

# Networks & Gaming in a Nutshell

CSC9N6

David Cairns

KGP, Davison - Chapter 29

## Topics

Game Types

Client - Server Architecture

Network Protocols

Game State

Network Issues

## Game Types

### Racing

### Flying

- MS Combat Flight Sim, IL2 Sturmovik

### First Person Shooters (FPS)

- Halo, Quake, Doom...

### Massively Multiplayer Online Role-Playing Game - MMORPG

- World of Warcraft, Everquest, Second Life

...

## Game State

The key concern for multiplayer gaming is maintaining a consistent game state for all players.

- All client actions should be collected
- Player interactions with game world and other players must be calculated
- Current state of the game fed back to the user

### Issues

- Variability in connection times
- Variability in client hardware
  - Faster processors, graphics cards, network speed/bandwidth
- Users appear and 'disappear' without warning

## Network Protocols - TCP/IP

### Transmission Control Protocol/Internet Protocol

- Creates a dedicated two way connection
- Data packets provided in time order
  - Missing packets resent
  - Higher latency due to packet ordering
    - Late arriving packets delay delivery to client of newer and more recent packets
- Used where reliable communication important
  - HTTP
  - FTP
  - Multiplayer games where latency is not critical but correct communication important.
    - Strategy, MMORPG

## Network Protocols - UDP

### User Datagram Protocol

- Connectionless
- Data packets delivered to client in order received
  - Missing packets ignored
  - Late packets can be ignored
- Used where only most recent information important
  - Audio/Video Streaming
  - Rapid action gaming where latency is important but only most recent information is relevant
    - FPS
    - Racing
    - Flying

## Network Protocols

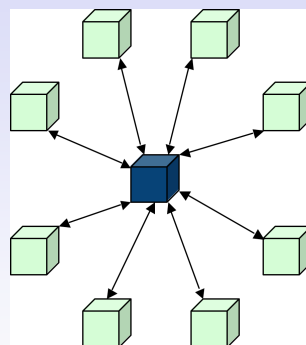
Connections between clients and servers are opened on virtual 'ports'. Common (used) ports are:

- 80 : HTTP > HyperText Transport Protocol (The Web)
- 21 : FTP > File Transfer Protocol
- 25 : SMTP > Simple Mail Transfer Protocol (Email)

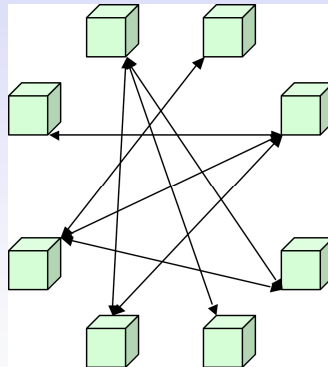
Games use their own port numbers (>1024)

- TCP/IP and UDP can be used simultaneously on different ports where: TCP/IP handles administration elements where reliability is important; UDP handles fast paced elements of the game where speed is important
- Firewalls block activity on certain ports

## Network Topology - Star



## Network Topology - Peer to Peer



## Client Server Architecture

### Method

- Client connects and gets current game state
- Client feeds player actions to server
- Server updates game state
- Server sends state updates to clients
- Client updates view of game

### Client and Server must keep in synchrony

- Packet loss and lag impact performance
- Often slowest client connection limits performance
  - Auto kick for high ping players

## Advantages for Client/Server

- Only one game state to maintain at server side
- Central location for all data
- Game logic processing maintained on server
- 'Thin' client with graphical emphasis

## Disadvantages for Client/Server

### Client Overload

- Server must have high bandwidth and CPU capacity to reliably handle numerous user requests
- Storage requirements for MMORPG can be large

### Server Failure

- One server - all clients lose connection

## Solutions

Large Multiplayer systems break game area into zones.

- Each zone handled by a separate server
- Server can be mirrored in case of failure

Dedicated Network 'Backbone'

- Games companies maintain own private networks
  - Can control reliability
  - All private network data gaming related
    - No bittorrent/multimedia streaming!

## Peer to Peer

Not widely used for gaming since difficult to maintain a distributed game state

Typical use is in media sharing applications:

- Usenet
- Skype
- BitTorrent

## Networking Issues

Packet Loss

Lag

Disconnects

Scalability

Cheating?

## Packet Loss

TCP/IP and UDP datagrams (data packets) do not always arrive at their destination

- If a router is very busy, it may ignore data
- A line may be unreliable, causing a slow down in data transfer
- When is a packet lost and not just delayed?

TCP/IP repeats request until all data is received.  
UDP ignores lost packets.

## Lag

The time taken to transfer packets of data between two computers is called network latency.

- A certain level of latency is expected
  - 20-40ms for a broadband PC would be considered good
- Network congestion and line noise can delay packets by 300-1000ms
- Lag is normally associated with periods where latency rises abruptly from its norm and calms down (or the player gets disconnected).

## Lag

- If a server is waiting on a player with high latency, the game may slow down for other players
  - If the player is ignored and the game moves on, their experience of the game will be very 'jerky' and they will find it increasingly difficult to play.
  - When should the server decide the player has disconnected without warning?
- The effect of lag/high latency spikes depends upon the type of game:
  - FPS and fast paced action games with rapid change of direction are more directly affected by lag.
  - Flying/space/racing games are less susceptible since it is possible to more easily predict the continued path of an object.

## Disconnects

### When is a client no longer a client?

- Monitor contact times
- 'Ping' client - timeout?

### Handling Disconnects

- Saving Player State?

## Scalability

### LAN

- 2-16 Players

### WAN

- FPS 2 - 128

### WAN - MMORPG

- 2 - 4,000,000
- WoW - Realms & Instances