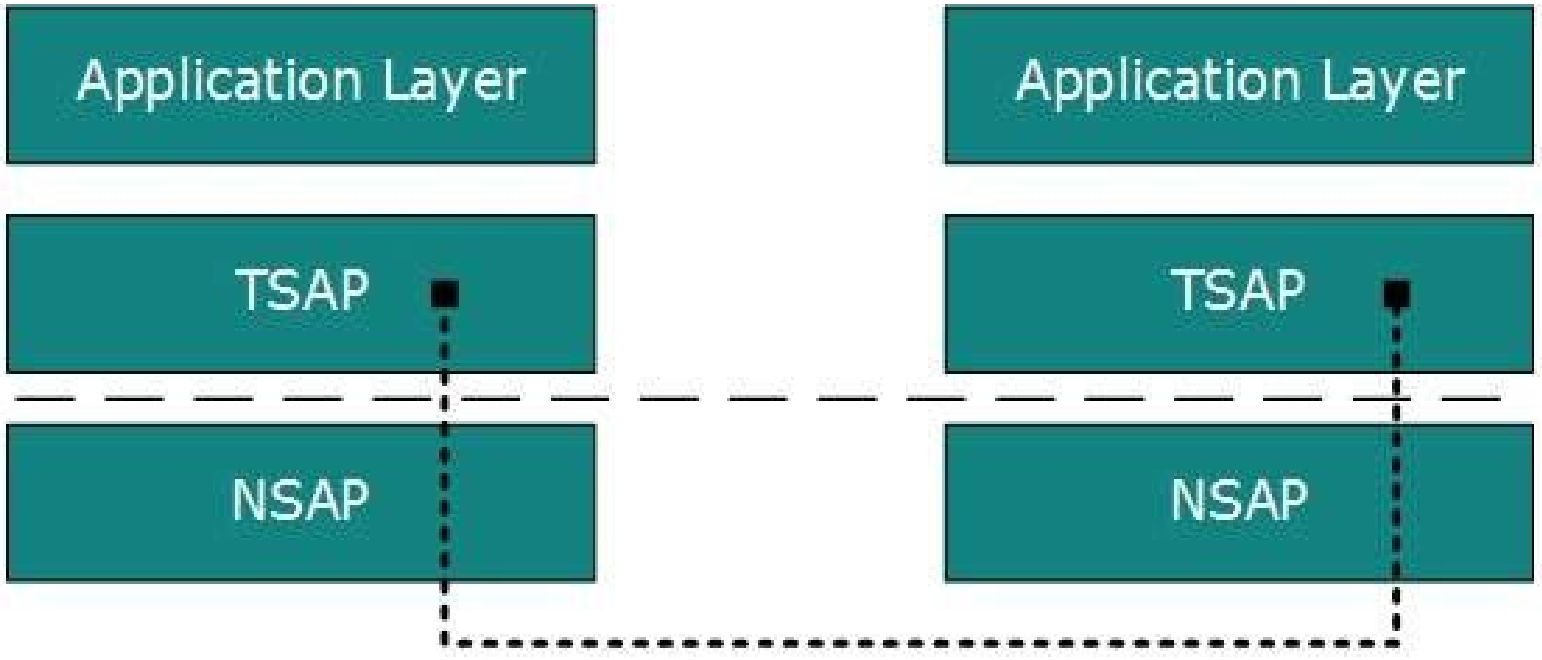
- The transport layer is a **4th layer** from the top.
- The main role of the transport layer is to provide the communication services directly to the **application processes** running on different hosts.
- Transport layer offers **peer-to-peer** and **end-to-end** connection between two processes on remote hosts.
- Transport layer takes data from upper layer (i.e. Application layer) and then **breaks it into smaller size segments**, **numbers each byte**, and **hands over to lower layer** (Network Layer) for delivery.

# *Functions*

- This Layer is the first one which **breaks the information data,** supplied by Application layer in to smaller units called **segments**.
- This layer ensures that **data must be received in the same sequence in which it was sent.**
- This layer provides end-to-end delivery of data between hosts which may or may not belong to the same subnet.
- All server processes intend to communicate over the network are equipped with well-known **Transport Service Access Points (TSAPs)** also known as **port numbers**.

# *End-to-End Communication*

- A process on one host identifies its peer host on remote network by means of TSAPs, also known as **Port numbers**.
- TSAPs are very well defined and a process which is trying to communicate with its peer knows this in advance.



- For example, when a DHCP client wants to communicate with remote DHCP server, it always requests on port number 67. When a DNS client wants to communicate with remote DNS server, it always requests on port number 53 (UDP).

The two main Transport layer protocols are:

- **Transmission Control Protocol**
  - It provides reliable communication between two hosts.
- **User Datagram Protocol**
  - It provides unreliable communication between two hosts.

# *Transmission Control Protocol (TCP)*

The Transmission Control Protocol (TCP) is one of the most important protocols of Internet Protocols suite. It is most widely used protocol for data transmission in communication network such as internet.

- Features
  - TCP is **reliable** protocol. That is, the receiver always sends either positive or negative acknowledgement about the data packet to the sender, so that the sender always has bright clue about whether the data packet is reached the destination or it needs to resend it.
  - TCP ensures that the data reaches intended destination in the same order it was sent.
  - TCP is connection oriented. TCP requires that connection between two remote points be established before sending actual data.
  - TCP provides error-checking and recovery mechanism.
  - TCP provides end-to-end communication.
  - TCP provides flow control and quality of service.
  - TCP operates in Client/Server point-to-point mode.

# *User Datagram Protocol (UDP)*

- The User Datagram Protocol (UDP) is simplest Transport Layer communication protocol available of the TCP/IP protocol suite.
- UDP is said to be an unreliable transport protocol.

***Requirement of UDP***

- A question may arise, why do we need an unreliable protocol to transport the data?

- **For example,** in case of video streaming, thousands of packets are forwarded towards its users. Acknowledging all the packets is troublesome and may contain huge amount of bandwidth wastage. The best delivery mechanism of underlying IP protocol ensures best efforts to deliver its packets, but even if some packets in video streaming get lost, the impact is not calamitous and can be ignored easily. Loss of few packets in video and voice traffic sometimes goes unnoticed.

# *Features*

- UDP is used when acknowledgement of data does not hold any significance.
- UDP is good protocol for data flowing in one direction.
- UDP is simple and suitable for query based communications.
- UDP is not connection oriented.
- UDP does not provide congestion control mechanism.
- UDP does not guarantee ordered delivery of data.
- UDP is suitable protocol for streaming applications such as VoIP, multimedia streaming.

# Session Layer

- The Session Layer allows users on different machines **to establish active communication sessions between them**.
- It's main aim is to **establish**, **maintain** and **synchronize** the interaction between communicating systems.
- Session layer manages and synchronize the conversation between two different applications.
- In Session layer, streams of data are marked and are resynchronized properly, so that the ends of the messages are not cut prematurely and data loss is avoided.

# *Functions of Session Layer*

- **Dialog Control :** This layer allows two systems to start communication with each other in **half-duplex** or **full-duplex**.
- **Token Management:** This layer prevents two parties from attempting the same critical operation at the same time.
- **Synchronization :** This layer allows a process to add checkpoints which are considered as synchronization points into stream of data.

  Example: If a system is sending a file of 800 pages, adding checkpoints after every 50 pages is recommended. This ensures that 50 page unit is successfully received and acknowledged. This is beneficial at the time of crash as if a crash happens at page number 110; there is no need to retransmit 1 to100 pages.

# Presentation Layer

- The primary goal of this layer is to take care of the **syntax** and **semantics** of the information exchanged between two communicating systems.
- Presentation layer takes care that the data is sent in such a way that the receiver will understand the information(data) and will be able to use the data.
- Languages(syntax) can be different of the two communicating systems. Under this condition presentation layer plays a role translator.
- In order to make it possible for computers with different data representations to communicate, the data structures to be exchanged can be defined in an **abstract** way.

# *Functions of Presentation Layer*

- **Translation:** Before being transmitted, information in the form of characters and numbers should be changed to bit streams. The presentation layer is responsible for **interoperability** between encoding methods as different computers use different encoding methods. It translates data between the formats the network requires and the format the computer.
- **Encryption:** It carries out encryption at the transmitter and decryption at the receiver.
- **Compression:** It carries out data compression to reduce the bandwidth of the data to be transmitted. *The primary role of Data compression is to reduce the number of bits to be transmitted.* It is important in transmitting multimedia such as audio, video, text etc.

# Application Layer

- Application layer is the top most layer in OSI and TCP/IP layered model.
- This layer exists in both layered Models because of its significance, of interacting with user and user applications.
- This layer is for applications which are involved in communication system.
- A user may or may not directly interacts with the applications. Application layer is where the actual communication is initiated and reflects. Because this layer is on the top of the layer stack, it does not serve any other layers.
- When an application layer protocol wants to communicate with its peer application layer protocol on remote host, it hands over the data or information to the Transport layer. The transport layer does the rest with the help of all the layers below it.

# *Services of Application Layers*

- **Network Virtual terminal:** An application layer allows a user to log on to a remote host. To do so, the application creates a software emulation of a terminal at the remote host. The remote host thinks that it is communicating with one of its own terminals, so it allows the user to log on.

- **File Transfer, Access, and Management (FTAM):** An application allows a user to access files in a remote computer, to retrieve files from a computer and to manage files in a remote computer.

- **Addressing:** To obtain communication between client and server, there is a need for addressing. When a client made a request to the server, the request contains the server address and its own address.

- **Mail Services:** An application layer provides Email forwarding and storage.

- **Directory Services:** An application contains a distributed database that provides access for global information about various objects and services.

- **Authentication**: It authenticates the sender or receiver's message or both.

# *Application architecture is of two types:*

1. **Client-server architecture:** An application program running on the local machine sends a request to another application program is known as a **client**, and a program that serves a request is known as a **server**.

- **Characteristics Of Client-server architecture:**
  - In Client-server architecture, clients do not directly communicate with each other. For example, in a web application, two browsers do not directly communicate with each other.
  - A server is fixed, well-known address known as IP address because **the server is always on** while the client can always contact the server by sending a packet to the sender's IP address.
- **Disadvantage Of Client-server architecture:**

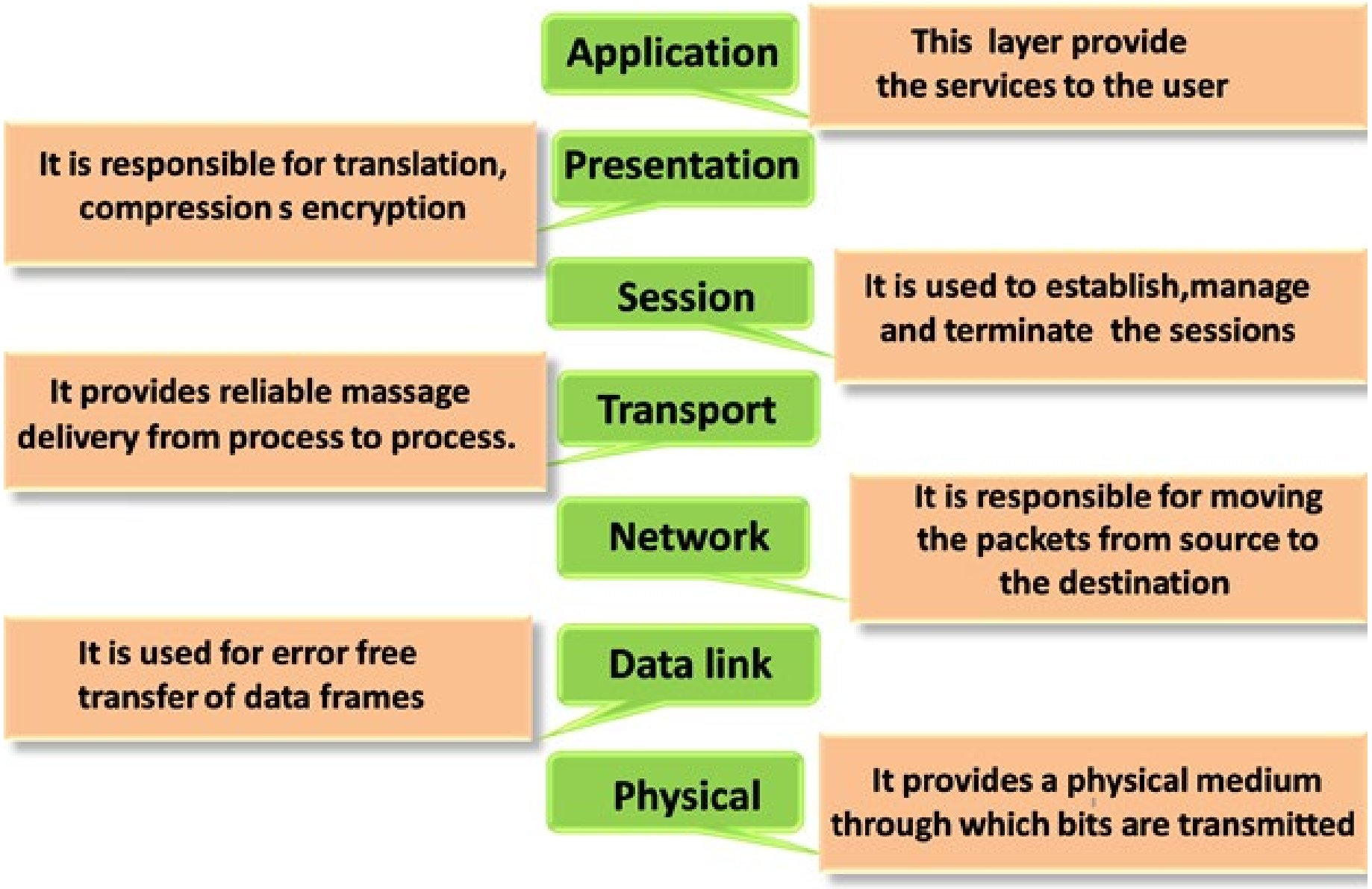
  It is a single-server based architecture which is incapable of holding all the requests from the clients. For example, a social networking site can become overwhelmed when there is only one server exists.

## 2. P2P (peer-to-peer) architecture

- It has no dedicated server in a data center.
- The peers are the computers which are not owned by the service provider. Most of the peers reside in the homes, offices, schools, and universities.
- The peers communicate with each other without passing the information through a dedicated server, this architecture is known as **peer-to-peer** architecture.
- The applications based on P2P architecture includes file sharing and internet telephony.

- **Features of P2P architecture**
  - **Self scalability:** In a file sharing system, although each peer generates a workload by requesting the files, each peer also adds a service capacity by distributing the files to the peer.
  - **Cost-effective:** It is cost-effective as it does not require significant server infrastructure and server bandwidth.

# Overview of OSI Layers



# DNS System

- ***Domain Name System (DNS)*** is a **naming service** that is used by TCP/IP network and is an essential service used by the Internet.
- Every time a user accesses a web page, the user must type a URL. Before the client communicates with the web server, the client computer needs to use DNS to retrieve the IP address of the web server.
- The DNS servers are often referred to as ***name servers***

# Electronic Mail

- Email is a service which allows us to send the message in electronic mode over the internet.
- It offers an efficient, inexpensive and real time mean of distributing information among people.

**E-Mail Address**

- Each user of email is assigned a unique name for his email account. This name is known as **E-mail address**. Different users can send and receive messages according to the e-mail address.
- E-mail is generally of the form username@domainname. For example, sujeet.k@inurture.co.in is an e-mail address where sujeet.k is username and inurture.co.in is domain name.

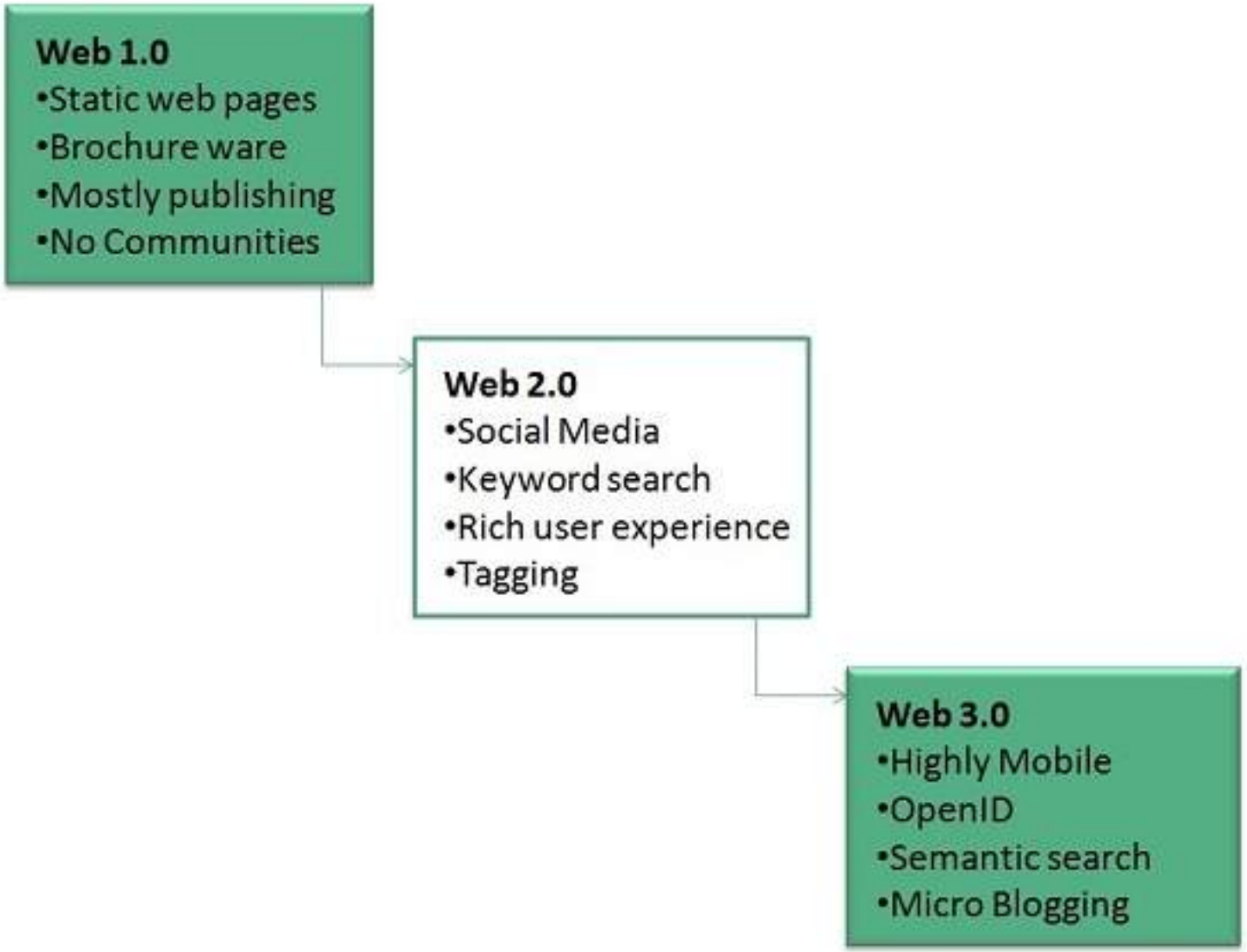
# The World Wide Web

- **WWW** stands for **World Wide Web**.

- In simple terms, The World Wide Web is a way of exchanging information between computers on the Internet, tying them together into a vast collection of interactive multimedia resources.

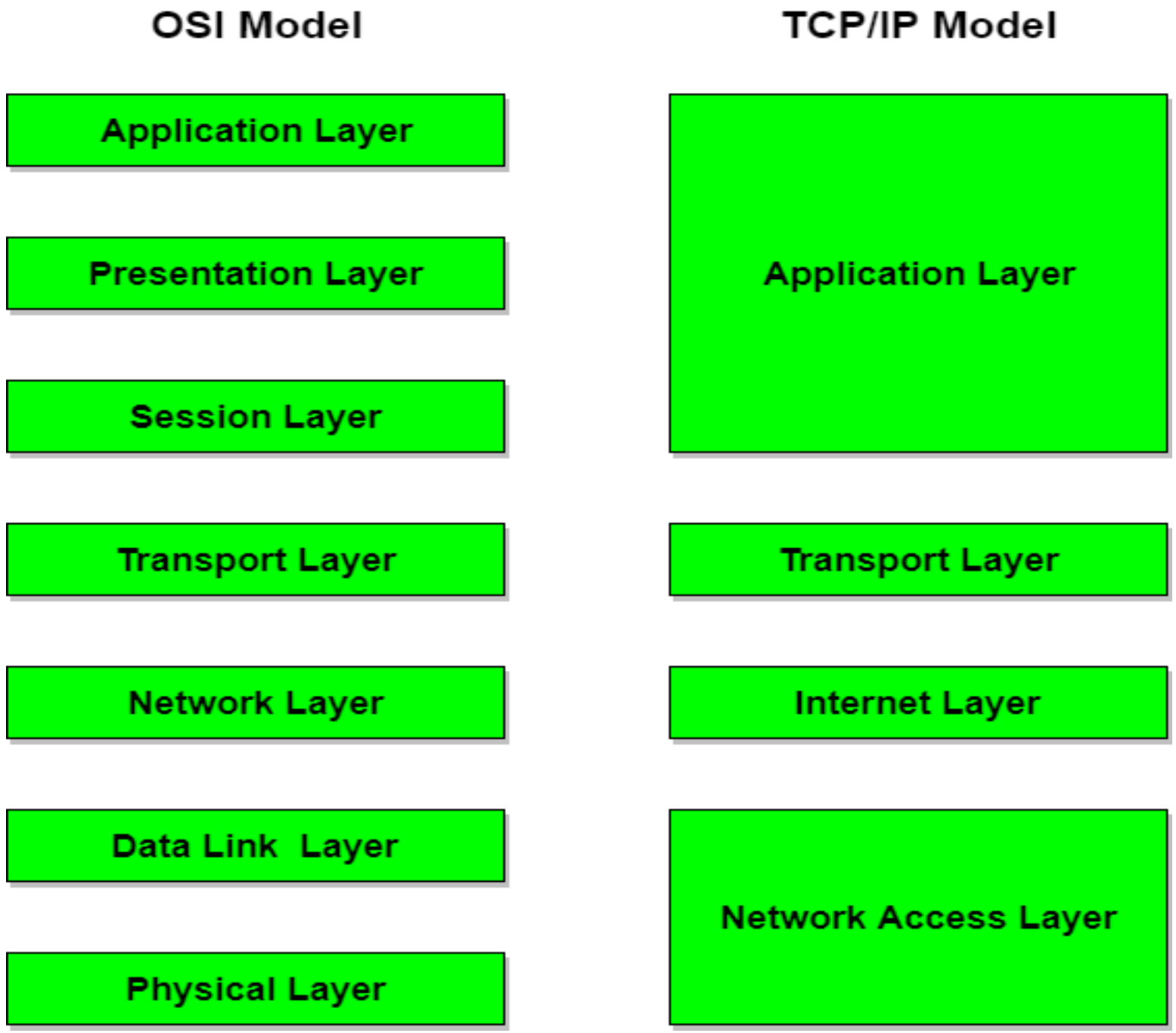
- **Internet** and **Web** is not the same thing: Web uses internet to pass over the information.

The following diagram briefly defines evolution of World Wide Web:



# *TCP/IP model*

- The TCP/IP model was developed **prior** to the OSI model.
- The TCP/IP model is not exactly similar to the OSI model.
- It contains four layers, unlike seven layers in the OSI model. The layers are:
  1. Process/Application Layer
  2. Host-to-Host/Transport Layer
  3. Internet Layer
  4. Network Access/Link Layer


OSI Model
TCP/IP Model
Application Layer
Presentation Layer
Session Layer
Transport Layer
Network Layer
Data Link Layer
Physical Layer
Application Layer
Transport Layer
Internet Layer
Network Access Layer

| TCP/IP | OSI |
| --- | --- |
| TCP refers to Transmission Control Protocol. | OSI refers to Open Systems Interconnection. |
| TCP/IP has 4 layers. | OSI has 7 layers. |
| TCP/IP is more reliable | OSI is less reliable |
| TCP/IP does not have very strict boundaries. | OSI has strict boundaries |
| Transport layer in TCP/IP does not provide assurance delivery of packets. | In OSI model, transport layer provides assurance delivery of packets. |
| TCP/IP model network layer only provides connection less services. | Connection less and connection oriented both services are provided by network layer in OSI model. |