ENSE 472 Project
Netcode

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Introduction

Challenges Netcode is trying to overcome:

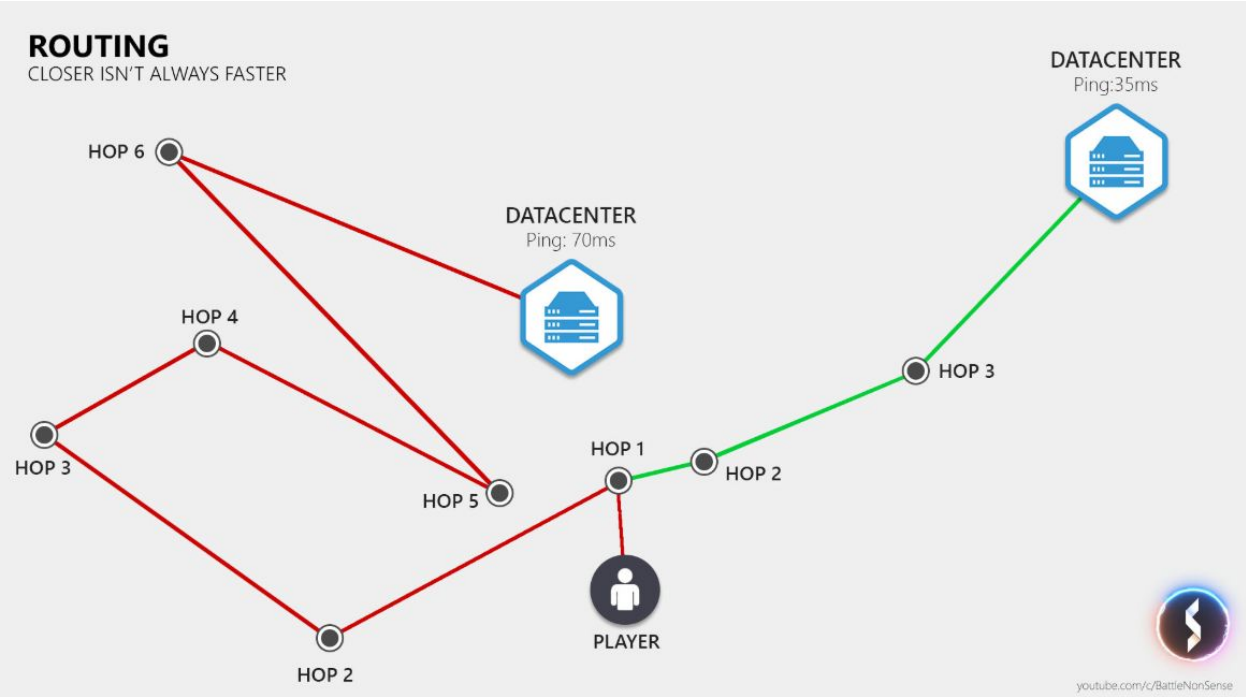
- Ping (latency)
- Routing
- Packet Loss
- Update Rates
- Tick Rates (simulation rates)

Ping

Time it takes to properly send a request to the server and get a reply back

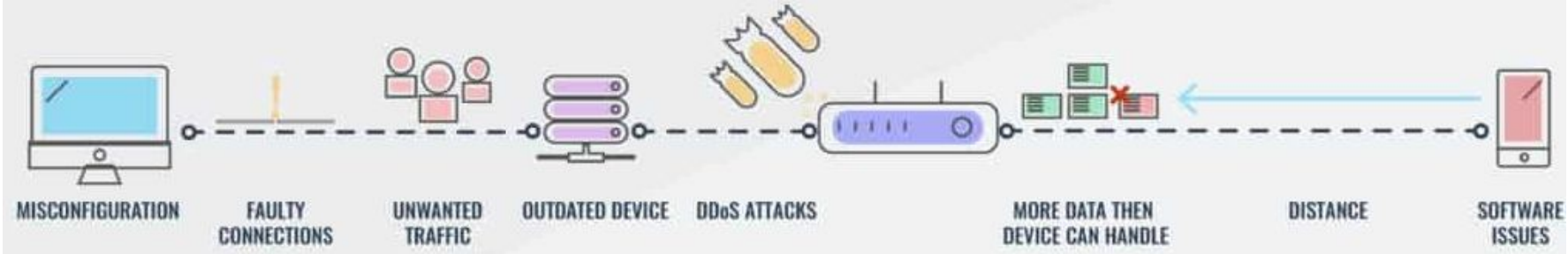
Routing

How packets are directed to the server



Packet Loss

Describes if the data is reaching its destination

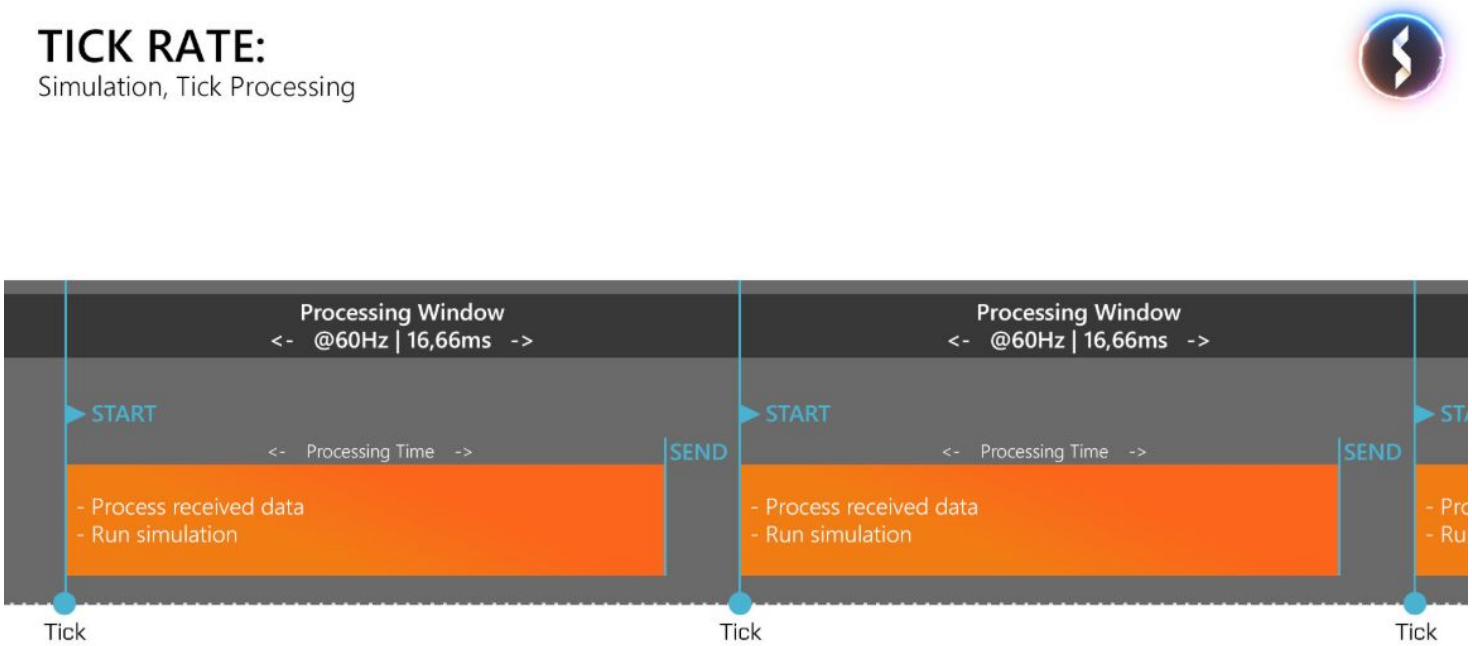


Update Rates

How often a game sends and receives data between client and server

Tick Rates

How often a server processes and produces all of the data received from its clients



TCP or UDP?

TCP:

- High overhead cost
- Increased ping (latency)
- Able to handle error conditions
- Simpler than UDP

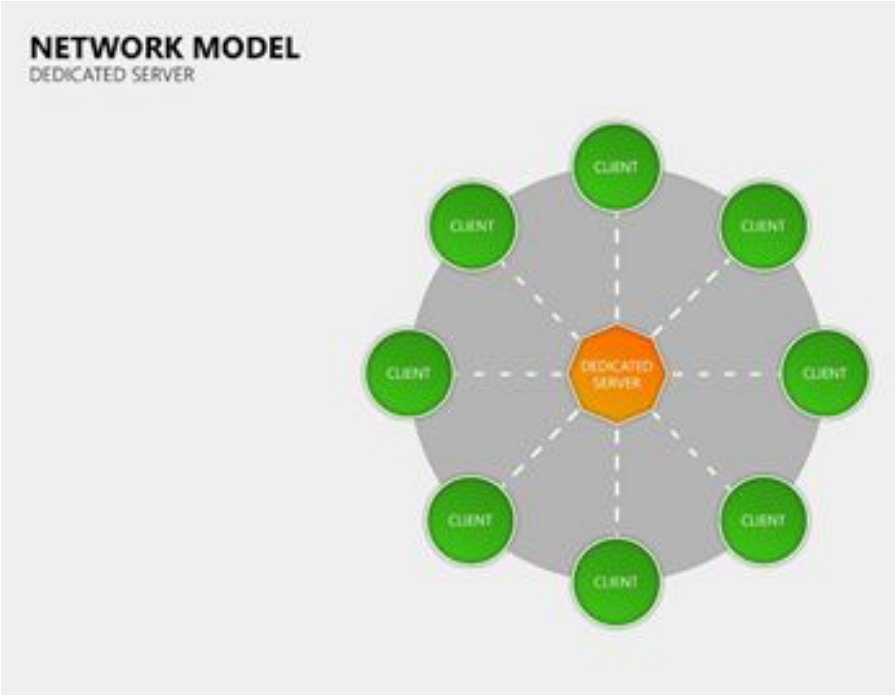
UDP:

- Lower overhead cost
- Decreased ping (latency)
- May need networking code implemented into the game engine
- Increased complexity

Network Models

Dedicated Servers

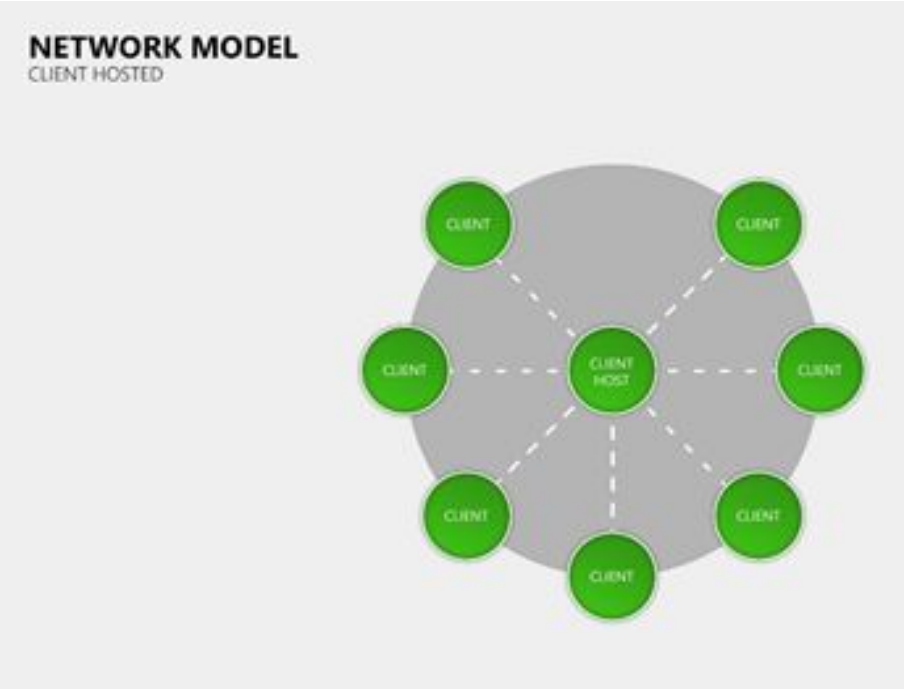
- Clients or players connect to a dedicated server
- A dedicated server being a specific computer utilized for hosting players
- Provide enough bandwidth and low latency for everyone connected
- Usually used for team based games
- Different forms of dedicated servers (cloud hosting, in house of off site)



Network Models

Client Hosted

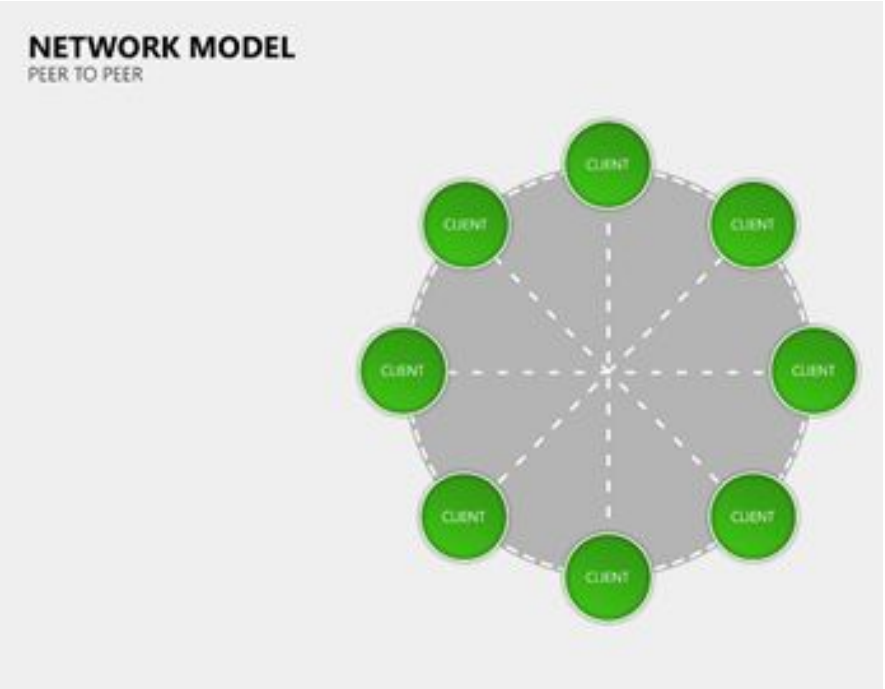
- The client or player acts as the host
- The player hosting has the advantage due to no lag while others experience lag
- Host player is able to see other players before they do
- Quality of the connection is entirely dependent on the host connection
- Host migration can occur
- Usually used for team based games



Network Models

Peer-to-Peer

- Clients or players communicate with each other, no server needed
- Generally utilized for 1v1 based games
- The distance between players determines the amount of input delay (ping)
- Two variations with delay-based and rollback that handle input delay



Network Models

Delay-Based

- Is the simplest and most common form to implement due to easy implementation and cheap cost
- creates artificial delay for the player on the local side to allow the inputs from the opposing player to catch up
- If the distance between both players is far the greater the frame delay (high ping), If the distance is short the smaller the frame delay (low ping)
- More artificial delay for greater distances, less for shorter distances

Network Models

Rollback

- Never has to wait for inputs like the delay-based model
- Local player inputs are displayed normally while opposing inputs arrive with frame delay
- The game will rollback or rewind to original frame that the input was meant to applied and re-simulate the frames ahead to reach the present frame
- Rollback will predict what the opposing player will do next
- Both ideas of delay-based and rollback can be applied together
- Rollback is an improvement over the delay-based model

Network Models

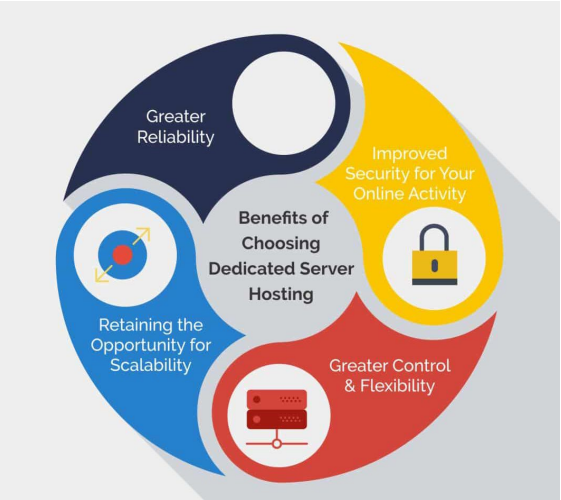
GGPO

- Is a free open source rollback library
- this library handles game sync and game states
- Can tell when games are out of sync and by how much
- Keeps track of inputs and understands when the game needs to rollback and by how much
- If rollback is required then any new inputs are applied
- Still falls on the developers to configure their game to work with GGPO

Benefits of Netcode

Dedicated Servers

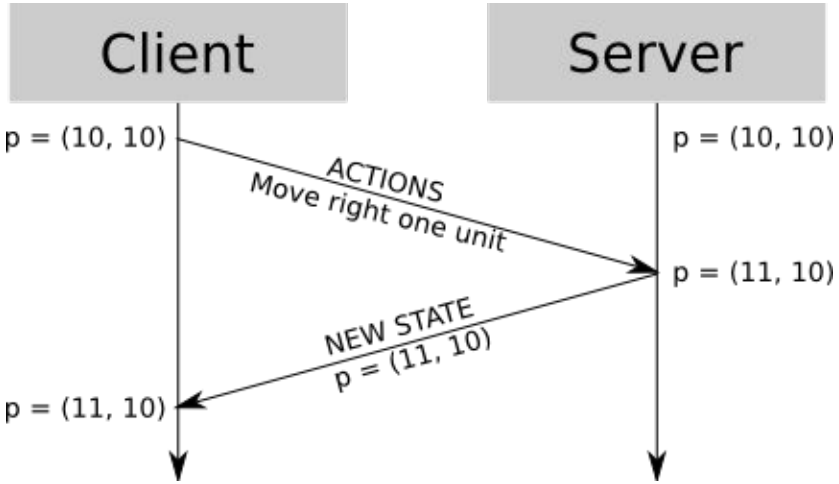
- Exclusive use of resources
- Reliability
- Accessibility/Controllability
- Security



Benefits of Netcode

Client hosted

- Shares many benefits with dedicated servers
- No expense for a physical server due to a client acting as host



Benefits of Netcode

Peer-to-Peer

- Simple to set up
- Cheaper than other methods
- No need for a server

Disadvantages of Netcode

Dedicated Servers

- Expensive
- Accessibility

Peer-to-peer

- Can see IP addresses of others
- More than 2 players causes immense traffic
- Developers ability to stop cheating is limited

Disadvantages of Netcodes

Client-Hosted

- Advantage to Host (Zero Lag)
- Host can cheat (Lag Switch)
- Others connect through host internet connection
- Host can see IP addresses of others
- Host migration

Challenges That Netcode Deals With

- Lag Compensation
- Hit registration
- Desynchronization

Case Study - Call of Duty: Modern Warfare (2019)

Uses both client hosted and dedicated server network models

Client Hosted:

- Tick rates drop (30Hz vs. 60Hz)
- Host migration
- Hosts ping - really good

Dedicated server:

- Tick rates (60Hz all around)
- Zero host migration
- Everyone's ping is dependant on their location to the server
- Higher costs

Conclusion

- Video games would not be able to be played online
- Synchronization between clients and servers
- Ultimately up to the developers which Netcode model(s) they want to use
- All Netcode models mentioned have advantages and disadvantages

Questions?