Experiment 5: Performance Analysis of TCP and UDP Protocols using Simulator

Aim

To compare the performance of TCP and UDP protocols in terms of delay, throughput, and reliability using a network simulator.

Background Theory

TCP (Transmission Control Protocol):
- Connection-oriented, reliable delivery, error checking, retransmission.
- Ensures ordered delivery of data.
- Used in HTTP, FTP, Email, SSH.

UDP (User Datagram Protocol):
- Connectionless, lightweight, no guaranteed delivery.
- Faster with low overhead.
- Used in VoIP, streaming, DNS.

Performance Notes:
TCP is reliable but slower, UDP is fast but less reliable.

Software/Tools Required

Cisco Packet Tracer / GNS3 / NS2 / NS3 / Wireshark; PCs, Switches, Routers (virtual inside simulator).

Objectives

1. Create a simple LAN.
2. Simulate TCP traffic (HTTP/FTP).
3. Simulate UDP traffic (VoIP/Streaming).
4. Compare TCP vs UDP performance.

Algorithm

1. Create a LAN topology.
2. Assign IP addresses.
3. Configure TCP traffic (HTTP/FTP).
4. Configure UDP traffic (VoIP/Streaming).
5. Capture events in Simulation Mode.
6. Compare observations of TCP vs UDP.

Step-by-Step Procedure (Expanded)

Step 1: Topology Setup
1. Open Cisco Packet Tracer.

2. Place 2 PCs, 1 Server, 1 Switch, 1 Router.
3. Connect with Copper Straight-Through cables.
4. Verify link lights are green.

Step 2: Assign IP Addresses
1. PC1 → 192.168.1.2, Mask 255.255.255.0, Gateway 192.168.1.1.
2. PC2 → 192.168.1.3.
3. Server → 192.168.1.10.
4. Router (Fa0/0):
- ip address 192.168.1.1 255.255.255.0
- no shutdown
5. Test connectivity using ping.

Step 3: TCP Traffic Simulation (HTTP)
(A) Server Setup:
- Enable HTTP service on Server.
- (Optional) Add large webpage.
(B) Client Setup:
- Open PC1 Web Browser → http://192.168.1.10.
(C) Simulation Mode:
- Enable TCP, HTTP, ARP filters.
- Observe 3-way handshake (SYN, SYN-ACK, ACK).
- View GET requests, Data + ACKs.
(D) Packet Loss Simulation (Optional):
- Disable switch port temporarily.
- Observe retransmissions by TCP.

Step 4: UDP Traffic Simulation (VoIP)
(A) VoIP Server Setup:
- Enable IP Telephony on Server.
(B) Phone Setup:
- Add 2 IP Phones, connect to Switch.
- Assign numbers (1001, 1002).
(C) Registration:
- Set Call Manager = Server IP.
(D) Call Simulation:
- Dial between phones.
- Simulation Mode → observe UDP packets (no retransmission).

Step 5: Analysis
- TCP: Reliable, retransmits lost data, higher delay.
- UDP: Faster, low latency, may drop packets.

Expected Output

- TCP: Shows handshake, retransmissions if loss, reliable delivery.
- UDP: Direct flow, no setup, faster but less reliable.

Result

TCP is reliable but slower, UDP is faster but less reliable. Both protocols were analyzed successfully.

Pre-Viva Questions

1. Differentiate between TCP and UDP.
2. What is the purpose of TCP 3-way handshake?
3. Which protocol is preferred for real-time applications?
4. How does TCP ensure reliability?

Post-Viva Questions

1. Why does UDP have lower delay compared to TCP?
2. What happens if TCP segments are lost?
3. Can UDP be used for file transfer? Why/why not?
4. Which protocol is better for video conferencing and why?

Comparison of TCP vs UDP

Feature	TCP	UDP
Connection	Connection-oriented	Connectionless
Reliability	Reliable, retransmission, ACKs	Unreliable, no ACKs
Speed	Slower due to overhead	Faster, low overhead
Ordering	Maintains order of packets	No guarantee of order
Use cases	Web, Email, File transfer	VoIP, Video streaming, DNS