

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)

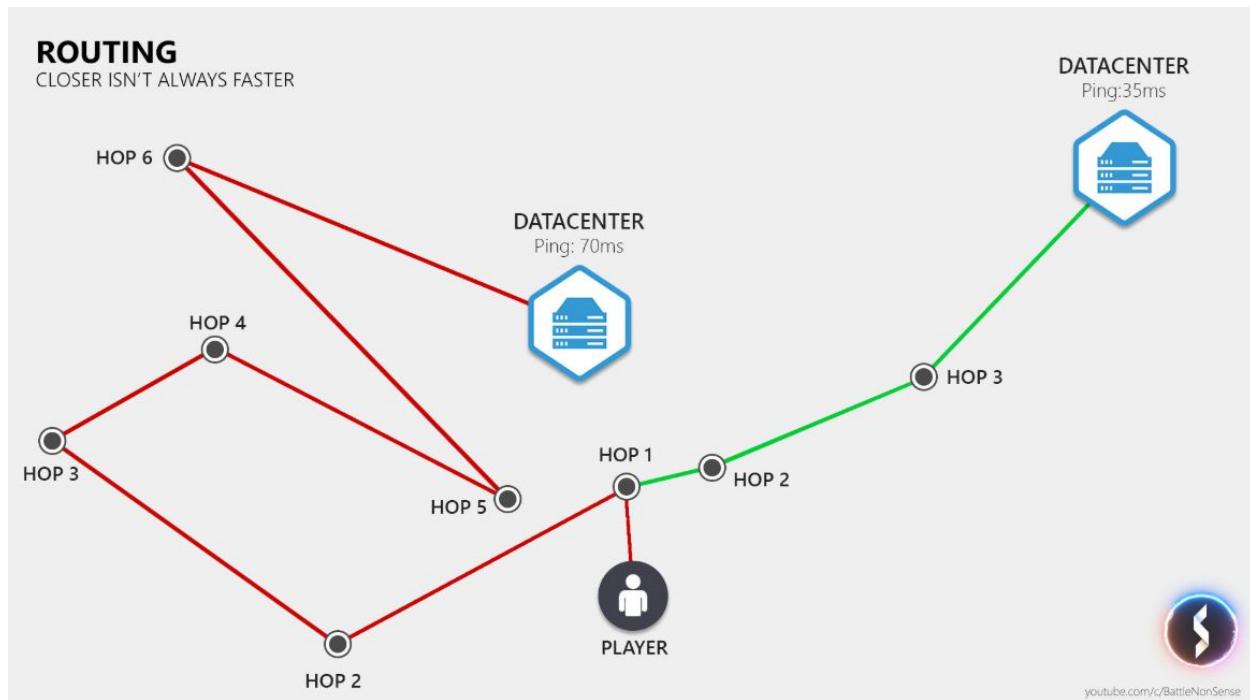
Ping

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



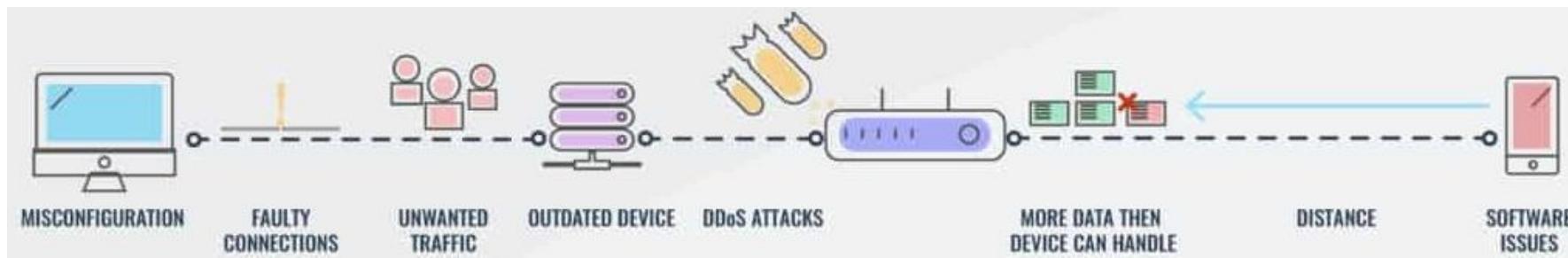
Routing

How packets are directed to the server



Packet Loss

Describes if the data is reaching its destination



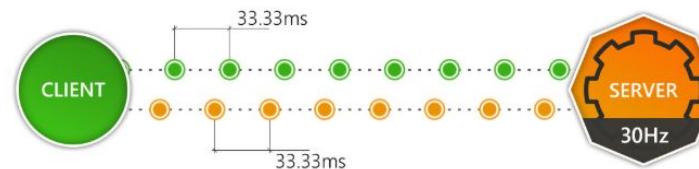
Update Rates

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

UPDATE RATES

ADDITIONAL DELAY

30Hz UP & DOWN:



60Hz UP & DOWN:

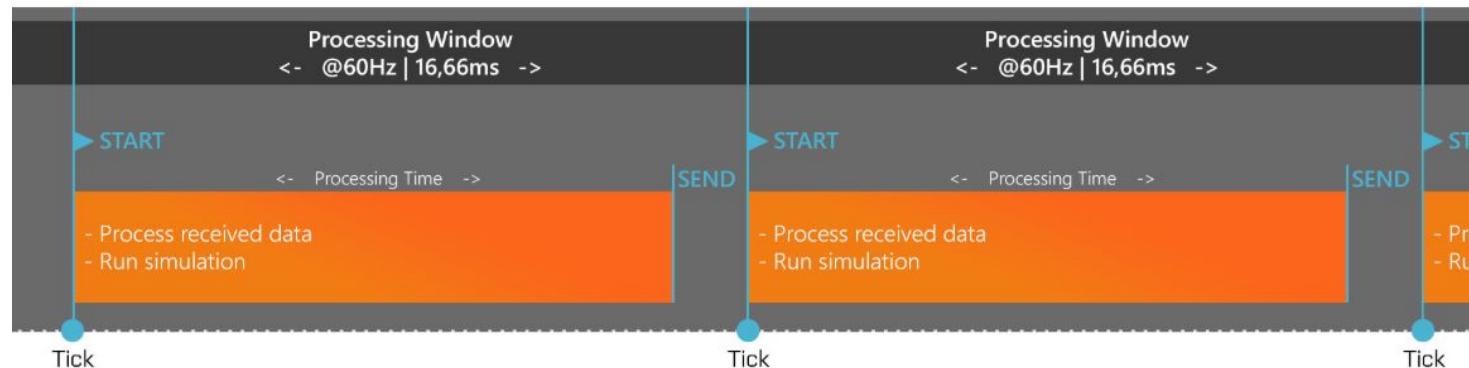


Tick Rates

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

TICK RATE:

Simulation, Tick Processing



TCP or UDP?

TCP:

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

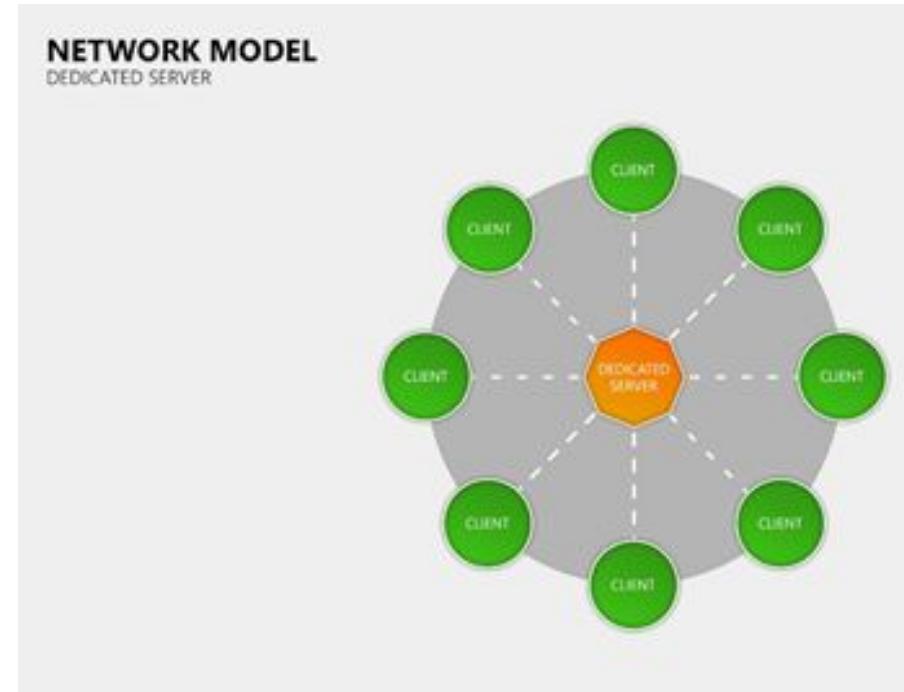
UDP:

- 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 or off site)



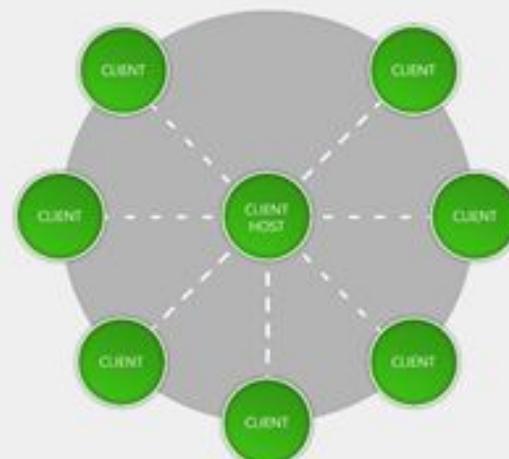
Network Models

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 MODEL

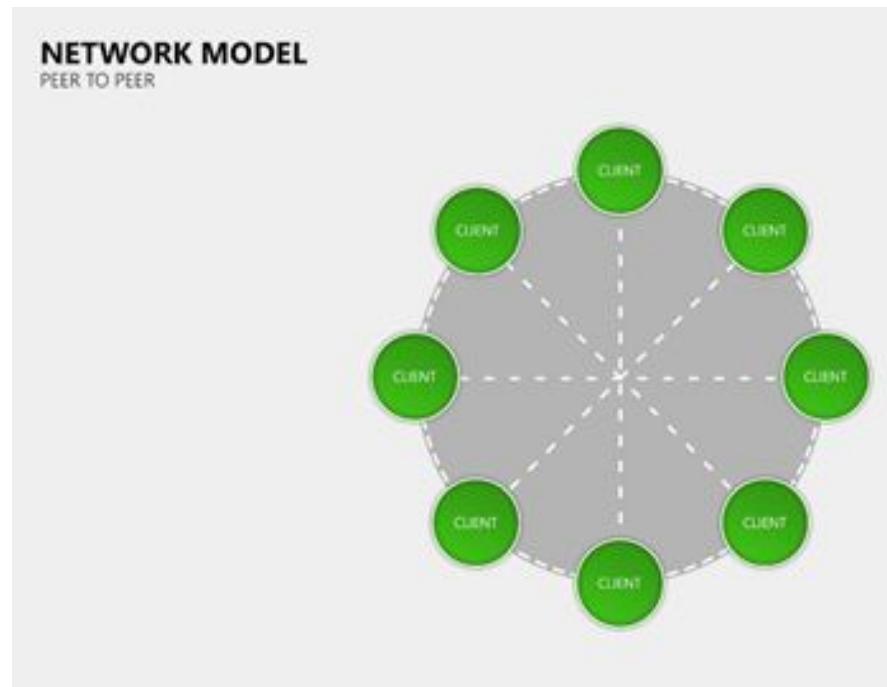
CLIENT HOSTED



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

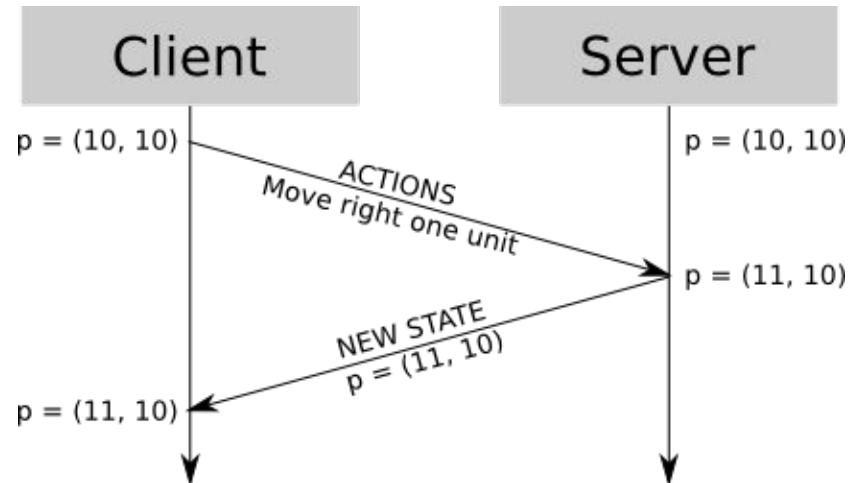
- Exclusive use of resources
- Reliability
- Accessibility/Controllability
- Security



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?

The image features a cartoon scientist with glasses and a white lab coat, holding a magnifying glass over a chalkboard. The chalkboard is filled with various physics-related drawings and equations, including:

- A graph showing a function $f(x)$ with a sharp peak.
- Text: "IE TUUTE REPORT ON QUANTUM GRAVITY DUE SEP 1st" and "CODE 6743176".
- Equation: $U_0 = U_0^2$.
- Equation: $d_0 = U_0^2 / d_0$.
- Equation: $U_L = U_L^2 / U_L$.
- Equation: $d_L = U_L^2 / d_L$.
- Equation: $\tilde{U}_L = \tilde{U}_L^2 / \tilde{U}_L$.
- Equation: $\tilde{d}_L = \tilde{U}_L^2 / \tilde{d}_L$.
- Text: "THRESHOLD BEHAVIOUR? ISR/BEAMSTRAHLENK"
- Text: "DON'T FORGET! ULI'S GOODBYE CAKE! 2:30pm"
- Diagram: A Feynman diagram showing $e^+ e^- \rightarrow f\bar{f}$ with intermediate particles γ/ν , χ^+ , χ^0 , and χ^- . It includes a "Light Stop?" question and "Supersymmetric particles?".
- Equation: $P_{\text{beam}} = \frac{dQ^2}{Q^2} \frac{\alpha_s(Q^2)}{2\pi} P_{\text{beam}}(z)$.
- Text: "Final-State emissions"
- Diagram: A circular diagram labeled "EW SYMMETRY BREAKING Higgs loop" with "Higgs pair" and "jet energy resolution" plots.
- Text: "Level one trigger" and "Luminosity Rate Ratio 4".
- Equation: $\frac{1}{4} S/M^2$.
- Text: "clearing" and "Search".
- Equation: $\sqrt{s} = 14 \text{ TeV}$.
- Text: "pb fb" and "jets + SUSY".
- Equation: $S = \frac{1}{4} A \sim \frac{M^2}{M_{\text{Planck}}}$.
- Diagram: A black hole entropy calculation.
- Text: "Black hole entropy" and "AdS/CFT You are here".
- Equation: $3M = 35$, $4M = 56$, $5M = 56$, $6M = 8$, $7M = 9$, $8M = 128$.
- Text: "D1, D2, D3 branes" and "A, B, C branes".
- Text: "SUSY!" and "UED".
- Text: "Black hole entropy" and "AdS/CFT You are here".
- Equation: $\frac{1}{4} M^2 = 171$.

At the bottom left, there is a logo with a stylized letter 'S' inside a circle, with the text "NETCODE 101" and "What You Need To Know".