UNIT – IV

THE TRANSPORT LAYER

SIP

SIP (Session Initiation Protocol) is an application-layer signaling protocol used to establish, manage, and terminate multimedia communication sessions such as voice calls, video conferencing, and instant messaging over IP networks.

Introduction

- Defined in RFC 3261 by the IETF.
- Operates at the application layer of the OSI model.
- Works with other protocols (RTP for media transport, SDP for session description).
- Widely used in VoIP (Voice over IP), video conferencing, and multimedia communication.

🔹 Key Features

- Session control: Establishes, modifies, and terminates sessions.
- Transport independence: Can run over UDP, TCP, or TLS.
- Text-based protocol: Modeled on HTTP, uses ASCII text messages.
- Scalability: Supports two-party, multiparty, and multicast sessions.
- Flexibility: Identifies participants using SIP addresses (similar to email or URLs).
- SIP Components

Component	Role
User Agent (UA)	End device (IP phone, softphone) initiating or receiving calls.
Proxy Server	Routes SIP requests between clients.
Registrar Server	Maintains user location information (registration).
Redirect Server	Directs clients to alternate servers.
Gateway	Connects SIP networks to PSTN or other protocols

SIP Messages

- INVITE: Initiates a session (e.g., call setup).

- ACK: Confirms session establishment.
- BYE: Terminates a session.
- REGISTER: Registers a user with a SIP server.
- OPTIONS: Queries capabilities of another SIP entity.
- CANCEL: Cancels a pending request
- SIP vs Other Protocols

Aspect	SIP	H.323	RTP
Role	Signaling (setup/control)	Signaling (older standard)	Media transport
Layer	Application	Application	Transport
Flexibility	High (text-based, extensible)	Complex, binary	N/A
Usage	VoIP, conferencing	Legacy systems	Audio/video delivery

Applications

- VoIP calls (Skype, Zoom, MS Teams).
- Video conferencing systems.
- Instant messaging and presence services.
- Telephony gateways connecting IP and traditional phone networks.

Video conferencing

Video conferencing enables real-time face-to-face communication across distances using audio/video streams, while multiplayer gaming connects players in shared virtual environments through networking protocols, synchronization, and interaction mechanics. Both rely heavily on low-latency communication, synchronization, and user engagement technologies.

Definition

- Video conferencing is an online technology that allows people in different locations to conduct real-time, face-to-face meetings without physical travel.

- It uses telecommunication technologies for simultaneous two-way audio and video transmission.

🔹 Key Features

- Real-time communication with audio, video, and sometimes screen sharing.
- Multi-party support (one-to-one or group meetings).
- Integration with collaboration tools (chat, file sharing, whiteboards).
- Cross-platform accessibility (PCs, smartphones, tablets).

🔹 Benefits

 Saves time and travel costs.

 Enhances remote collaboration in education, business, and healthcare.

 Supports distance learning and telemedicine

Multiplayer gaming

Definition

- Multiplayer gaming allows multiple players to interact in real-time within a shared virtual environment.
- It can be cooperative (co-op) or competitive (PvP).

🔹 Networking Fundamentals

- Client-server architecture or peer-to-peer connections.
- State synchronization ensures all players see consistent game states.
- Lag compensation and prediction algorithms reduce latency effects.
- Matchmaking systems connect players of similar skill levels.

🔹 Key Features

- Social interaction – chat, voice, and team collaboration.
- Persistent worlds – ongoing environments (MMORPGs).
- Cross-platform play – PC, console, mobile integration.
- Competitive ranking systems – esports and leaderboards.

🔹 Benefits

- Builds community and teamwork skills.
- Provides immersive entertainment and global connectivity.
- Drives innovation in networking and graphics technologies.

🔻 Challenges

- Latency and lag – can disrupt gameplay.
- Cheating and hacking – requires strong security measures.
- Server scalability – handling millions of concurrent players.

Comparison Table

Aspect	Video Conferencing	Multiplayer Gaming
Purpose	Communication & collaboration	Entertainment & competition
Core Technology	Audio/video streaming	Game networking & synchronization
Latency Sensitivity	High (speech/video clarity)	Very high (real-time gameplay)
User Interaction	Meetings, presentations	Cooperative/competitive play
Challenges	Bandwidth, security, fatigue	Lag, cheating, scalability