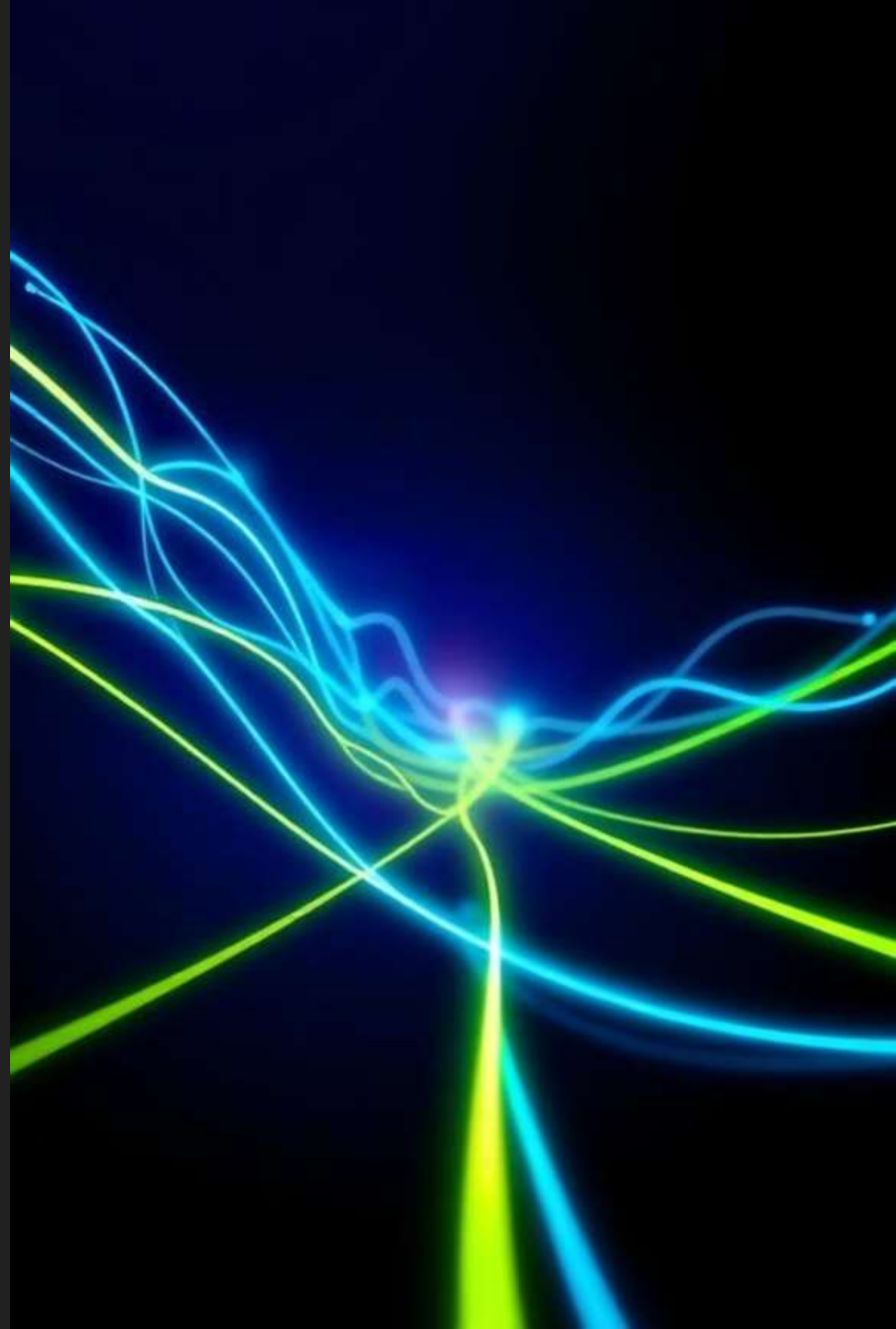
Transport-Layer Protocols: UDP

Explore the User Datagram Protocol (UDP), a fundamental component of the Internet's transport layer. Developed by David P. Reed in 1980, UDP provides connectionless, lightweight communication, ideal for specific network applications.



What is UDP?

OSI Layer 4

A transport layer protocol, operating at OSI Layer 4.

Datagrams

Sends messages as datagrams without prior connection setup.

No Guarantees

Offers no assurance of delivery, ordering, or duplication protection.

Time-Sensitive

Suited for applications demanding low latency and time-critical data.

Key Characteristics of UDP

Connectionless

No handshake or session establishment is required.

Minimal Header

Fixed 8-byte header for efficiency.

Checksum

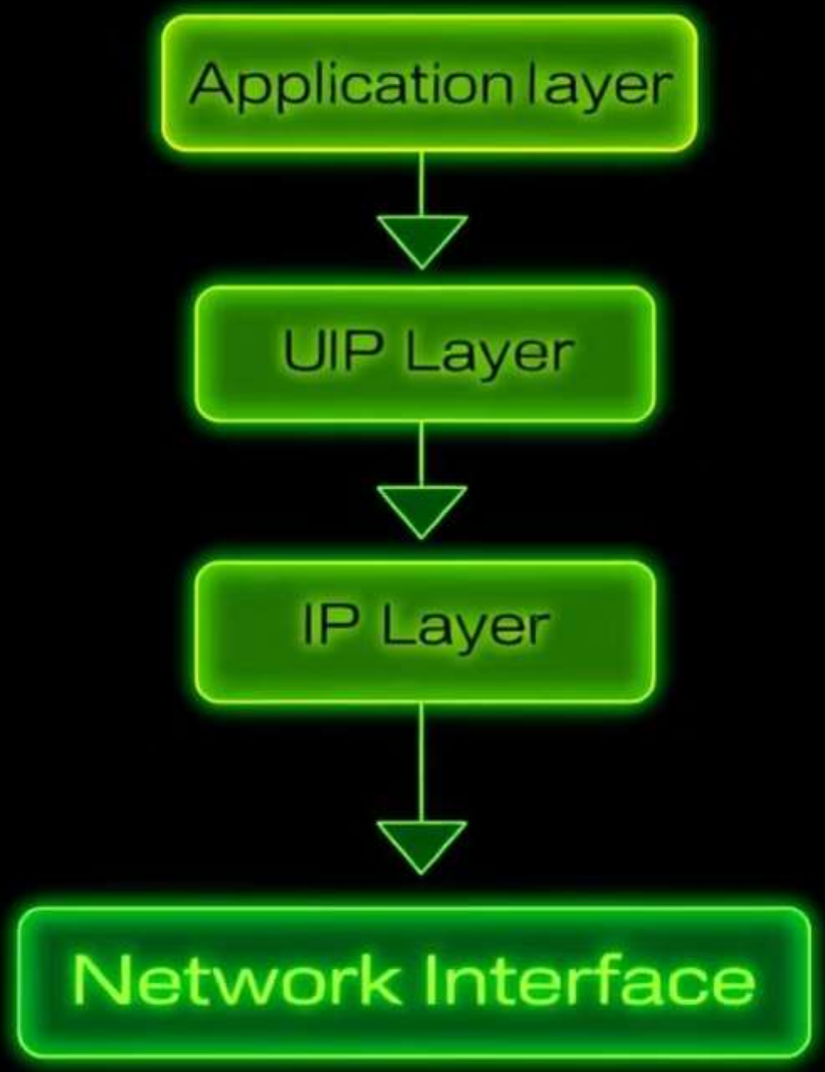
Optional checksum for data integrity, particularly in IPv4.

Port Numbers

Utilises port numbers for effective multiplexing and demultiplexing.

UDP Header Format

- **Source Port (16 bits):** Identifies the sending application.
- **Destination Port (16 bits):** Identifies the receiving application.
- **Length (16 bits):** Total length of the UDP header and data.
- **Checksum (16 bits):** Optional field for error detection.



UDP Encapsulation in the Network Stack

- Application data is forwarded to the UDP layer.
- UDP adds its header to the data, creating a datagram.
- The datagram is then passed to the IP layer for routing and delivery.
- IP adds its header, and the packet is sent across the network.

Advantages of UDP

1

Low Overhead

Minimal header size ensures fast transmission.

2

Multicast & Broadcast

Efficiently supports group communication.

3

Real-Time Ready

Ideal for VoIP and online gaming due to its speed.

4

No Retransmission

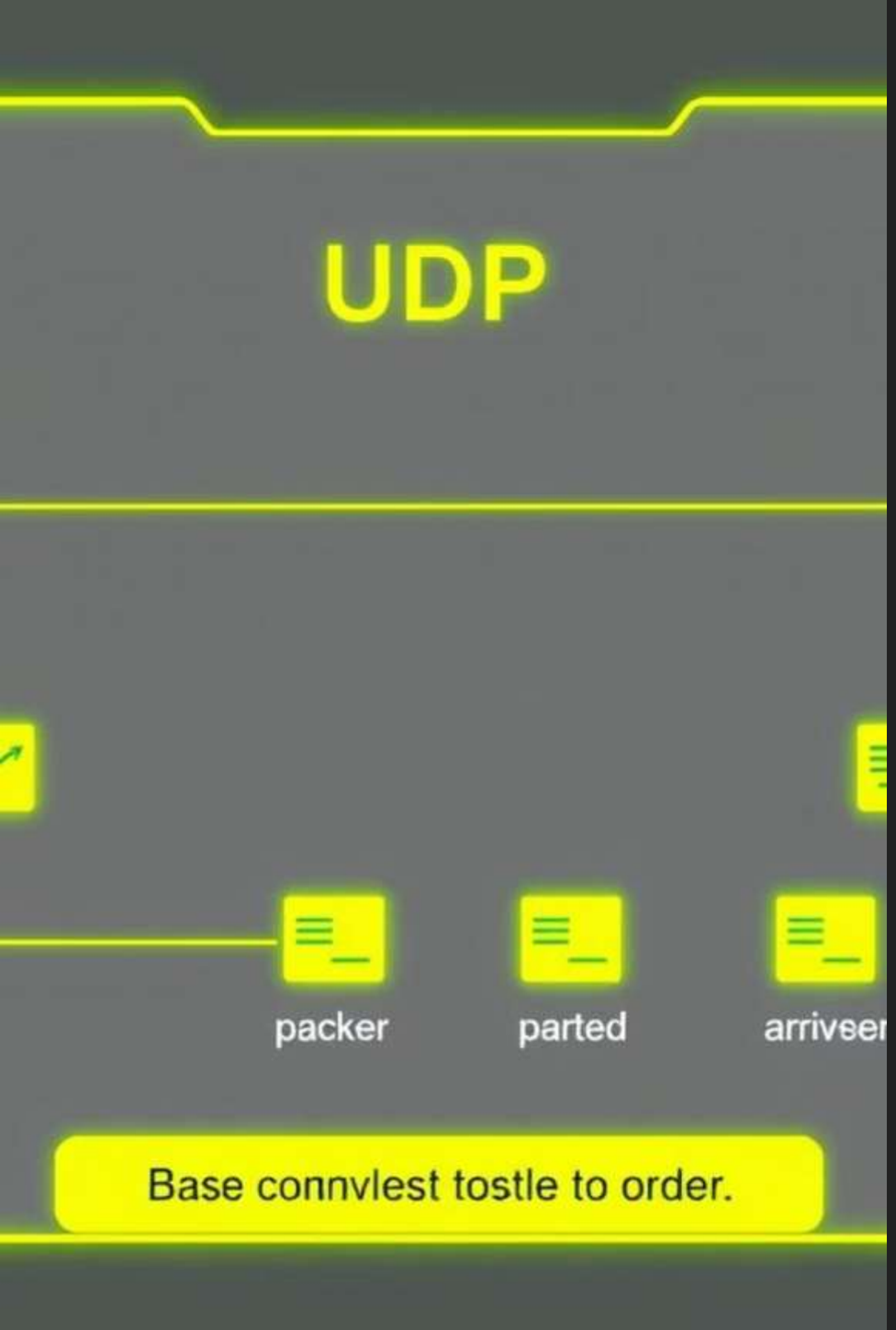
Avoids delays, perfect for live streaming services.

Common UDP Use Cases

- **DNS Queries:** Quick request-response for domain name resolution.
- **DHCP:** Dynamic Host Configuration Protocol for IP address assignment.
- **VoIP and Video Conferencing:** Prioritises low latency for clear communication.
- **Streaming Protocols:** Such as RTP and IPTV, where timely delivery is critical.

UDP vs TCP: Key Differences

Connection	Connectionless	Connection-oriented
Reliability	No guarantees	Reliable delivery
Header Size	8 bytes (fixed)	20-60 bytes
Use Case	Speed > Reliability	Reliability Critical



UDP Communication Flow

- **Sender:** Transmits datagrams directly without establishing a connection.
- **Transmission:** Packets may be lost, duplicated, or arrive out of sequence.
- **Receiver:** Processes datagrams as they arrive, without acknowledgments.
- **No Feedback:** The sender receives no confirmation of delivery or receipt.

Summary

Simple & Fast

UDP is a lightweight, efficient transport protocol.

Speed Over Reliability

Ideal for applications prioritising rapid data transmission.

Minimal Overhead

Utilises a small header and supports multiplexing via ports.

Wide Adoption

Commonly used in DNS, VoIP, streaming, and other real-time applications.