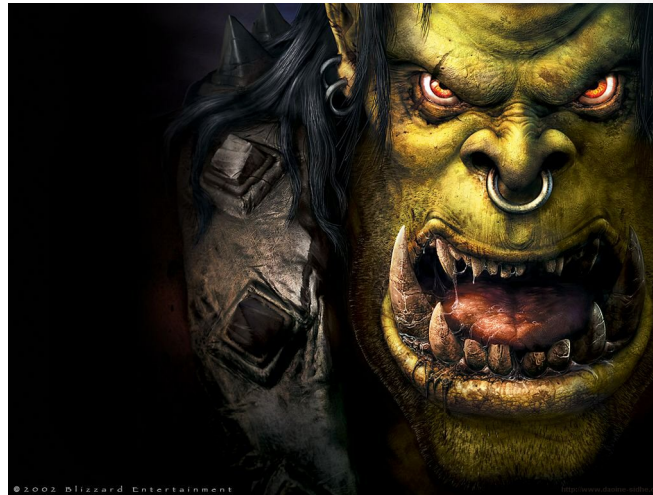


IMPROVING SCALABILITY IN MMOGS - A NEW ARCHITECTURE -



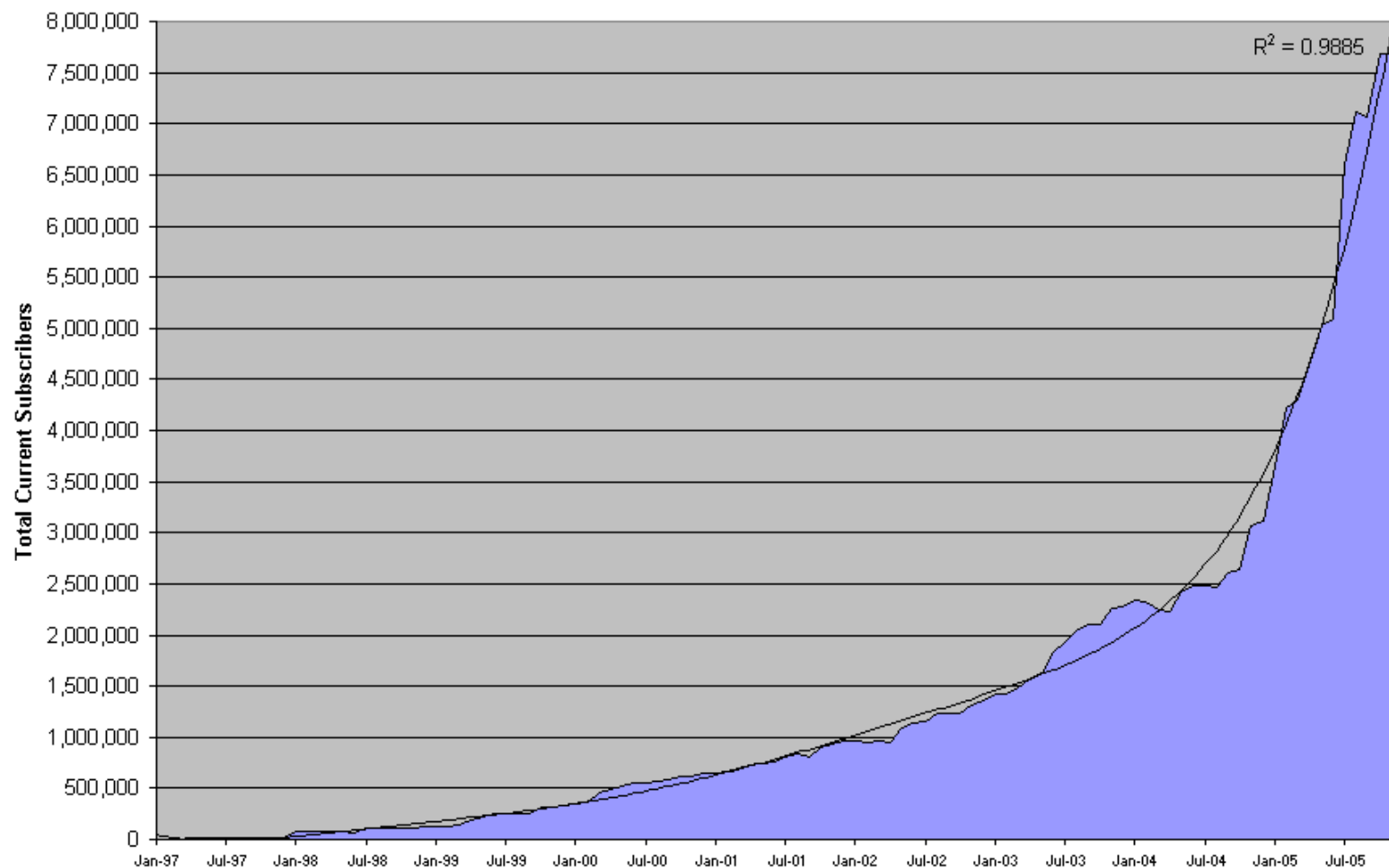
by
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Georgia Institute of Technology

Outline

1. MMOGs: tremendous growth
2. Traditional MMOGs architecture and its flaws
3. Related work
4. Our solution
5. Implementation
6. Results
7. Work in progress

MMOG market: rapid growth

Total MMOG Active Subscriptions (Excluding Lineage, Lineage II, and Ragnarok Online)

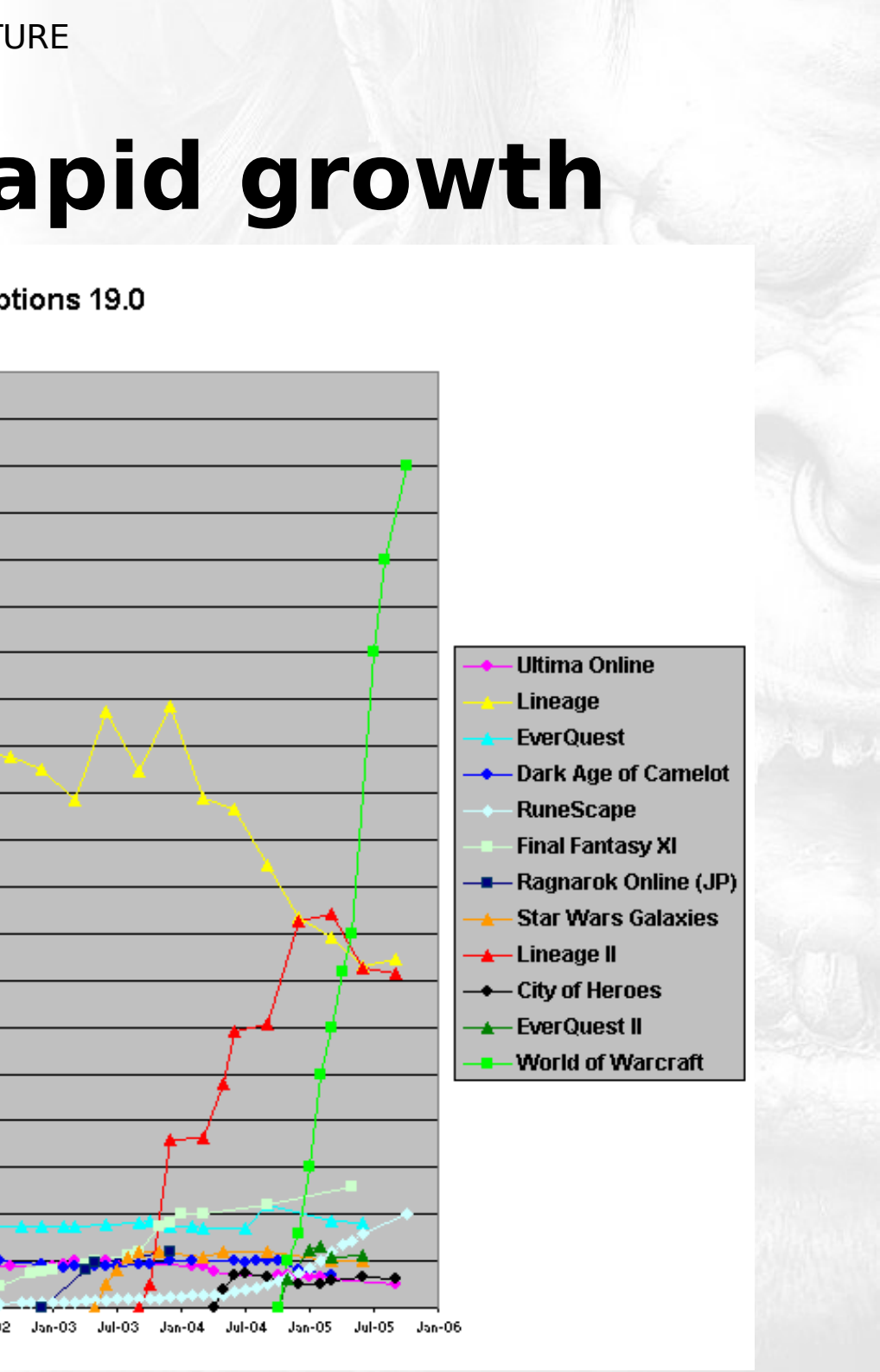


Rapid growth

Options 19.0

The graph displays the subscriber counts for various MMORPGs over a four-year period. The y-axis represents the number of subscribers, with horizontal grid lines indicating increments of 10 million. The x-axis shows time from January 2002 to January 2006. World of Warcraft (green line with square markers) shows a dramatic increase starting in early 2005, reaching over 50 million subscribers by January 2006. Lineage II (red line with triangle markers) shows a sharp rise in mid-2004, peaking around 15 million in early 2005 before a slight decline. Lineage (yellow line with triangle markers) maintains a high subscriber base, fluctuating between 10 and 20 million from 2002 to 2004, then declining. Other games like EverQuest, Dark Age of Camelot, RuneScape, Final Fantasy XI, Ragnarok Online (JP), Star Wars Galaxies, City of Heroes, EverQuest II, and Ultima Online show much lower and more stable subscriber counts throughout the period.

Game	Jan-02	Jul-03	Jan-04	Jul-04	Jan-05	Jul-05	Jan-06
Ultima Online	~1M	~1M	~1M	~1M	~1M	~1M	~1M
Lineage	~15M	~12M	~18M	~10M	~5M	~8M	~10M
EverQuest	~2M	~2M	~2M	~2M	~2M	~2M	~2M
Dark Age of Camelot	~1M	~1M	~1M	~1M	~1M	~1M	~1M
RuneScape	~0.5M	~0.5M	~0.5M	~0.5M	~0.5M	~0.5M	~0.5M
Final Fantasy XI	~0.5M	~0.5M	~0.5M	~0.5M	~0.5M	~0.5M	~0.5M
Ragnarok Online (JP)	~0.5M	~0.5M	~0.5M	~0.5M	~0.5M	~0.5M	~0.5M
Star Wars Galaxies	~0.5M	~0.5M	~0.5M	~0.5M	~0.5M	~0.5M	~0.5M
Lineage II	~0.5M	~0.5M	~0.5M	~5M	~15M	~12M	~10M
City of Heroes	~0.5M	~0.5M	~0.5M	~0.5M	~0.5M	~0.5M	~0.5M
EverQuest II	~0.5M	~0.5M	~0.5M	~0.5M	~0.5M	~0.5M	~0.5M
World of Warcraft	~0.5M	~0.5M	~0.5M	~0.5M	~5M	~30M	~50M



The MMOG challenge

- 20,000 players on a same map. They all move at the same time
- They all want updates of the world with a latency $< 200\text{ms}$
- Manage game state consistency for all these players

Traditional MMOGs architecture and its flaws

- Server cluster hosted by the game editor
- Secure
- Gives the server host a total control over the network

but ...

- Centralized
- CPU and bandwidth intensive for the server with constant updates
- Non-resilient to a crash of the server
- Lots of variation in the popularity the game implies **scalability issues**

Related work

Full P2P solution:

Peer-to-Peer Support for Massively Multiplayer Games, B. Knutsson, H. Lu, W. Xu, B. Hopkins

Separate world in zones:

A Distributed Event Delivery Method with Load Balancing for MMORPGs, Shinya Yamamoto, Yoshihiro Murata, Keiichi Yasumoto and Minoru Ito

Issues:

Security and Latency
Gamestate consistency

The idea...

Important observations on MMOGs

- Huge map
- Players in one region of the map don't interact with the players in another region
- Players are rarely scattered uniformly on the map; they usually gather in groups
- Most players stay connected for at least an hour, and some of them are connected much more than that

Our solution to improve scalability

- Dynamically divide the world into independent zones
- Delegate the workload to several super peers per zone
- Smooth transition from zone to zone
- Keep a main server to control the whole network

3 level hierarchy

- **Main Server**

- Hosted by the game editor/publisher

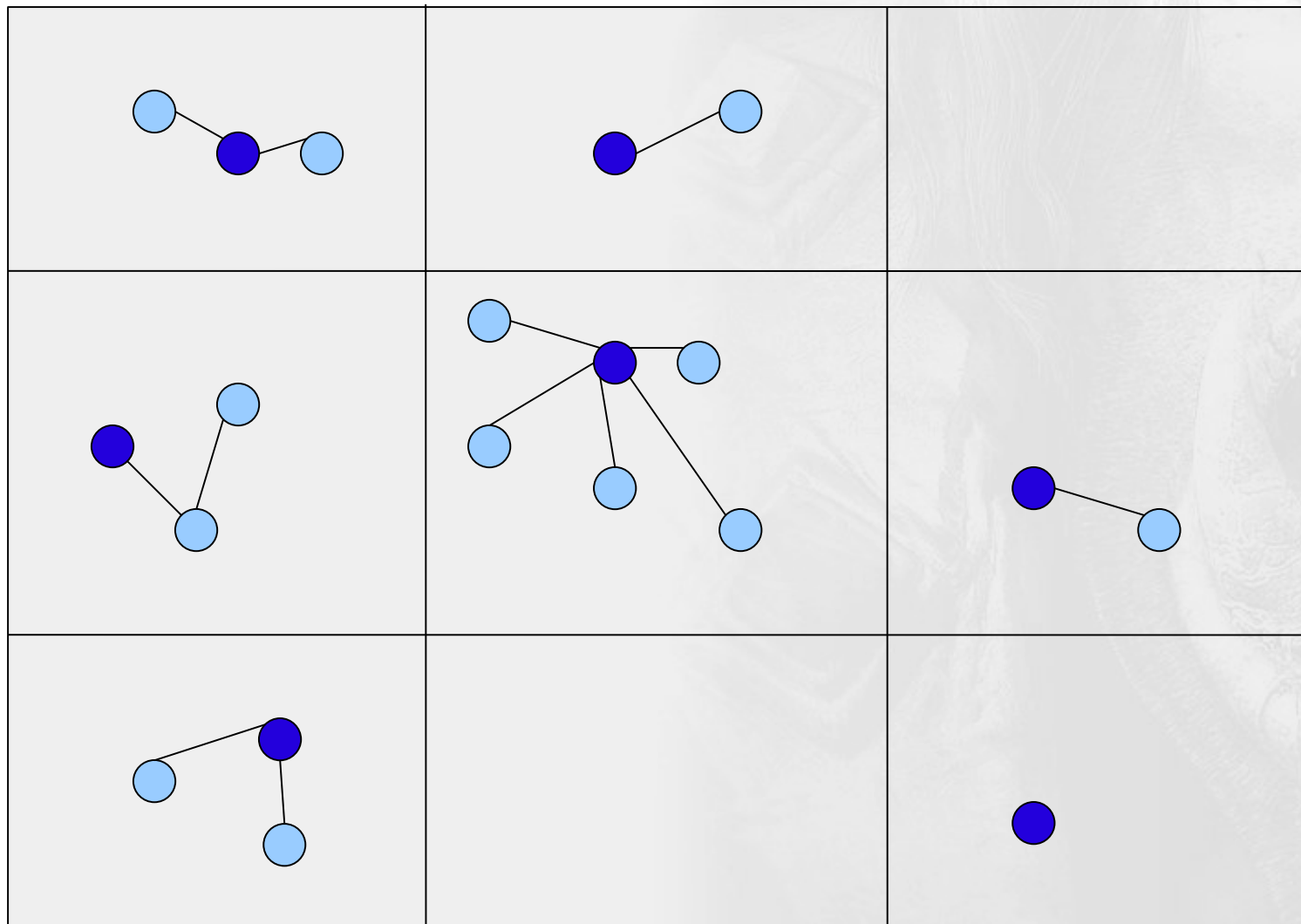
- **Super Peers**

- Manage a zone and reports to Main Server

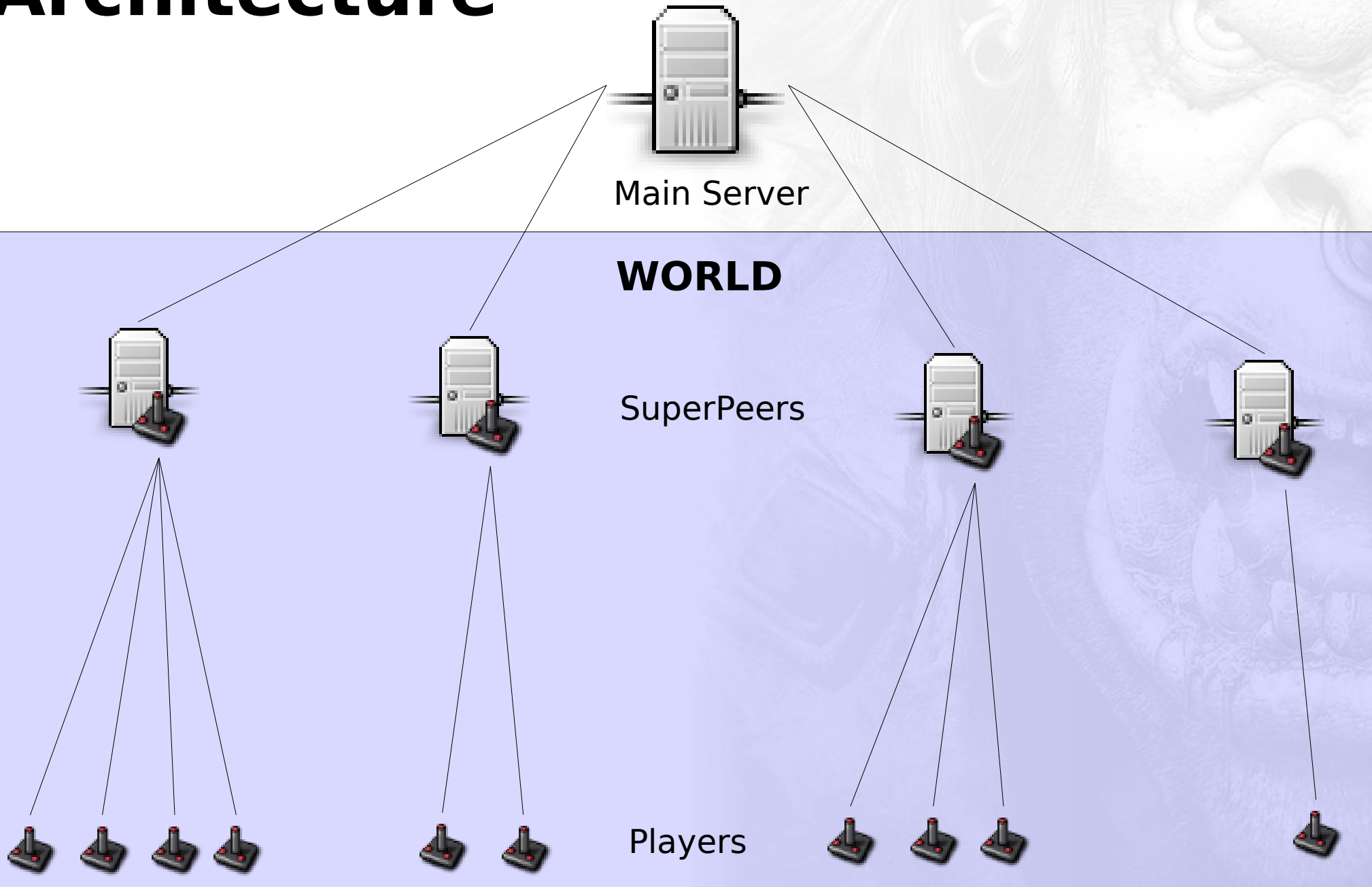
- **Simple peers**

- Connected to the Super Peer of its zone

The world: Peers & SuperPeers



Architecture

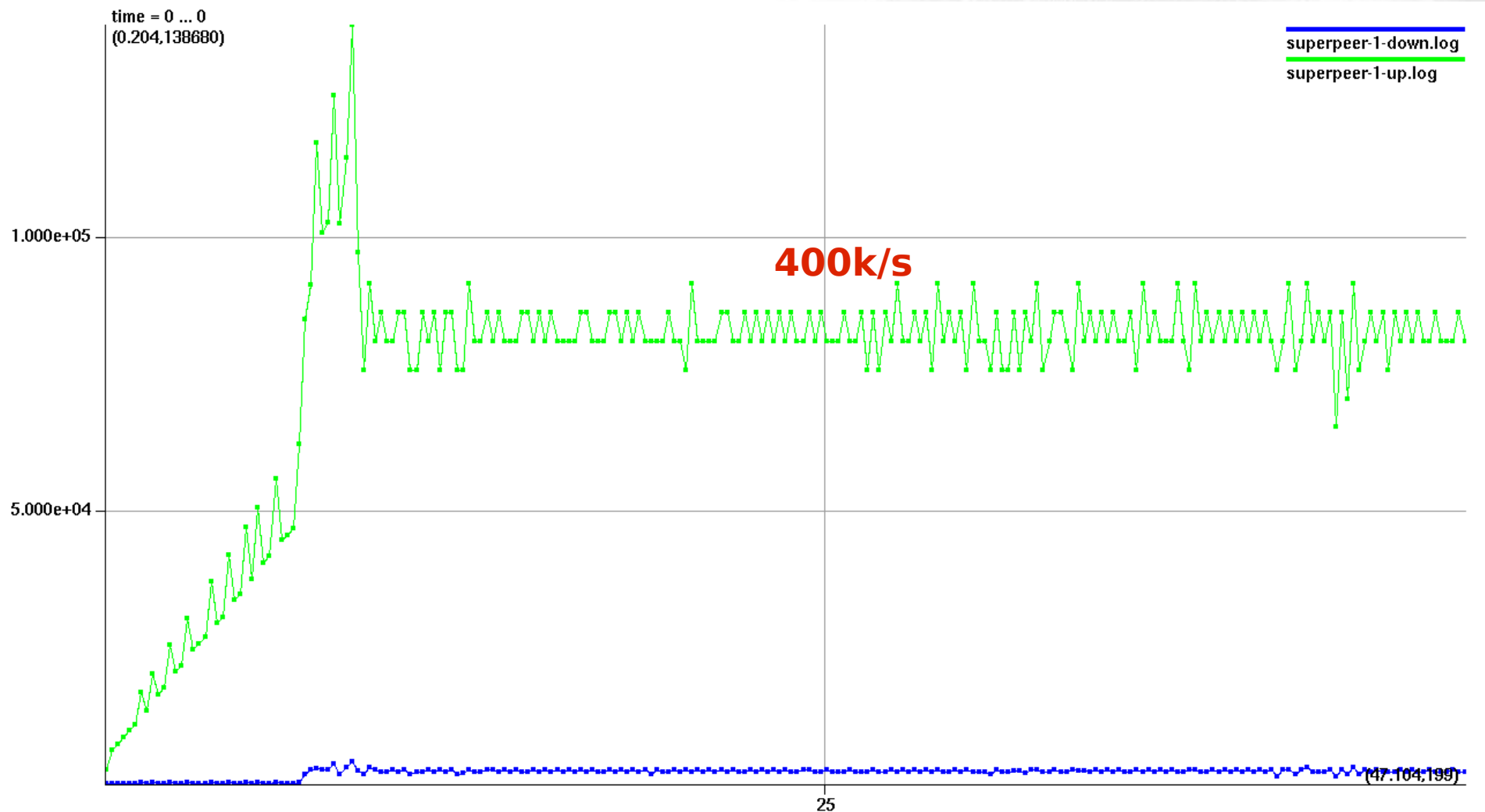


Experimental results

Server Side

Standard MMOG architecture

100 players



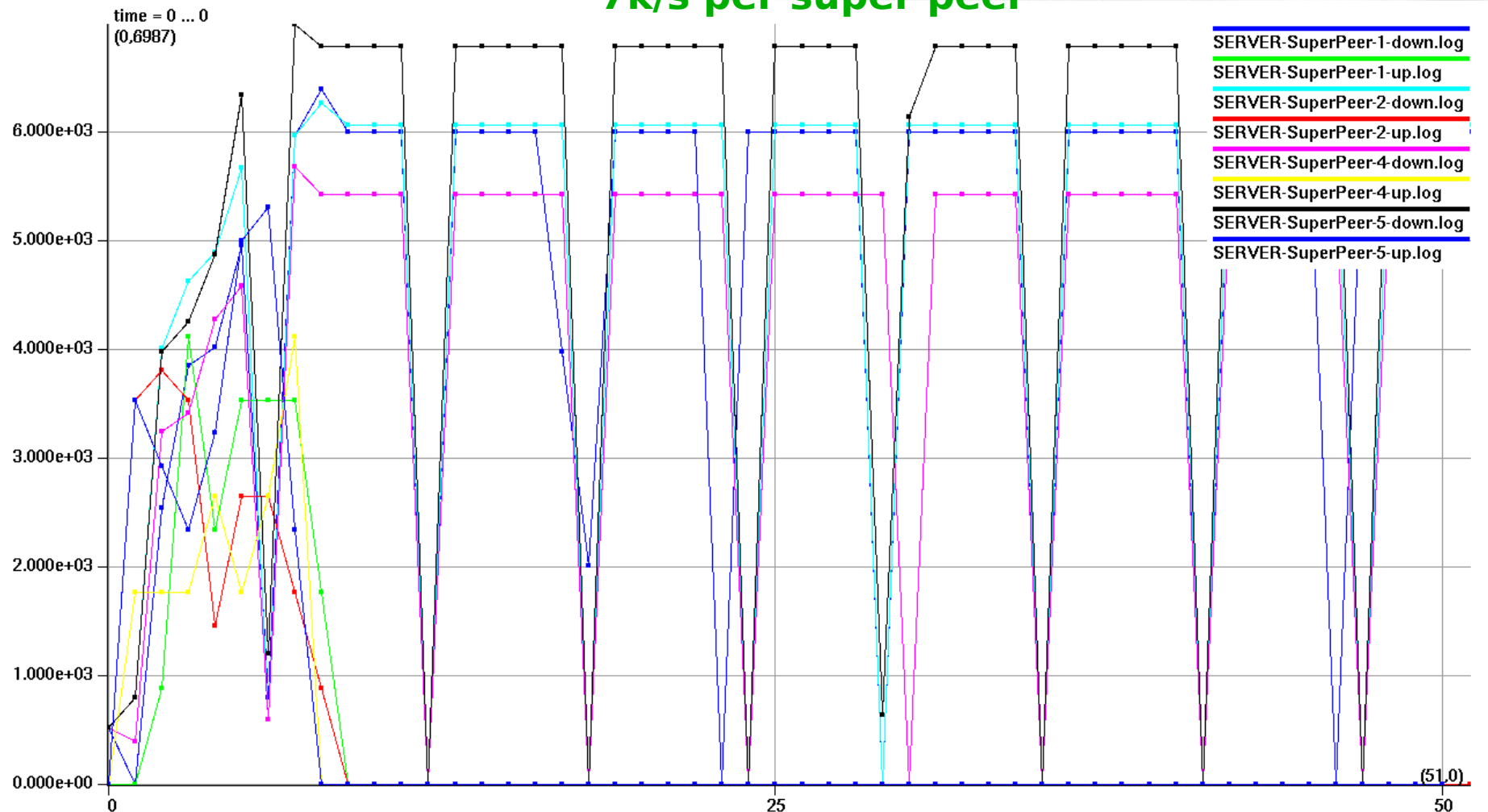
Experimental results

Server Side

Our MMOG architecture

100 players
4 zones
1 update per second

7k/s per super peer

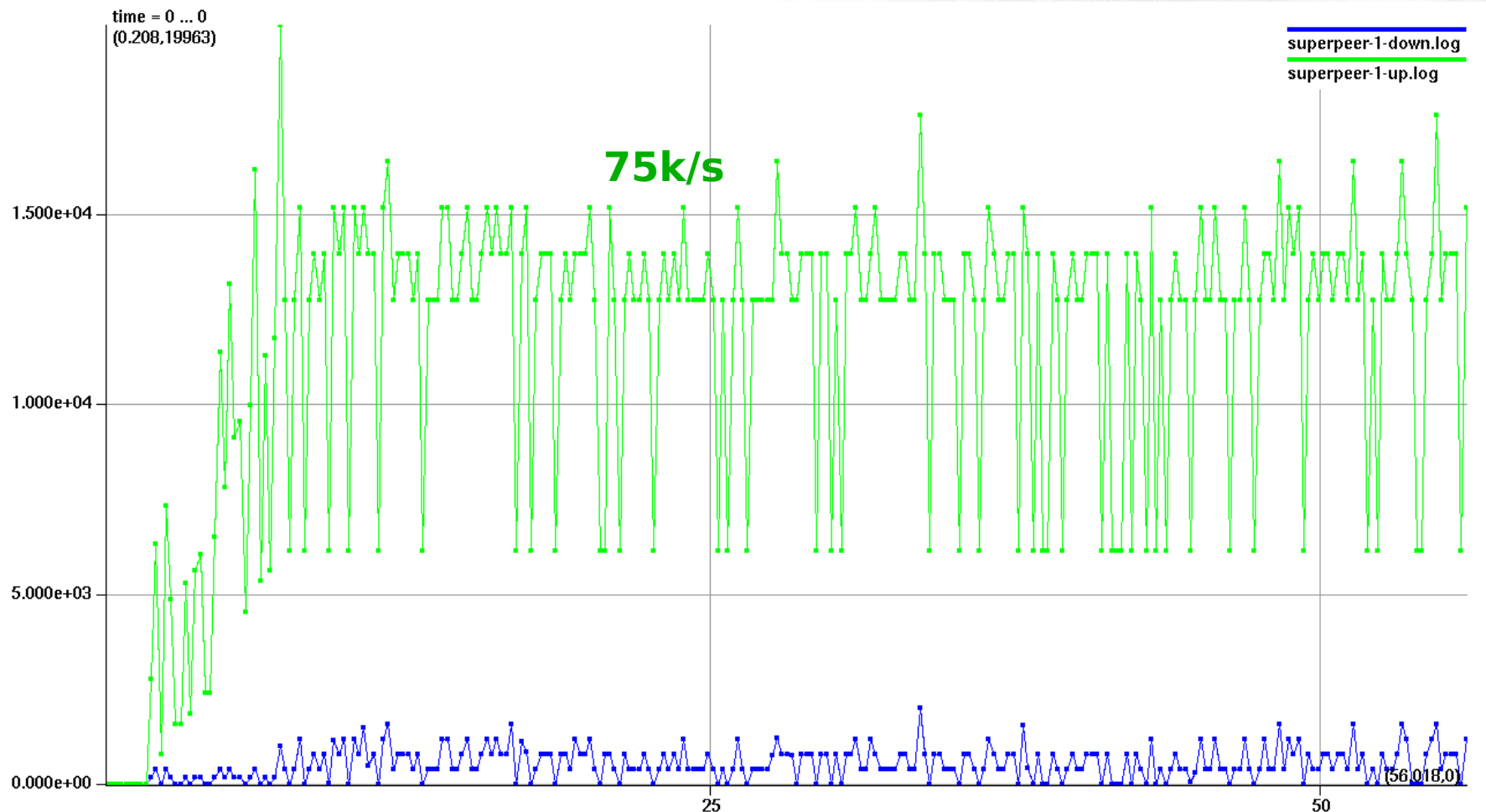


Experimental results

SuperPeer Side

Our MMOG architecture

100 players
4 zones



For each SuperPeer

Work in progress...

- **Smooth transition between zones**

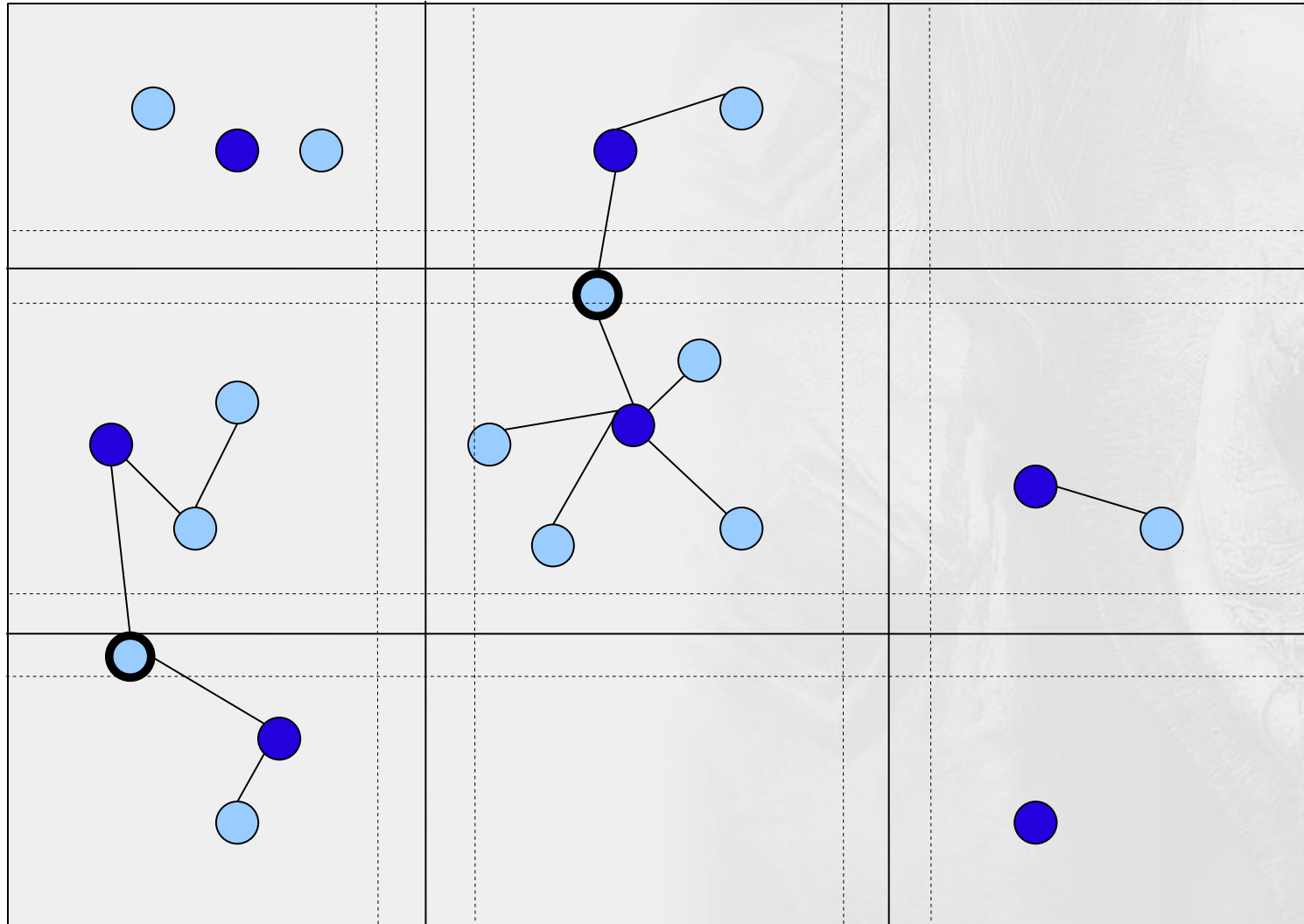
- *Temporarily connect a peer to 2 or more Super Peers*

- **Dynamic subdivision of the zones**

- *When a threshold is reached, the Main Server automatically subdivides a zone into 4 zones to lower the resources needed by the SuperPeer*

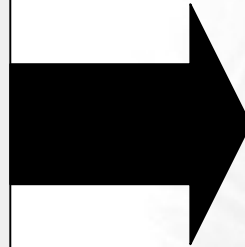
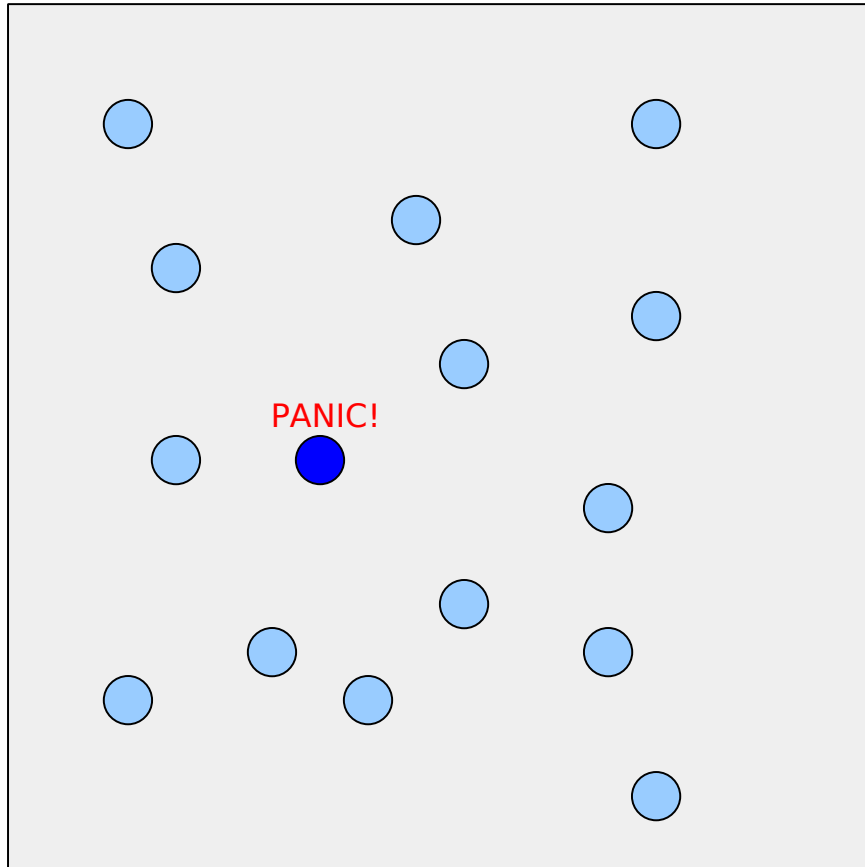
Smooth transition

Peers connected to 2 SuperPeers temporarily

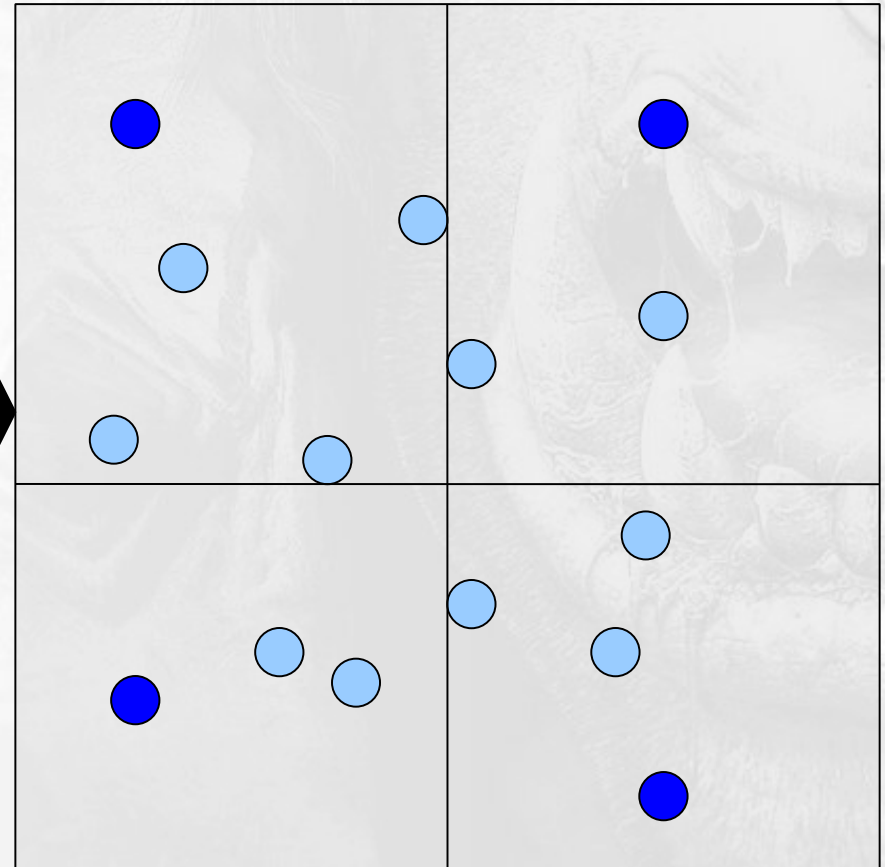


Dynamic subdivision

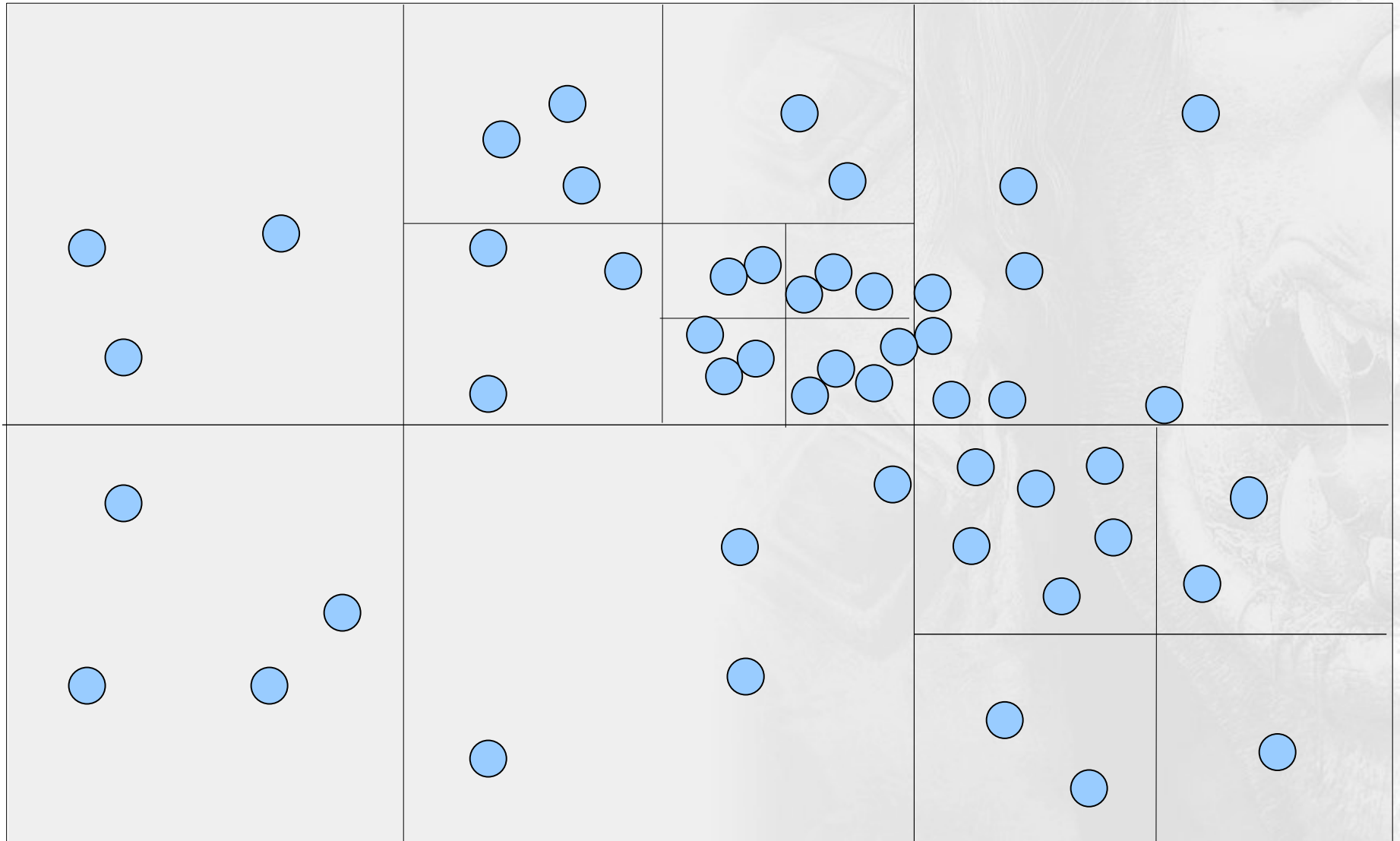
SuperPeer overwhelmed
sends Panic messages
to Main Server



Main Server subdivides
the zone to reduce the workload
of the Super Peer



Dynamic subdivision

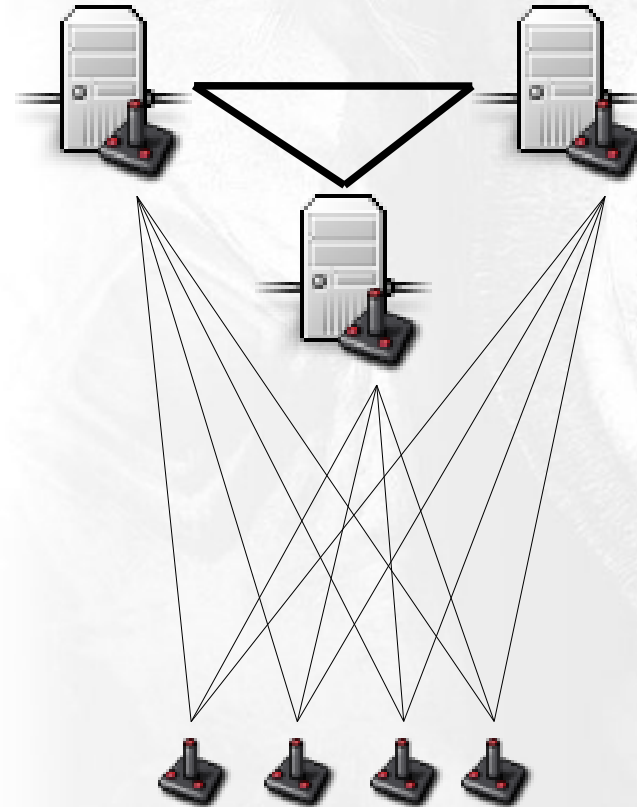
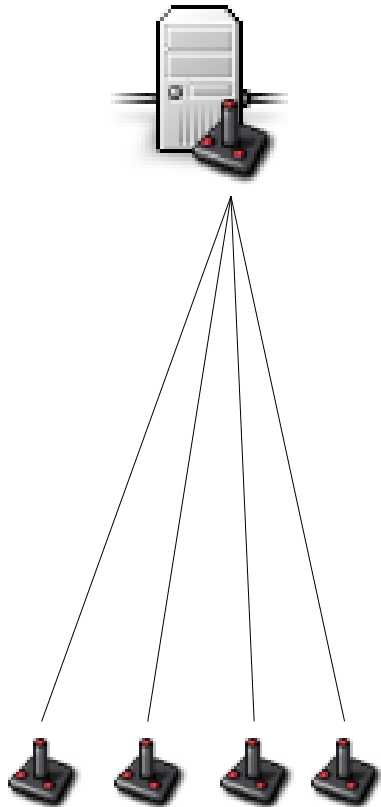


Future Work

- Observations
 - Each zone has one server, unique point of failure
 - A super peer can cheat easily
 - Players have spare upload bandwidth
 - Super peers have spare download bandwidth
- Proposed solution: Multiple super peers per zone
 - Improves cheat protection
 - Improves client experience when a super crashes or disconnect
 - Improves latency

Future Work

- Multiple super peers per zone



Questions?

Project hosted by SourceForge:

<http://sourceforge.net/projects/scalamo/>

- **Source code freely accessible**
- **Join the project by sending us an email**

Ariel: ariel.vardi@gatech.edu

Philippe: philippe.david@gatech.edu

Thank you!