

Performance Analysis of Multiplayer Online Games

Muhammet Şen

Advisor: Atay Özgövde

Boğaziçi University, Computer Engineering

Introduction

Multiplayer gaming is an important part of the gaming industry and multiplayer games become bigger and more advanced with enhancements in hardware and software technologies. While games are getting better and better with those advancements, two important aspects directly affect the design and quality of a multiplayer game: maximum number of players and the size of the game world. This project focuses on different solutions and approaches that allow game developers to increase those aspects.

Motivation

The main goal of the project is dividing the game world into smaller parcels that can be deployed to different servers separately. Being able to horizontally scale, distributing the load to many servers, is beneficial since it decreases the loss when a server goes down and allows having more computational power than a single server can provide.

Solution types

There are different approaches to handle the communication between different servers. A server may want to get updates from other servers and managing this communication is not trivial. Each solution has different types of advantages and disadvantages.

1. **Naive** Each server sends every update to every other server
2. **Server Buffers**. A servers gets an update only if the object is close to it
3. **Neighbors**. Servers share updates only with their neighbor servers.

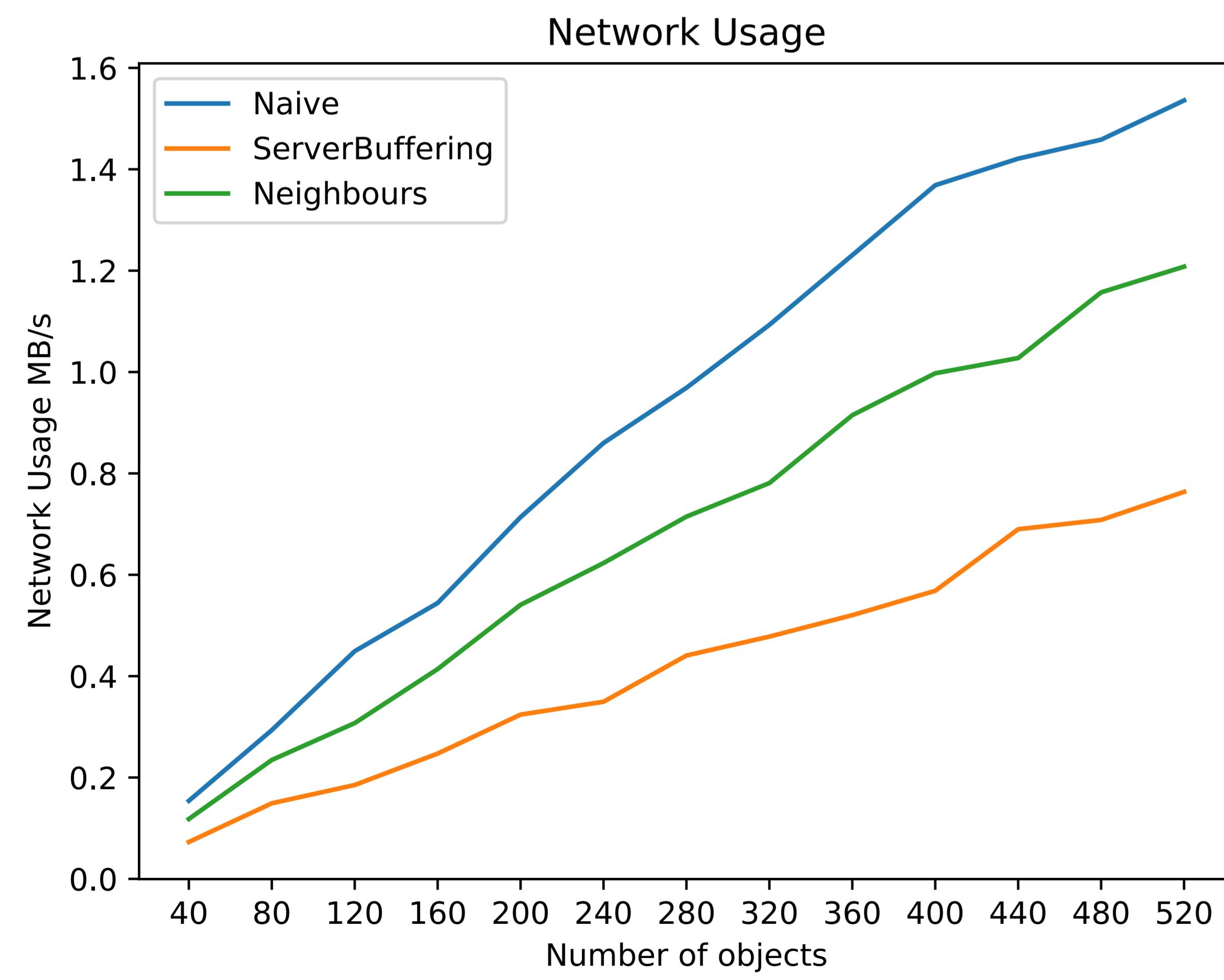


Figure 1. Average network usages of solution types

Factors

There are different factors that affect that creating smaller parcels process. Mention that these factors heavily depend on the requirements and design of the game and may not be applicable to a certain game.

- **Server Count** The number of servers to utilize and divide the game world into
- **Buffer Size** The ratio between a parcel's size and the buffer zone between its neighbor parcels.
- **Parcel Shape** Shape of a parcel - Square or Hexagon
- **Radius of Area of Interest** Radius of the area around a player that limits what the player sees and interacts.
- **Update Frequency** Frequency of updates between game servers and players.

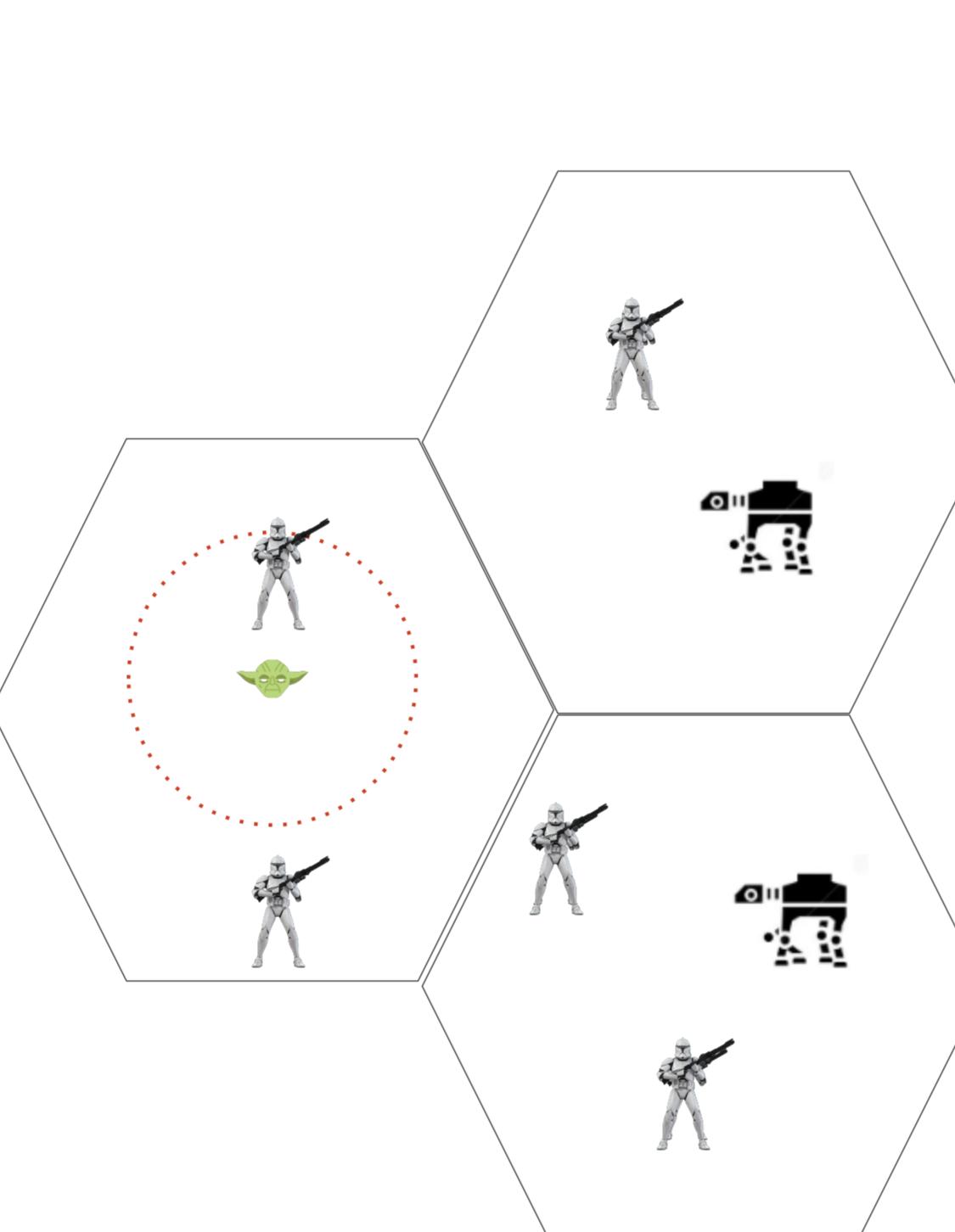


Figure 2. Area Of Interest

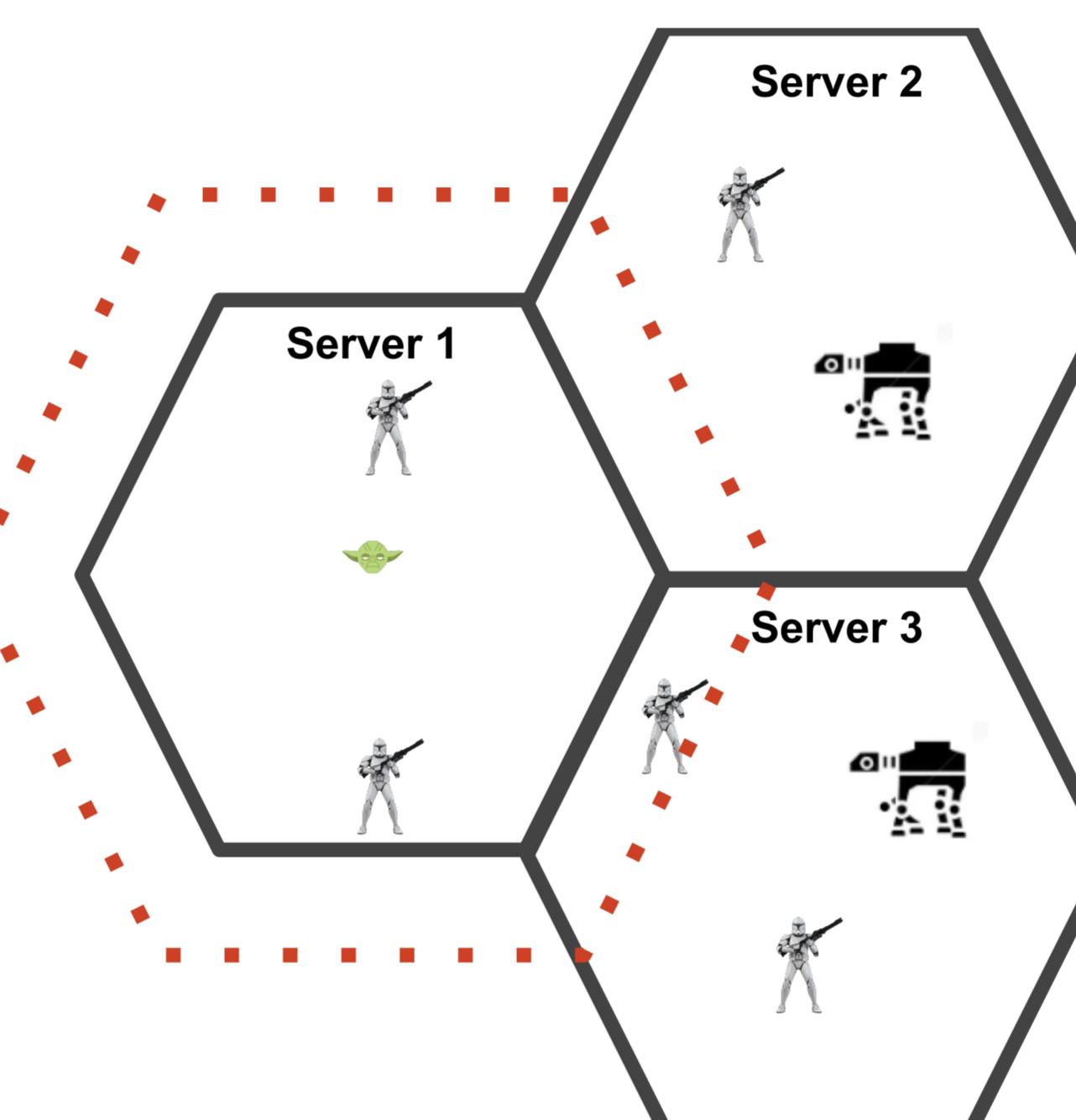


Figure 3. Server Buffer Area

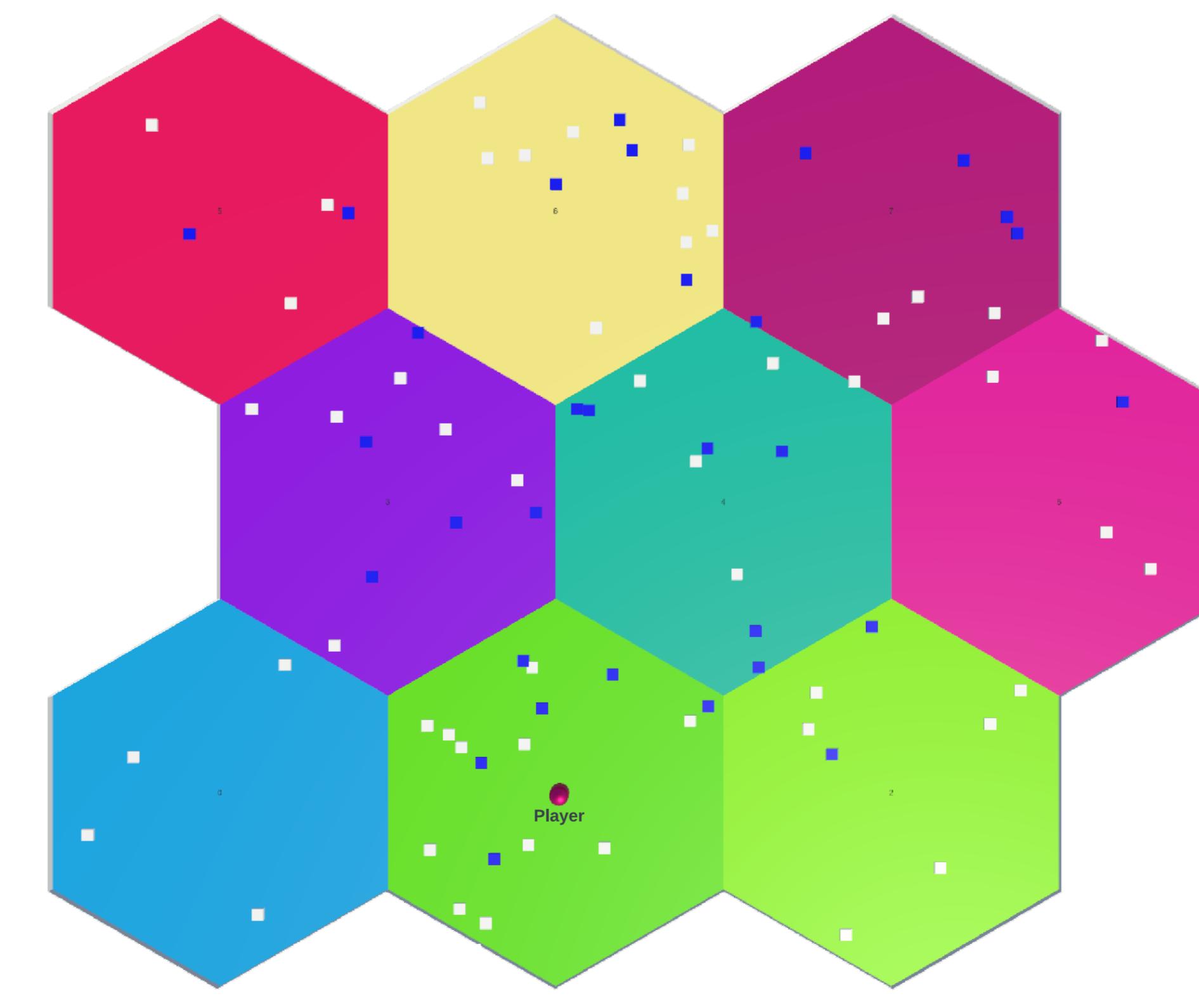


Figure 4. Hexagon parcel configuration with 9 servers

Results

Server - Server Communication

As expected, increasing the number of objects in the game world linearly increases the network usage of servers. However, there is a remarkable difference between three solution types. Naive approach uses up to 35% more bandwidth than Neighbors and 150% more bandwidth than Server Buffering approach.

Client - Server Communication

Using Area of Interest to limit the data transferred to players has a massive effect on the network usage. Following table shows network usage of a 1 minute game session. When Area Of Interest is taken into account, server-to-server communication strategies do not affect the bandwidth usage of the player.

Solution Type	Network Usage (MB)
Naive	9.63
Server Buffers	3.25
Neighbors	6.32
Naive with Area of Interest	0.72
Server Buffers with Area of Interest	0.72
Neighbors with Area of Interest	0.72

Table 1. Client's network usage in one minute

Conclusion

This project focused on building a testing and analyzing platform that can be used to try out different algorithms and methods for multiplayer games' network infrastructures. The platform is ready to use with many configuration parameters and support for deploying to multiple servers. Moreover, it includes many scripts for running tests, collecting metrics, and creating plots.

Further Work

Collecting server metrics was trivial since all server instances are running inside Docker Containers and the platform utilizes Docker's stats API to collect metrics. However, client is running in the browser and collecting metrics may depend on the browser and operating system of the client. Currently, the platform utilizes Wireshark to get network usage data, which can be problematic in some cases. Hence, a more structured and diverse metric collection system would be beneficial.