# 1. **Week Objective**:

- ✓ To study OSI model in terms of architecture, layer functionalities, and protocol usage to gain a deeper understanding of modern network communication systems.
- ✓ To study and compare the OSI and TCP/IP models in terms of architecture, layer functionalities, and protocol usage to gain a deeper understanding of modern network communication systems.
- ✓ To study and compare the TCP and UDP protocol in TCP Model in terms of functionalities, protocol usage and applications to gain a deeper understanding of modern network communication systems.

# 2. Introduction

A network is a group of connected, communicating devices such as computers and printers. An internet is two or more networks that can communicate with each other. The most notable internet is called the “Internet” which is composed of hundreds of thousands of interconnected networks.

Protocols – A protocol is a set of rules that governs communication. For example, in a face-to-face communication between two persons, there is a set of implicit rules in each culture that define how two persons should start the communication, how to continue the communication, and how to end the communication

Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) both are protocols of the Transport Layer Protocols. TCP is a connection-oriented protocol whereas UDP is a part of the Internet Protocol suite, referred to as the UDP/IP suite. Unlike TCP, it is an unreliable and connectionless protocol.

# 3. TCP and UDP

TCP/IP protocol suite specifies two protocols for the transport layer: UDP (User Datagram Protocol) and TCP (Transmission Control Protocol).

TCP is represented as a connection-oriented protocol, TCP presents end-to-end communications. Moreover, when the communication is created among the transmitter and receiver, the data can be send over that communication.

While the UDP is a simple connectionless protocol. UDP does not constitute a dedicated end-to-end communication among the transmitter and the receiver before the real communication takes place. However, the data is being transported in one trend from the transmitter to the receiver with no need to verifying the receiver case.

UDP considered as a connectionless protocol and does not provide the reliable delivery for the data. UDP and TCP are various from each other in terms of the basic features for the data transmission.

However, TCP is more reliable comparing to the UDP, where TCP uses the retransmissions and the message acknowledgment if there is some loss in the packets.

| Basis | Transmission Control Protocol (TCP) | User Datagram Protocol (UDP) |
|---|---|---|
| Type of Service | TCP is a connection-oriented protocol. Connection orientation means that the communicating devices should establish a connection before transmitting data and should close the connection after transmitting the data. | UDP is the Datagram-oriented protocol. This is because there is no overhead for opening a connection, maintaining a connection, or terminating a connection. UDP is efficient for broadcast and multicast types of network transmission. |
| Reliability | TCP is reliable as it guarantees the delivery of data to the destination router. | The delivery of data to the destination cannot be guaranteed in UDP. |
| Error checking mechanism | TCP provides extensive error-checking mechanisms. It is because it provides flow control and acknowledgment of data. | UDP has only the basic error-checking mechanism using checksums. |
| Acknowledgment | An acknowledgment segment is present. | No acknowledgment segment. |
| Sequence | Sequencing of data is a feature of Transmission Control Protocol (TCP). this means that packets arrive in order at the receiver. | There is no sequencing of data in UDP. If the order is required, it has to be managed by the application layer. |
| Speed | TCP is comparatively slower than UDP. | UDP is faster, simpler, and more efficient than TCP. |
| Retransmission | Retransmission of lost packets is possible in TCP, but not in UDP. | There is no retransmission of lost packets in the User Datagram Protocol (UDP). |
| Header Length | TCP has a (20-60) bytes variable length header. | UDP has an 8 bytes fixed-length header. |
| Weight | TCP is heavy-weight. | UDP is lightweight. |
| Handshaking Techniques | Uses handshakes such as SYN, ACK, SYN-ACK | It's a connectionless protocol i.e. No handshake |
| Broadcasting | TCP doesn't support Broadcasting. | UDP supports Broadcasting. |
| Protocols | TCP is used by HTTP, HTTPs , FTP , SMTP and Telnet . | UDP is used by DNS , DHCP , TFTP, SNMP , RIP , and VoIP . |
| Stream Type | The TCP connection is a byte stream. | UDP connection is a message stream. |
| Overhead | Low but higher than UDP. | Very low. |
| Applications | This protocol is primarily utilized in situations when a safe and trustworthy communication procedure is necessary, such as in email, on the web surfing, and in military services. | This protocol is used in situations where quick communication is necessary but where dependability is not a concern, such as VoIP, game streaming, video, and music streaming, etc. |

**UDP: User Datagram Protocol**

UDP is a connectionless, unreliable transport protocol. It does not add anything to the services of IP except for providing process-to-process communication instead of host-to-host communication.

UDP Services:

- ✓ Process-to-Process Communication
- ✓ Connectionless Services
- ✓ Encapsulation and Decapsulation
- ✓ Queuing
- ✓ Multiplexing and Demultiplexing

Typical Applications of UDP:

I. UDP is suitable for a process that requires simple request-response communication with little concern for flow and error control. It is not usually used for a process such as FTP that needs to send bulk data.
II. UDP is suitable for a process with internal flow and error-control mechanisms. For example, the Trivial File Transfer Protocol (TFTP) process includes flow and error control. It can easily use UDP.
III. UDP is a suitable transport protocol for multicasting. Multicasting capability is embedded in the UDP software but not in the TCP software.
IV. UDP is used for management processes such as SNMP.
V. UDP is used for some route updating protocols such as Routing Information Protocol (RIP).
VI. UDP is normally used for real-time applications that cannot tolerate uneven delay between sections of a received message.

**TCP: Transmission Control Protocol**

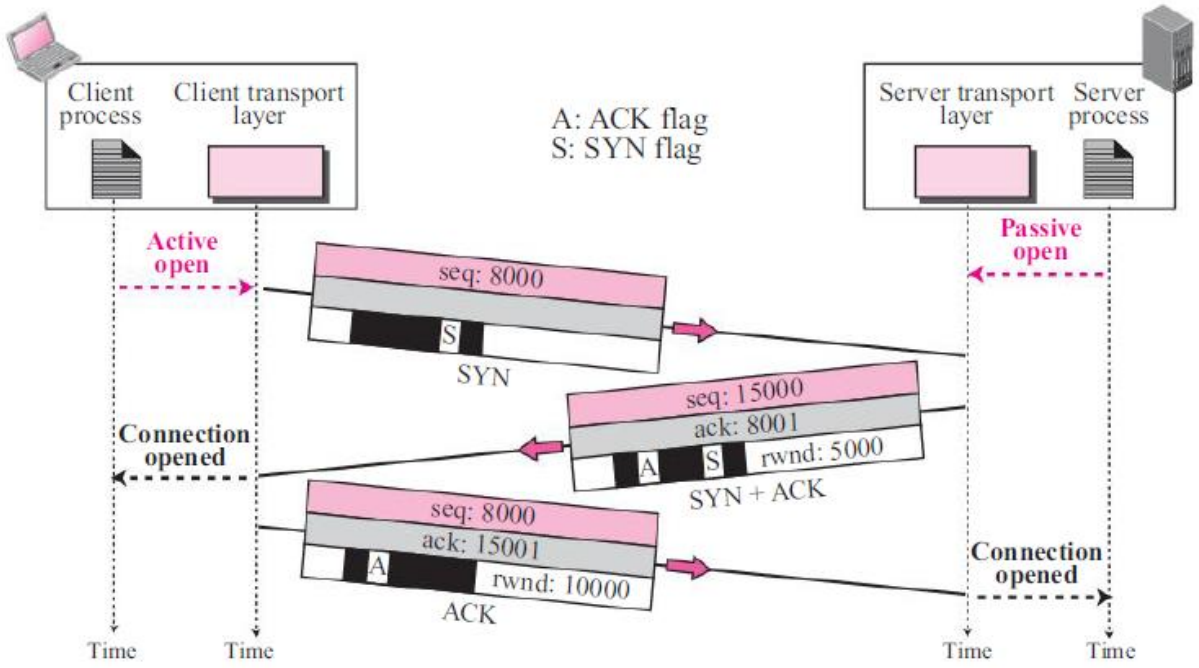
TCP lies between the application layer and the network layer, and serves as the intermediary between the application programs and the network operations.

TCP Services:

- ✓ Process-to-Process Communication
- ✓ Stream Delivery Service
- ✓ Full-Duplex Communication
- ✓ Multiplexing and Demultiplexing
- ✓ Connection-Oriented Service
- ✓ Flow Control
- ✓ Error Control
- ✓ Congestion Control

TCP Connection: Three-way Handshaking

**Figure 15.9** *Connection establishment using three-way handshaking*




**Applications of TCP**

- **World Wide Web (WWW)**: When you browse websites, TCP ensures reliable data transfer between your browser and web servers.
- **Email**: TCP is used for sending and receiving emails. Protocols like **SMTP** (Simple Mail Transfer Protocol) handle email delivery across servers.
- **File Transfer Protocol (FTP)**: FTP relies on TCP to transfer large files securely. Whether you're uploading or downloading files, TCP ensures data integrity.
- **Secure Shell (SSH)**: SSH sessions, commonly used for remote administration, rely on TCP for encrypted communication between client and server.
- **Streaming Media**: Services like Netflix, YouTube, and Spotify use TCP to stream videos and music. It ensures smooth playback by managing data segments and retransmissions.

**Which Protocol is Better: TCP or UDP?**

The answer to this question is difficult because it totally depends on what work we are doing and what type of data is being delivered. UDP is better in the case of online gaming as it allows us to work lag-free. TCP is better if we are transferring data like photos, videos, etc. because it ensures that data must be correct has to be sent. In general, both TCP and UDP are useful in the context of the work assigned by us. Both have advantages upon the works we are performing, that's why it is difficult to say, which one is better.

# 4. Conclusion

TCP and UDP are two vital transport layer protocols with distinct purposes. TCP ensures reliable, ordered, and error-checked delivery of data — perfect for emails, file transfers, and web browsing. On the other hand, UDP is fast and connectionless, ideal for real-time services like video streaming and online gaming. Choosing between the two depends on the application's need for speed vs reliability.

# 5. References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