

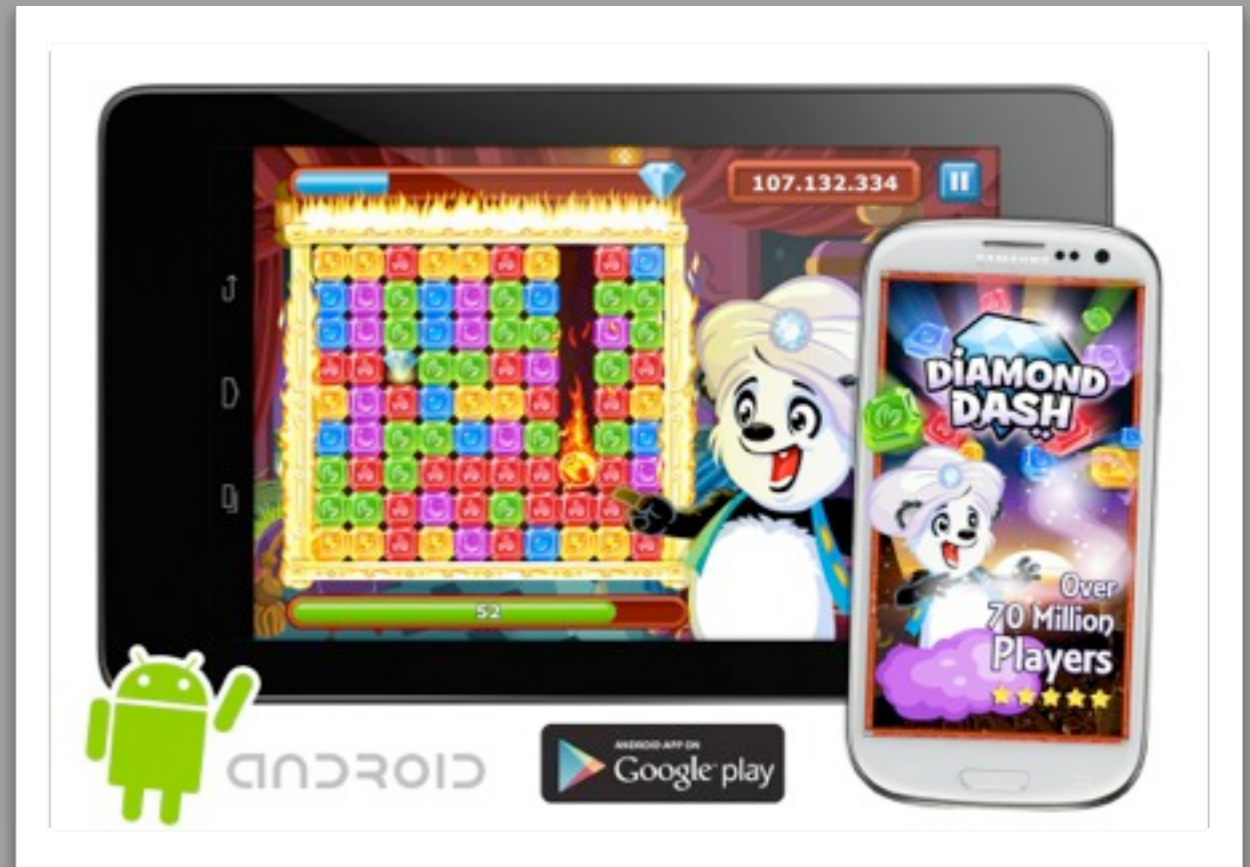
# Reliving the history of multi player games

@phuesler

@rirei



**wooga**









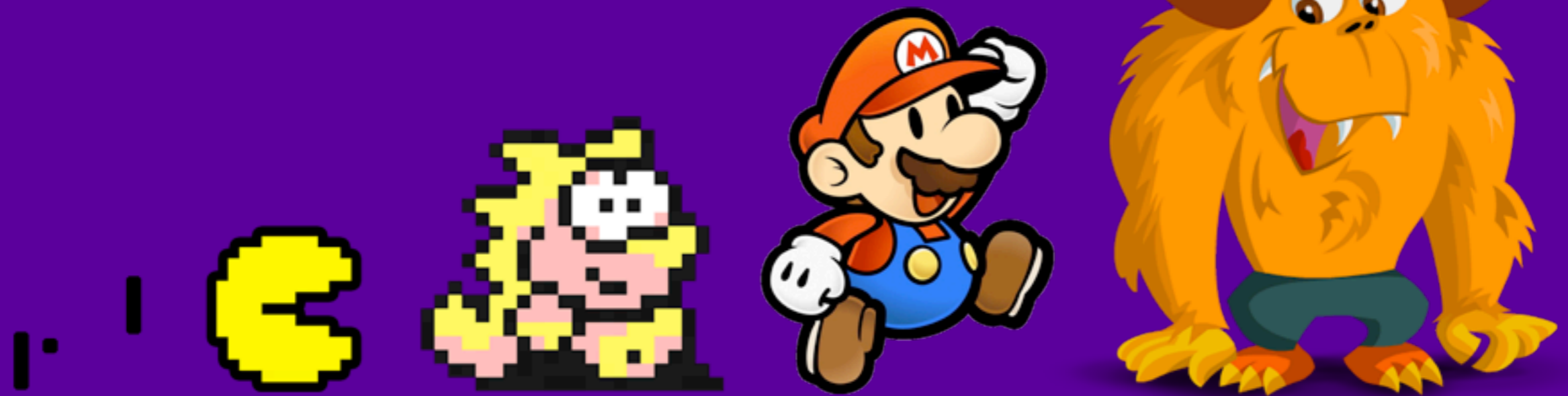


At Wooga

**Evolution**

**is driven by teams**

# Technologies





# Architecture



# Platforms



# User interaction



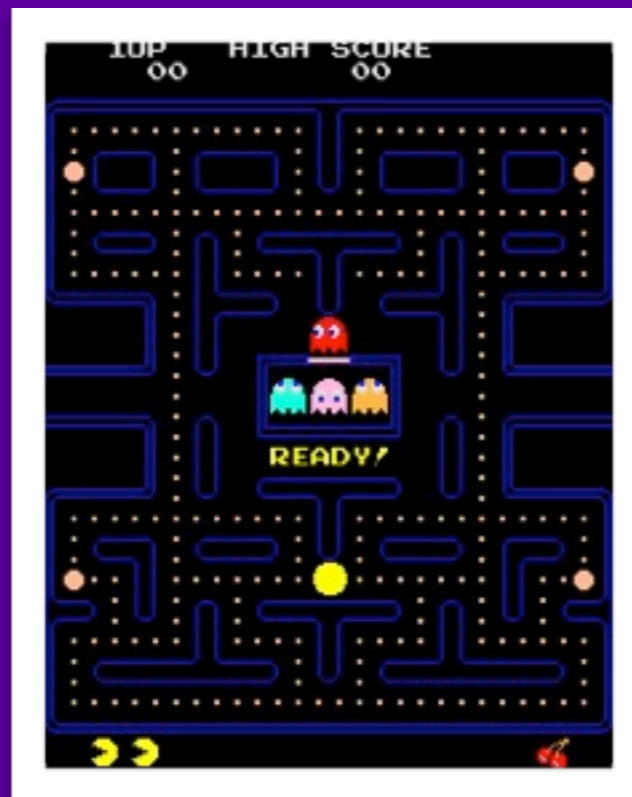


Level 1:

**Read-only**

**interaction**

# High score



Pacman

# Jelly Splash





Health and coin indicators at the top of the screen. On the left, five red hearts are shown in a row, with the word "full" below them. On the right, a coin icon with a sad face and a plus sign is shown, with the number "0" below it.



# Level 145



Target information box containing a small profile picture of Jesper and the text "Target: 51050".

Objective box containing a dark grey slime icon and the text "Clear all the dark slime! You have 17 moves!".

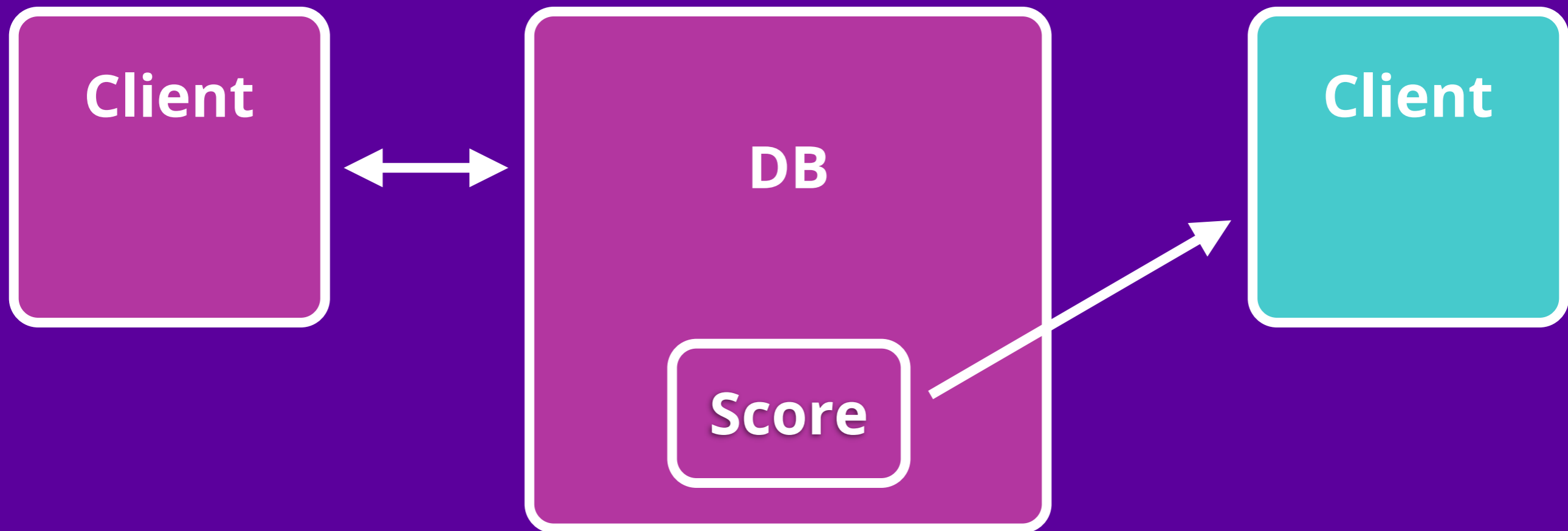
**Play**

- 1 **Jesper**  
51050
- 2 **Horia**  
49700
- 3 **Al**  
37250
- 4 **Sascha**  
36000
- 5 **Annelie**  
34150
- 6 **Leonardo**  
32100





# read-only access

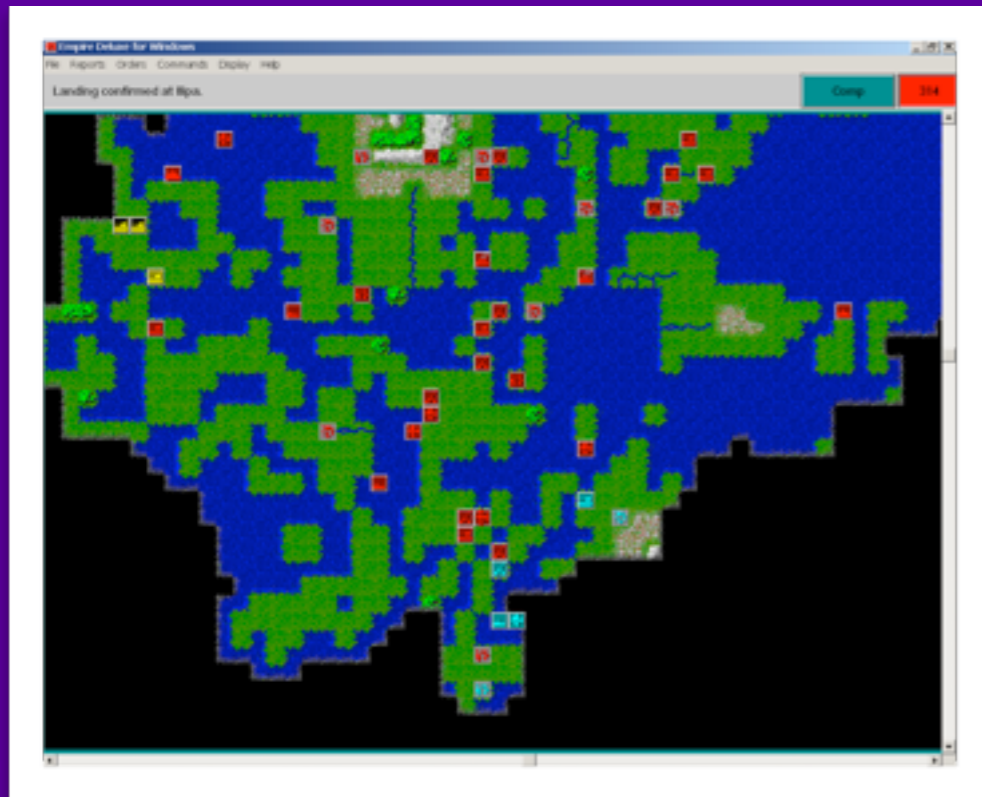


Level 2:

**Inbox**

**interaction**

# Turn based



Empire



Civilization



- 35365
- 187515
- 76536
- 33972
- 17

58 +

9367 44

7



Accept

Refuse

Jesper

Sebastian W. 33

Sascha G. 33

Invite Friend

Marcel I. 34

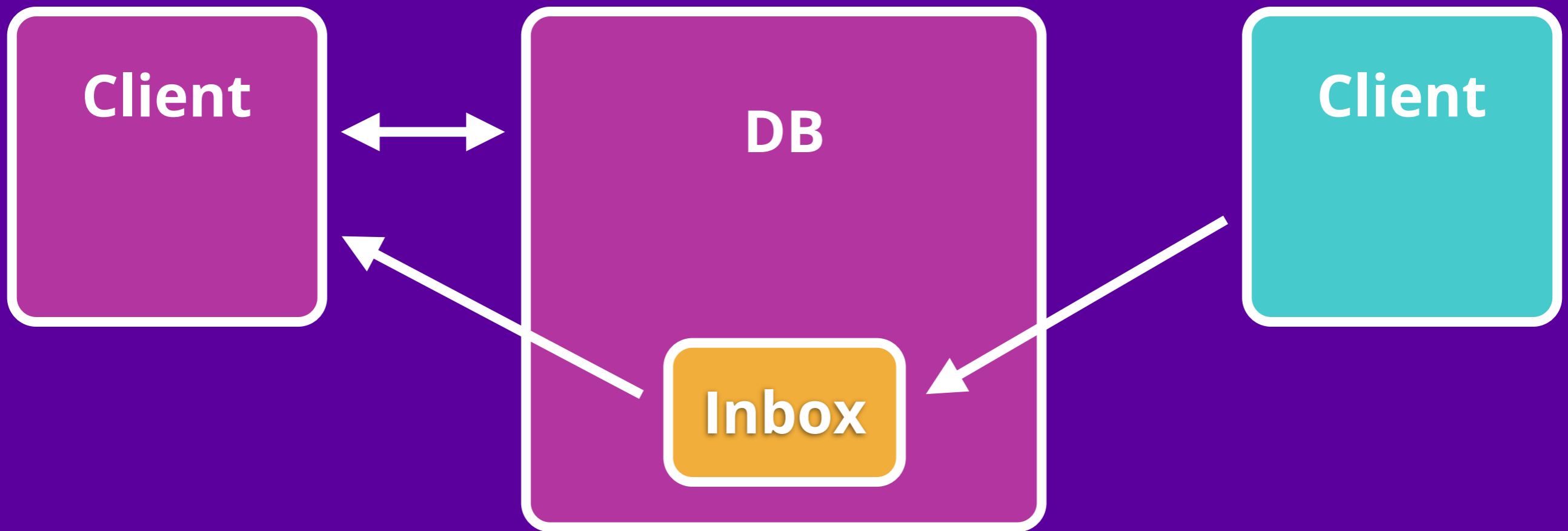
Hasan H. 36

Saschor K. 40

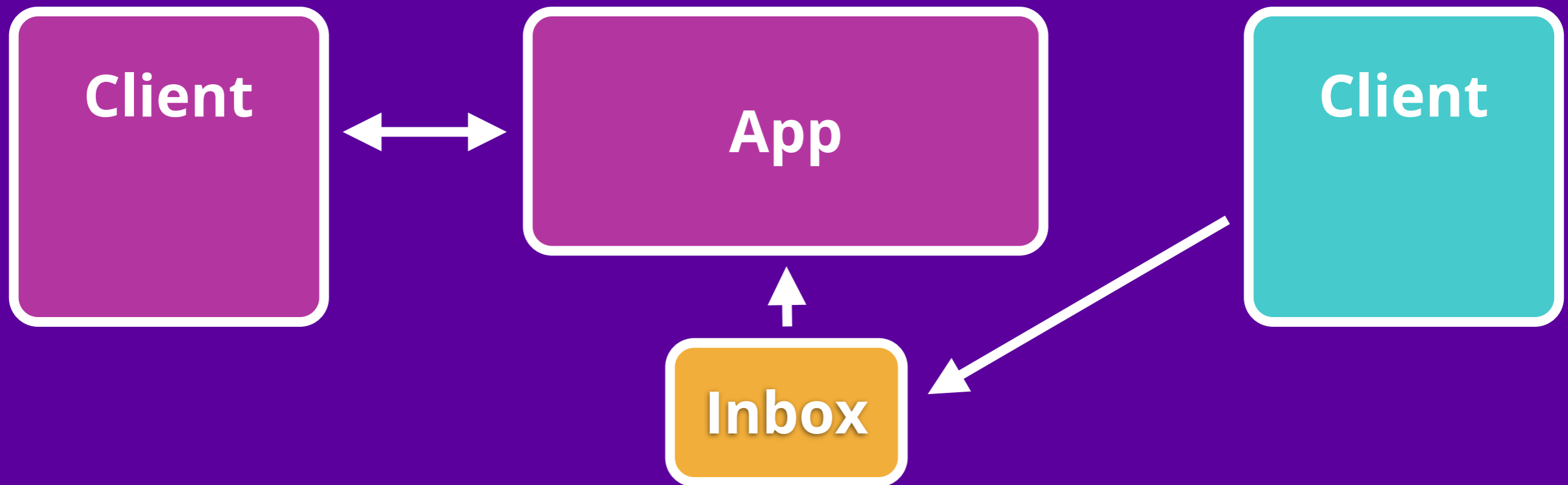
Game navigation icons: target, up arrow, market stall, lion, and other controls.



# inbox



# Inbox interaction



# woo.ga/backend



## Evolution of Backend @ Wooga

Suhmar Yethadka



## Scalable game servers

Knut Nesheim @knutin



## Erlang as a cloud citizen

Paolo Negri @hungryblank



## Getting real with erlang

From the idea to a live system

Knut Nesheim @knutin  
Paolo Negri @hungryblank



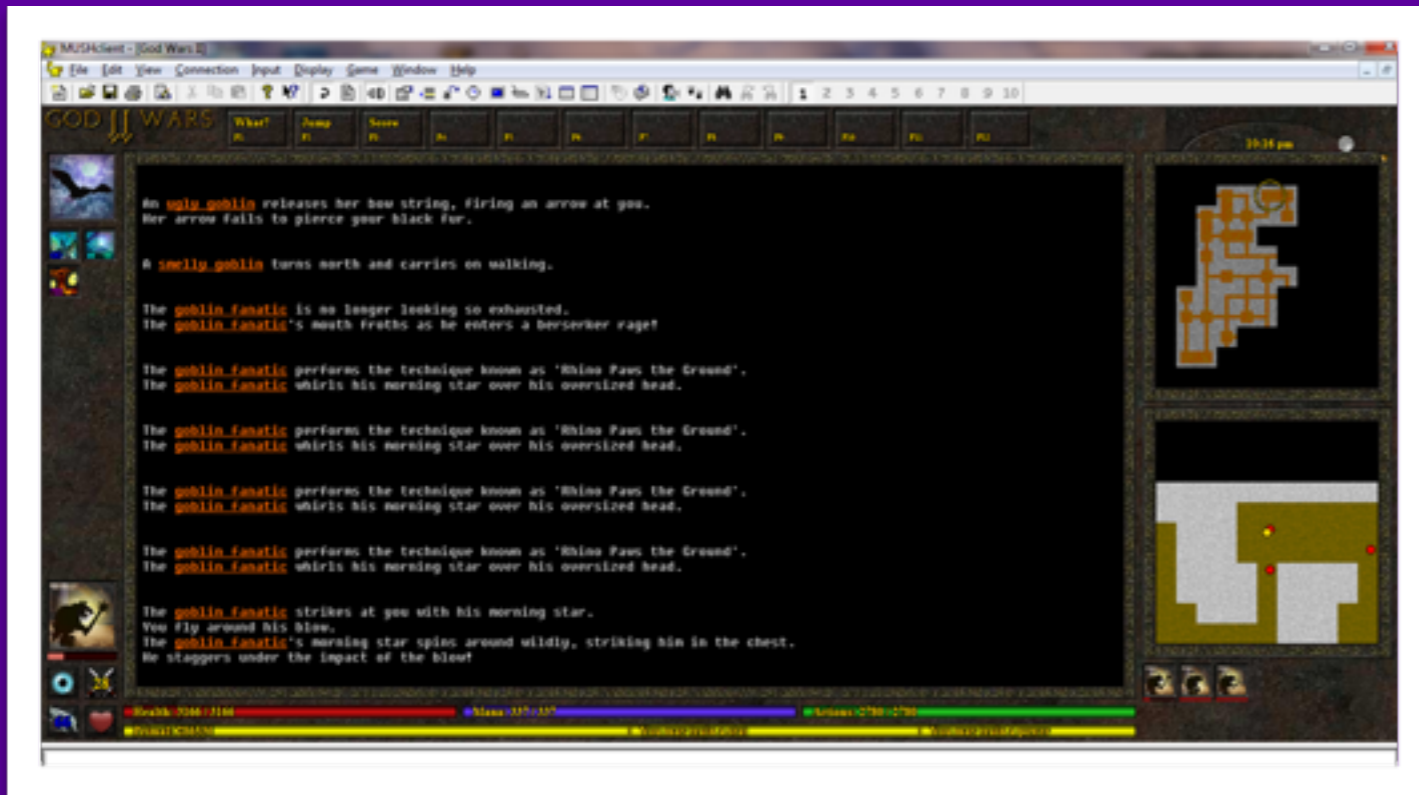
Level 3:

**Real**

**interaction**



# Real interaction



MUD



World of Warcraft



- 
- 
- 

Market stall with a red and white striped awning and a sign that says "kalen". A blue hippo character is standing behind the counter.

A red and white striped lighthouse with a sign that says "rippy" hanging from its side.

A group of penguins wearing hats, sitting on a wooden crate. One penguin is holding a guitar.

A young boy with brown hair, wearing a yellow shirt and blue pants, is fishing in a blue pond.

A brown bear is running across the grassy field.

Outdoor picnic area featuring a pink and white checkered blanket, two blue and white striped chairs, a blue pot on a stand, and a metal grill.

**Lures**

29	8	Buy More			
----	---	----------	--	--	--

Shopping cart icon with a red prohibition sign over it.



Like 153k

5127 +

41 +

390

10 1310

- 
- 
- 

balen

hippy

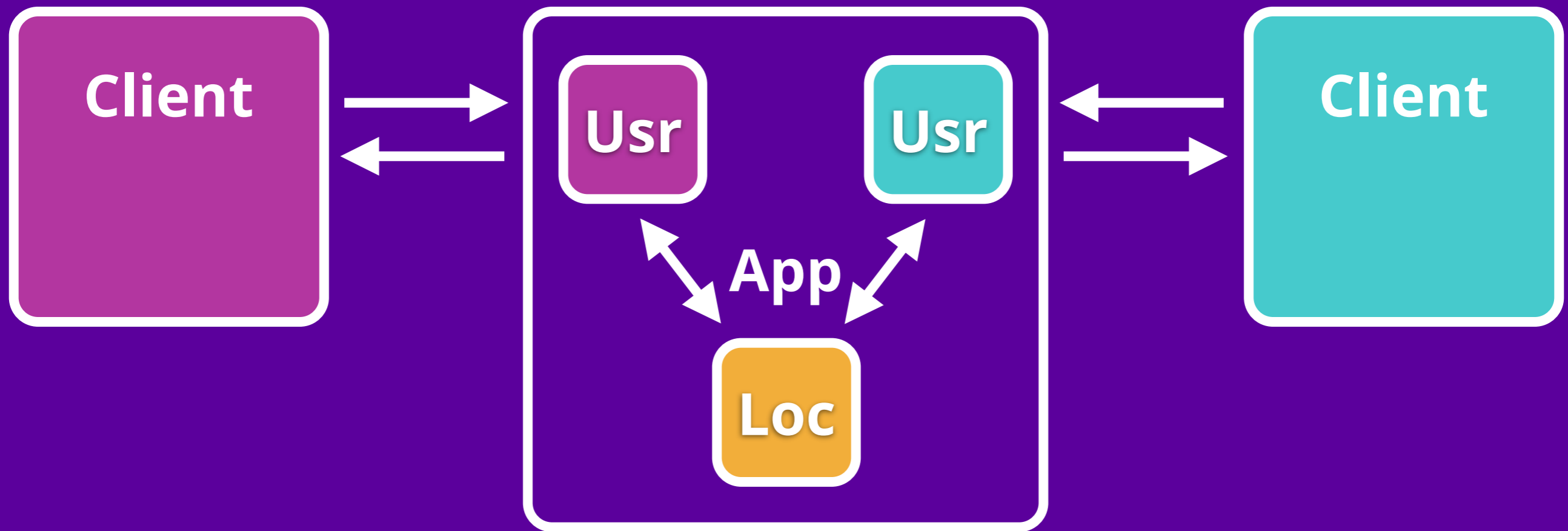
Fish escaped

Lures

		Buy More			
29	8				



# Real interaction





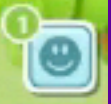
Like 153k

5127 +

41 +

390

10 1310



- 
- 
- 

Market stall with a sign that says "kale". A hippo character is standing behind the counter.

A red and white striped lighthouse with a sign that says "nippy" hanging from its side. A boy character is standing near the base.

A group of penguins wearing hats, sitting on a wooden crate. One penguin is holding a guitar.

A girl character with blonde hair is fishing in a blue pond. A boy character is standing nearby.

Outdoor picnic area with a pink and white checkered blanket, two blue and white striped chairs, a grill, and a pot.

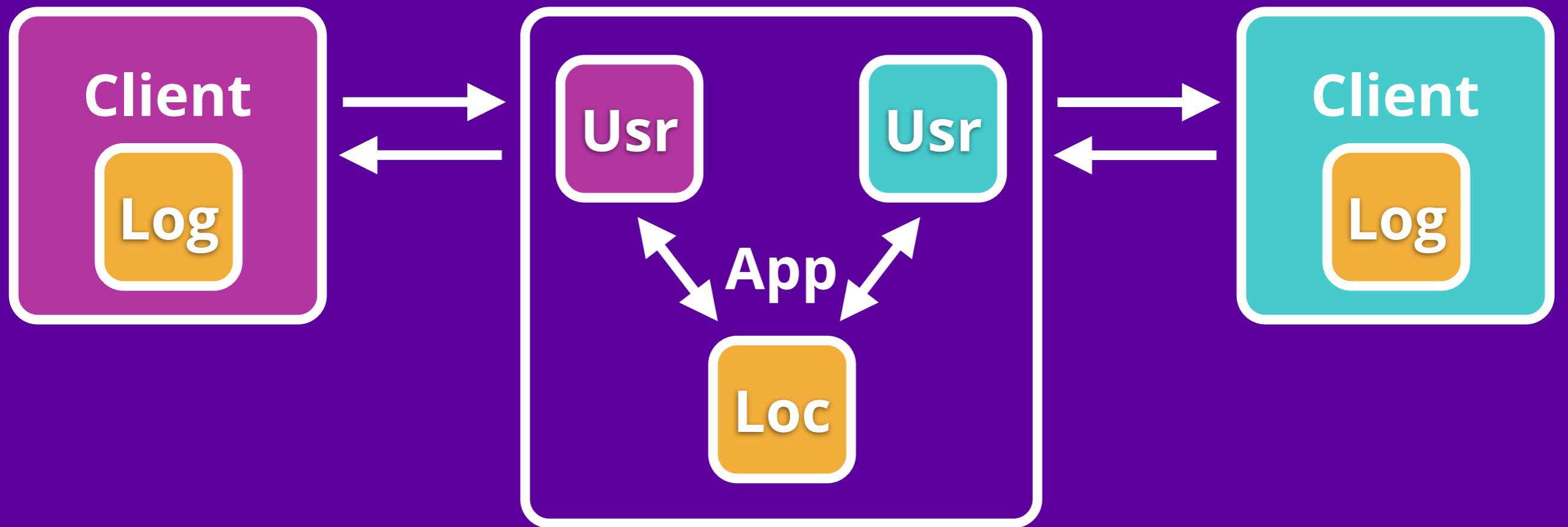
**Lures**

		Buy More			
29	8				

Shopping cart area with a shopping basket, a brown bag, a red prohibition sign, and a fork and knife.



# Handling conflicts



- 
- 
- 

Reminder



Lures

29	8	Buy More				
----	---	----------	--	--	--	--

Shopping cart, suitcase, and other icons

# woo.ga/backend

## **You are not alone**

Scaling Multiplayer Games

---

Jesper Richter-Reichhelm - @jrrei  
Knut Nesheim - @knutin

Level 4:

**Real time**

**interaction**



# Real time interaction



Super Mario Kart



Starcraft

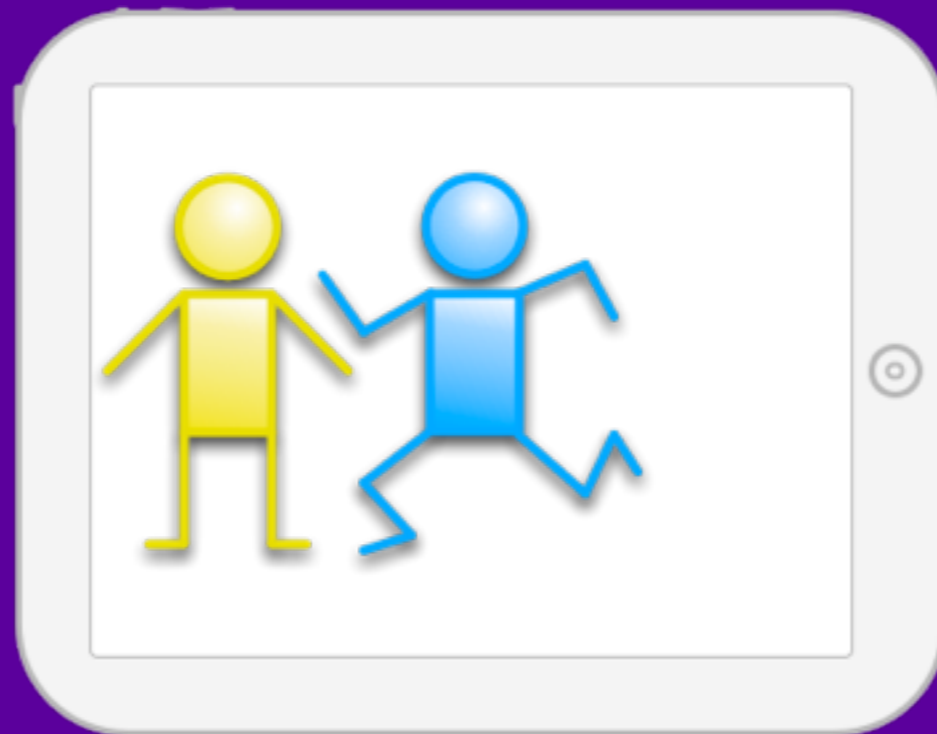




**Player 1**



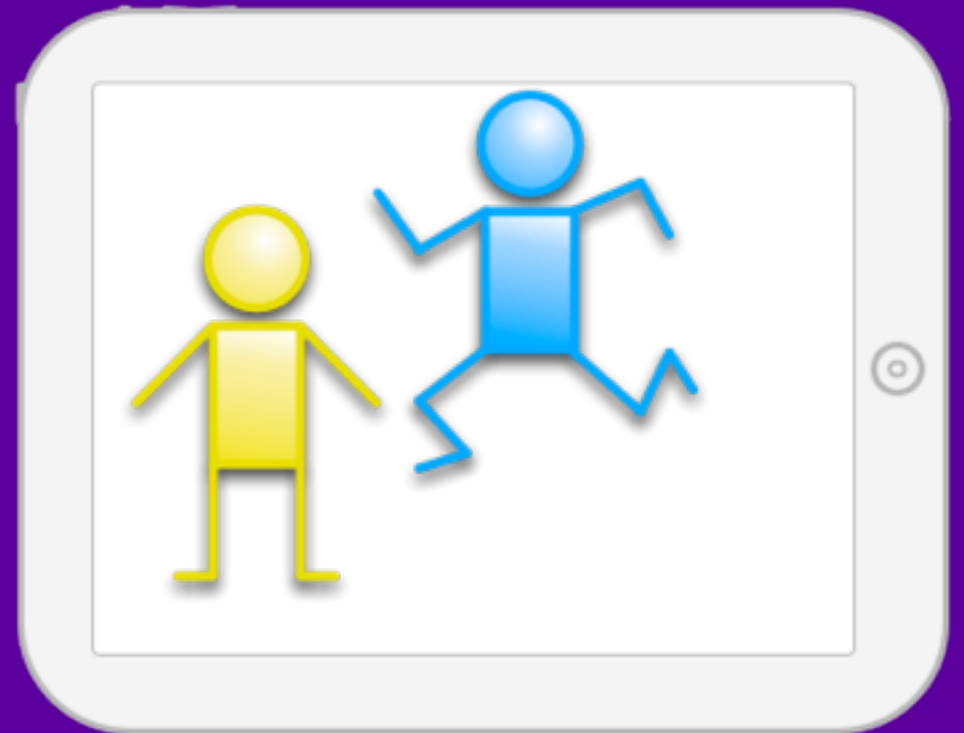
**Player 2**



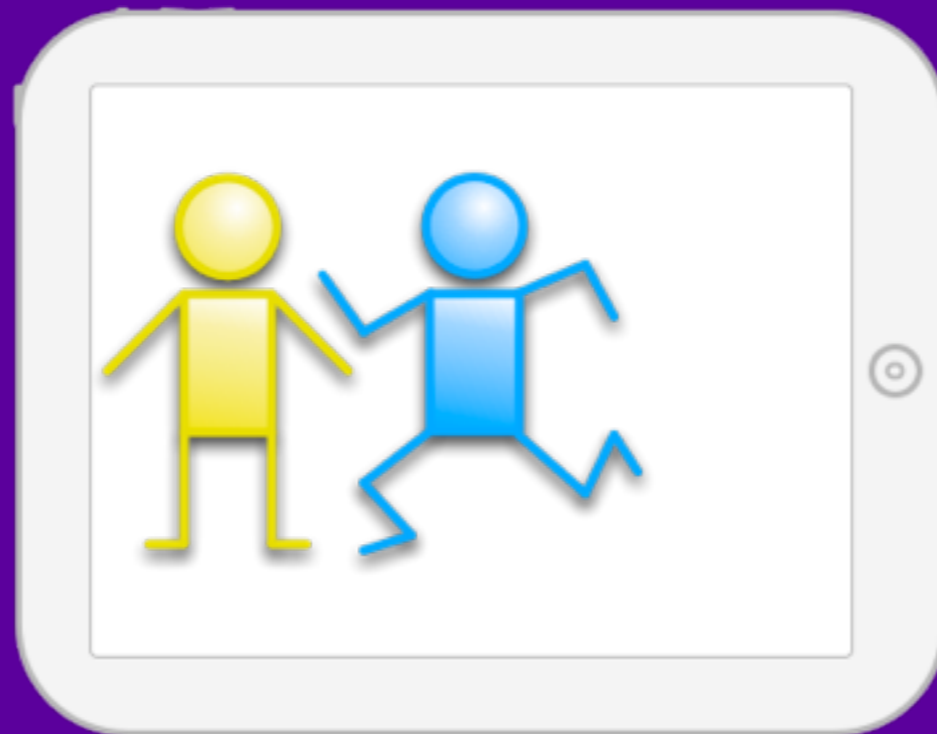
**Server**



**Player 1**



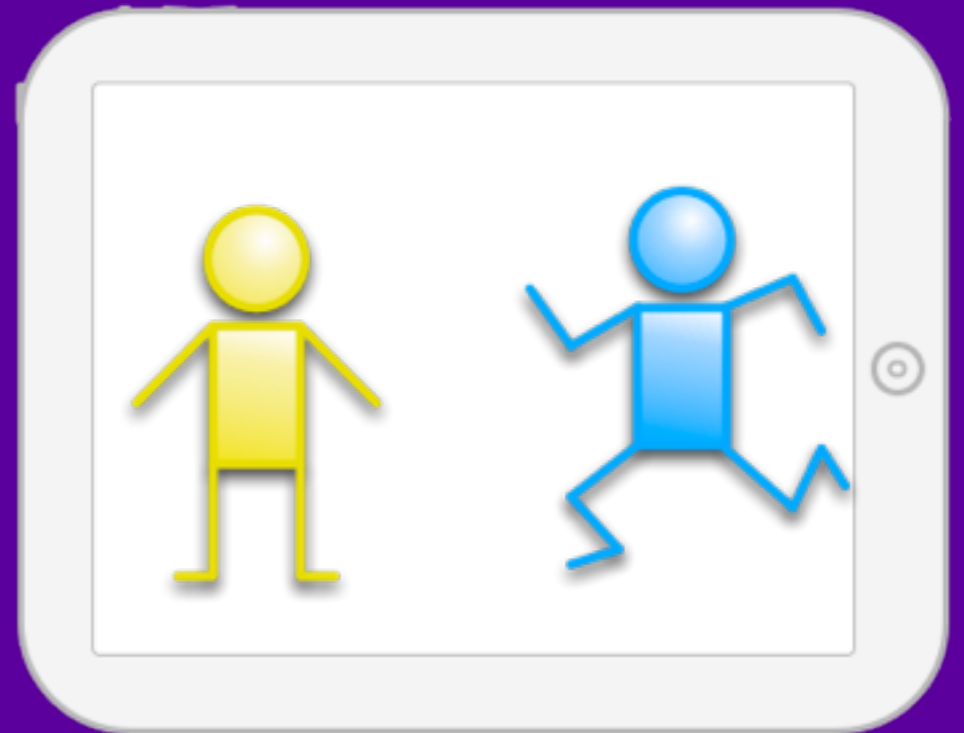
**Player 2**



**Server**



**Player 1**



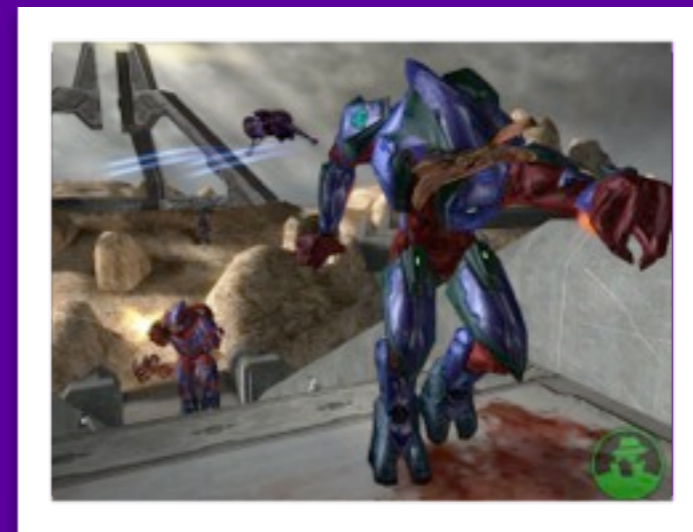
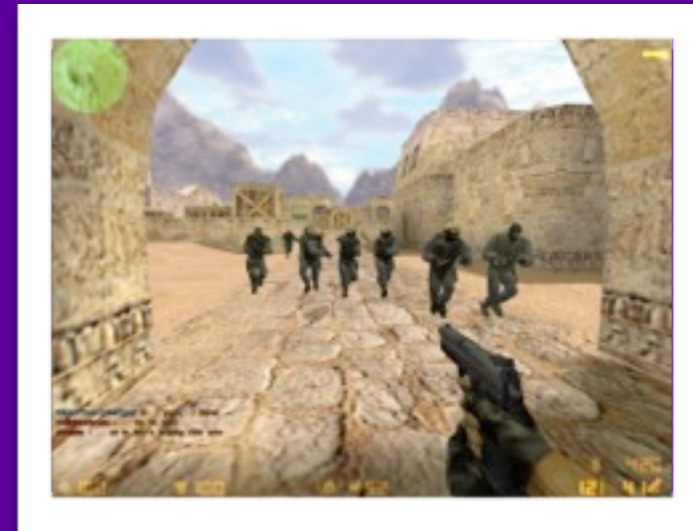
**Player 2**



**Server**



# Sources of inspiration



# We depend on

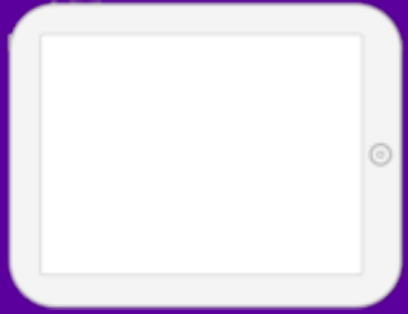
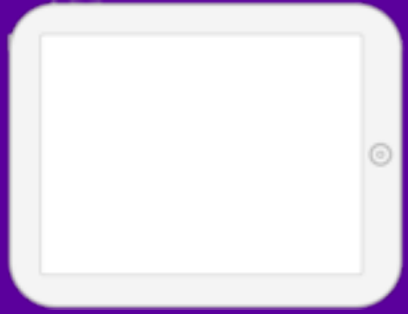
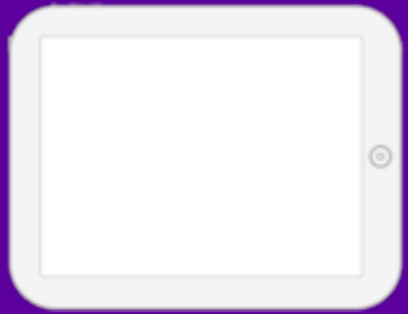
- **good throughput**
- **low latency**
- **low packet loss**
- **no jitter**

Level 4:

**Real time**

**interaction on mobile**





**3G**



**Internet**

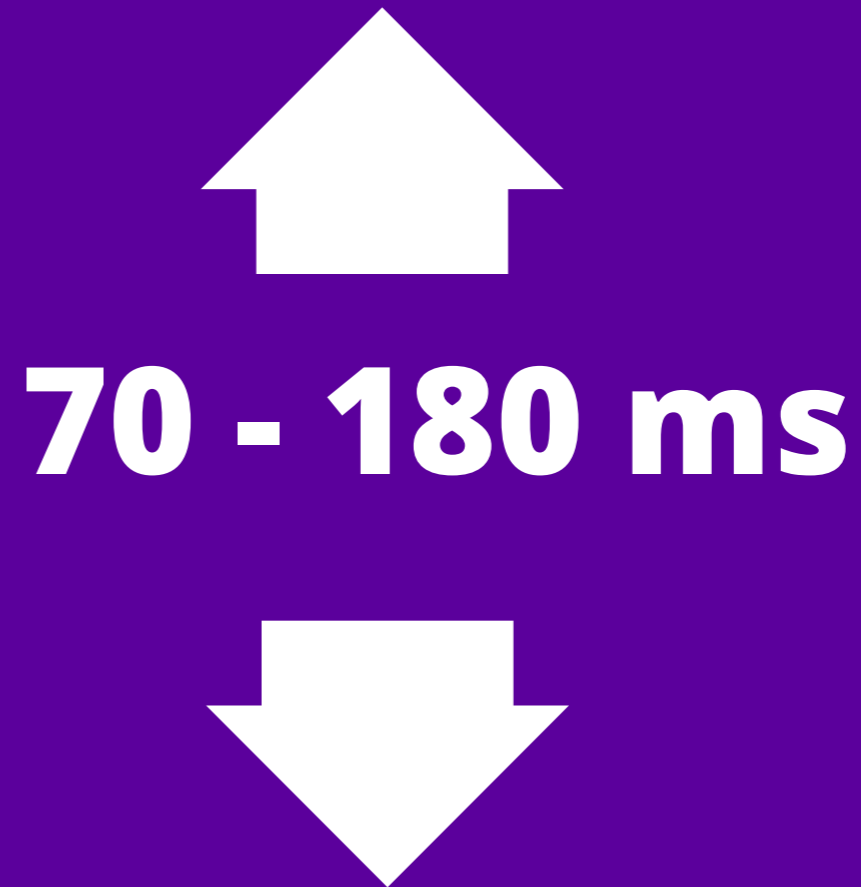


# Bandwidth



[https://de.wikipedia.org/wiki/High\\_Speed\\_Uplink\\_Packet\\_Access](https://de.wikipedia.org/wiki/High_Speed_Uplink_Packet_Access)  
[https://de.wikipedia.org/wiki/High\\_Speed\\_Downlink\\_Packet\\_Access](https://de.wikipedia.org/wiki/High_Speed_Downlink_Packet_Access)

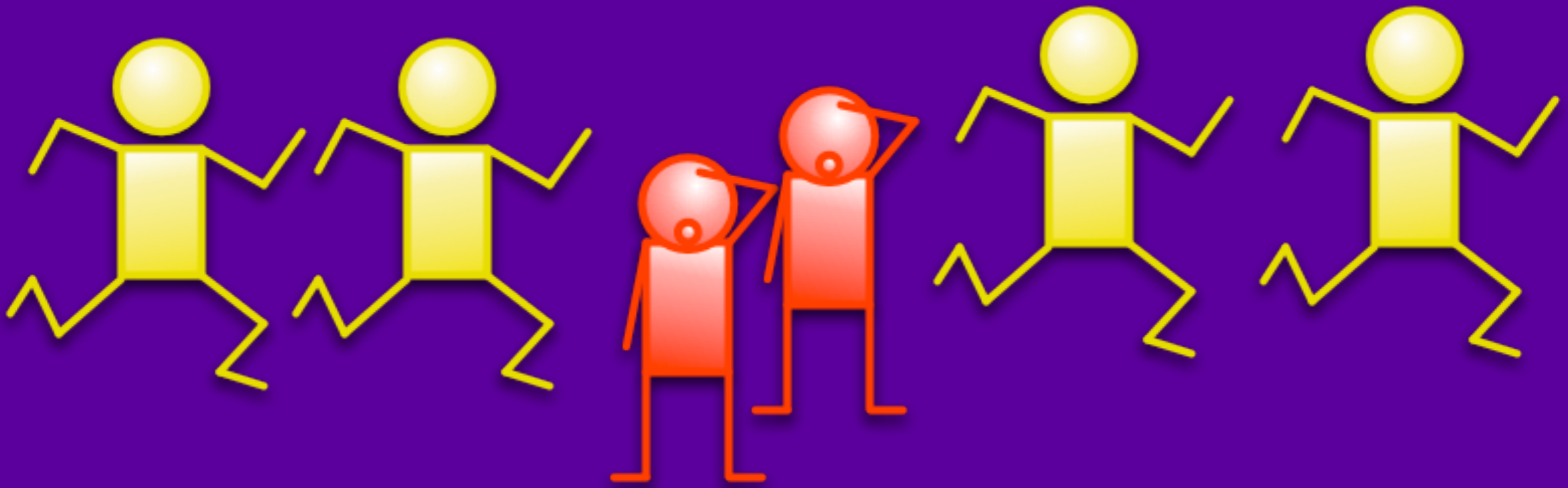
# Added Latency (RTT) \*



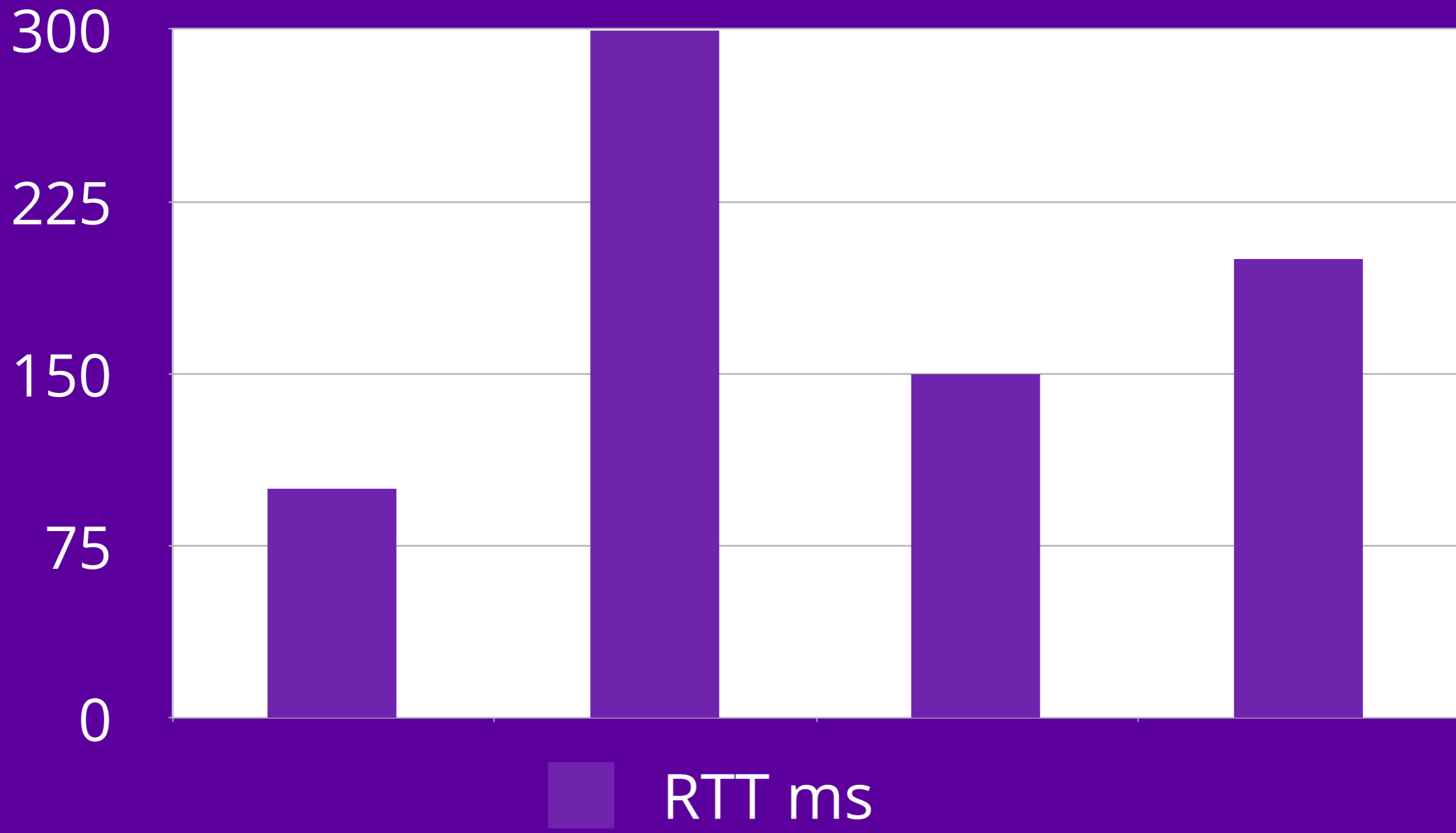
\* HSDPA/HSUPA



# Packet loss



# Latency Jitter



# Let's do



## Bomberman



**ROOK CHALLENGER MASTER**

8 65%

**61** Player\_18199053  
3701

**62** Shoguyabu 🐼  
3685

**63** Player\_45502620  
3666

**64** Minte  
3570

**65** Bebe  
3557

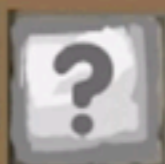
Players online:

**PLAY**

**PLAY WITH FRIENDS**

**PRACTICE**

**FEEDBACK**



Real Time

Interpolation

Lag Compensation

Lockstep

Quality of Service

Packet Loss

TCP

UDP

Client Prediction

Peer-To-Peer

Latency

Object Replication

Protocol

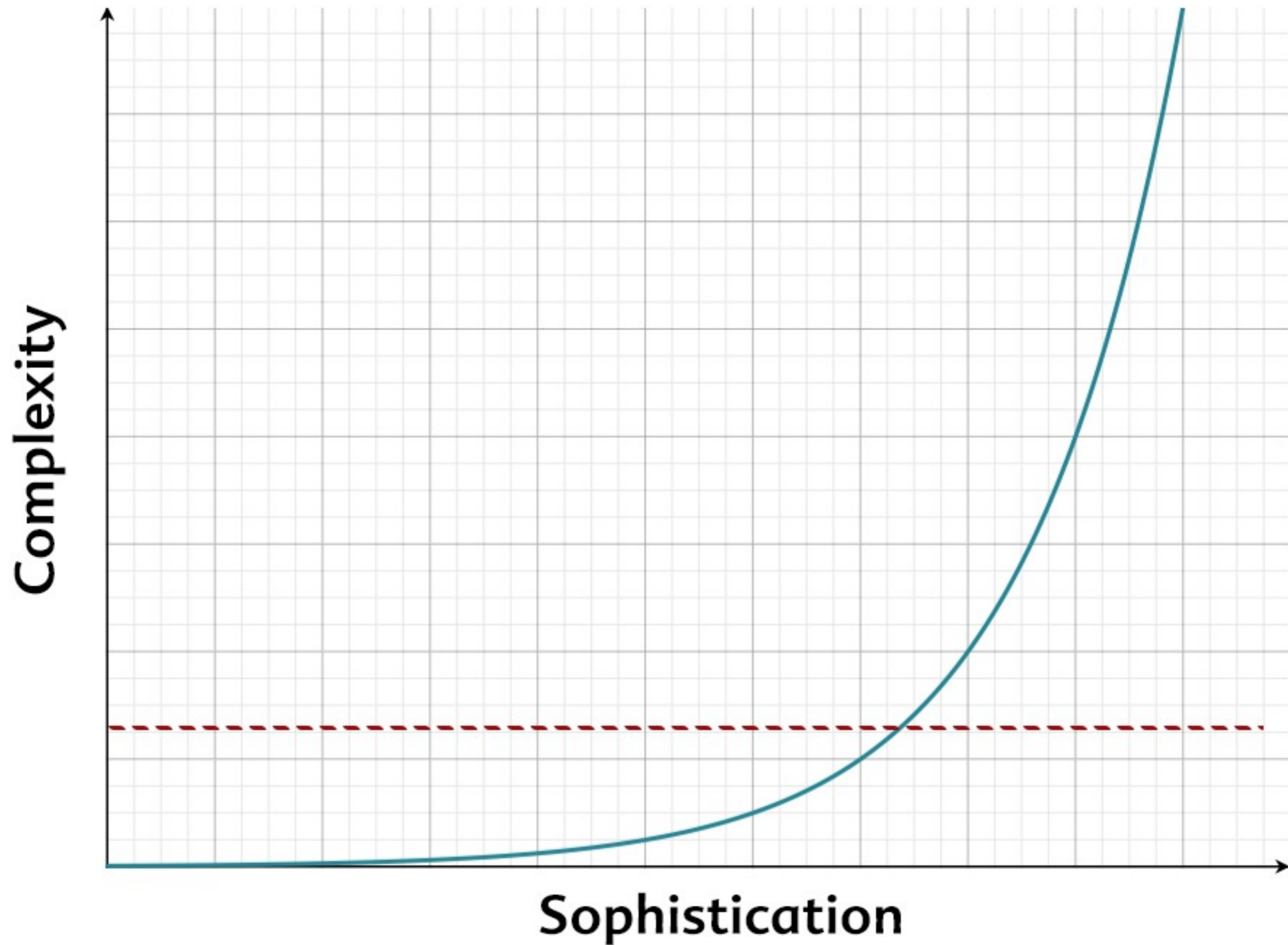
Synchronization

Physics

Extrapolation

Collision Detection

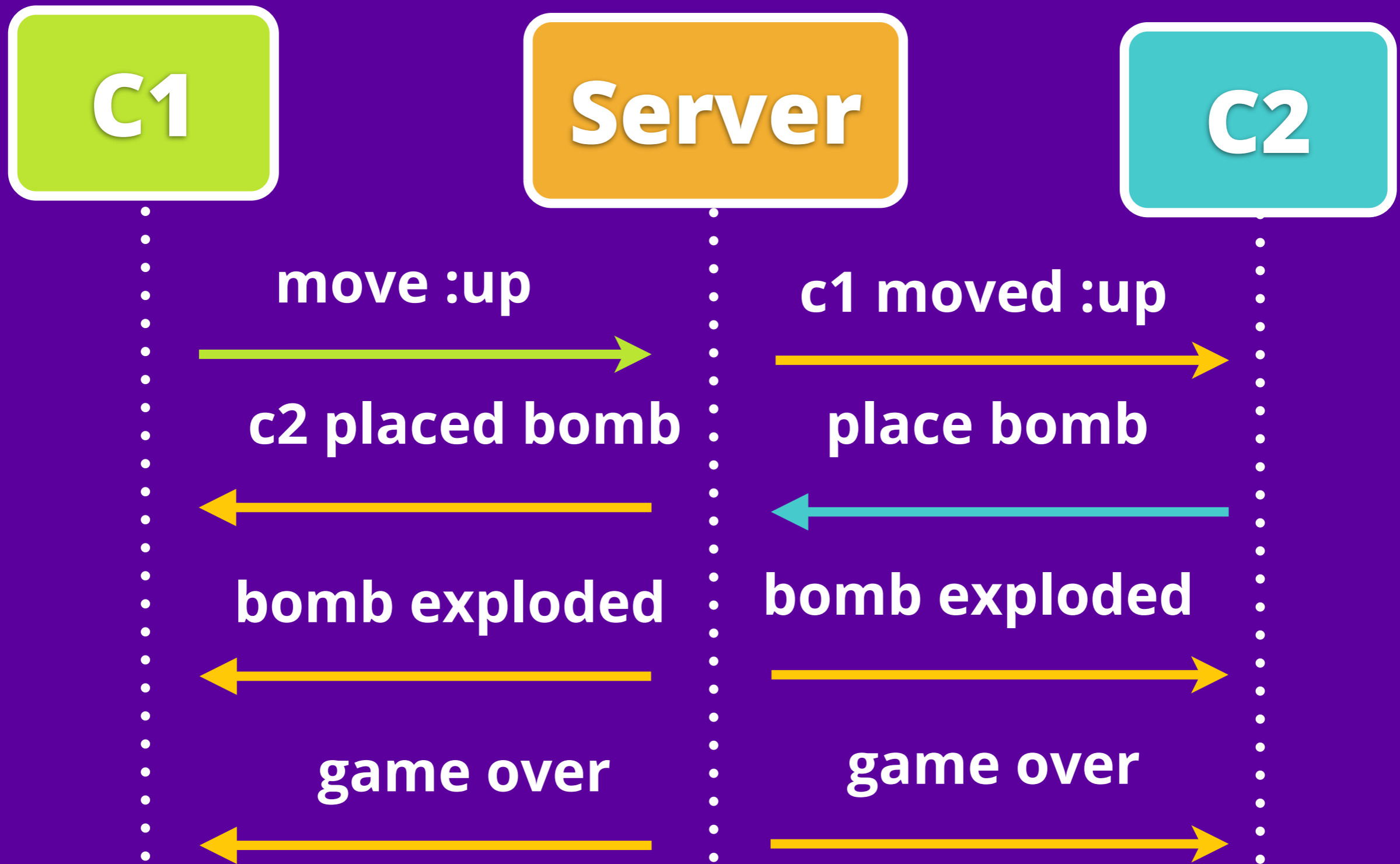
Match Making





1

# Architecture





TCP  
←→  
JSON



*EASY!!!*



**Works on  
wifi**



**game doesn't  
work on 3G**



# Jitter





# Dropped packets

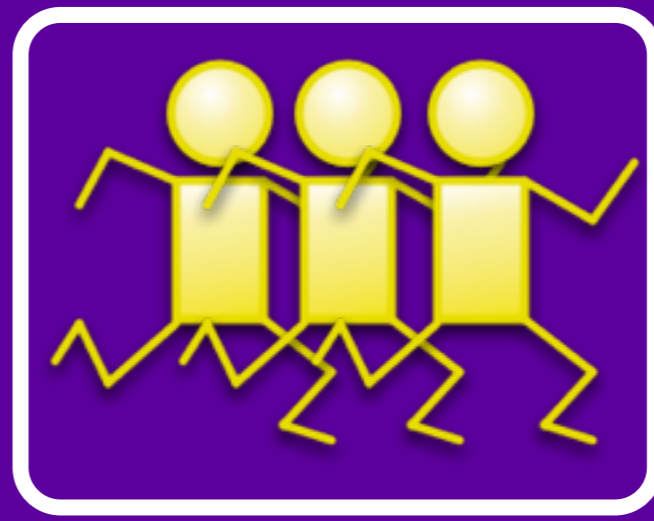


# TCP Packet Ordering and Resend



# TCP Flow and Congestion

## Control



# Warping



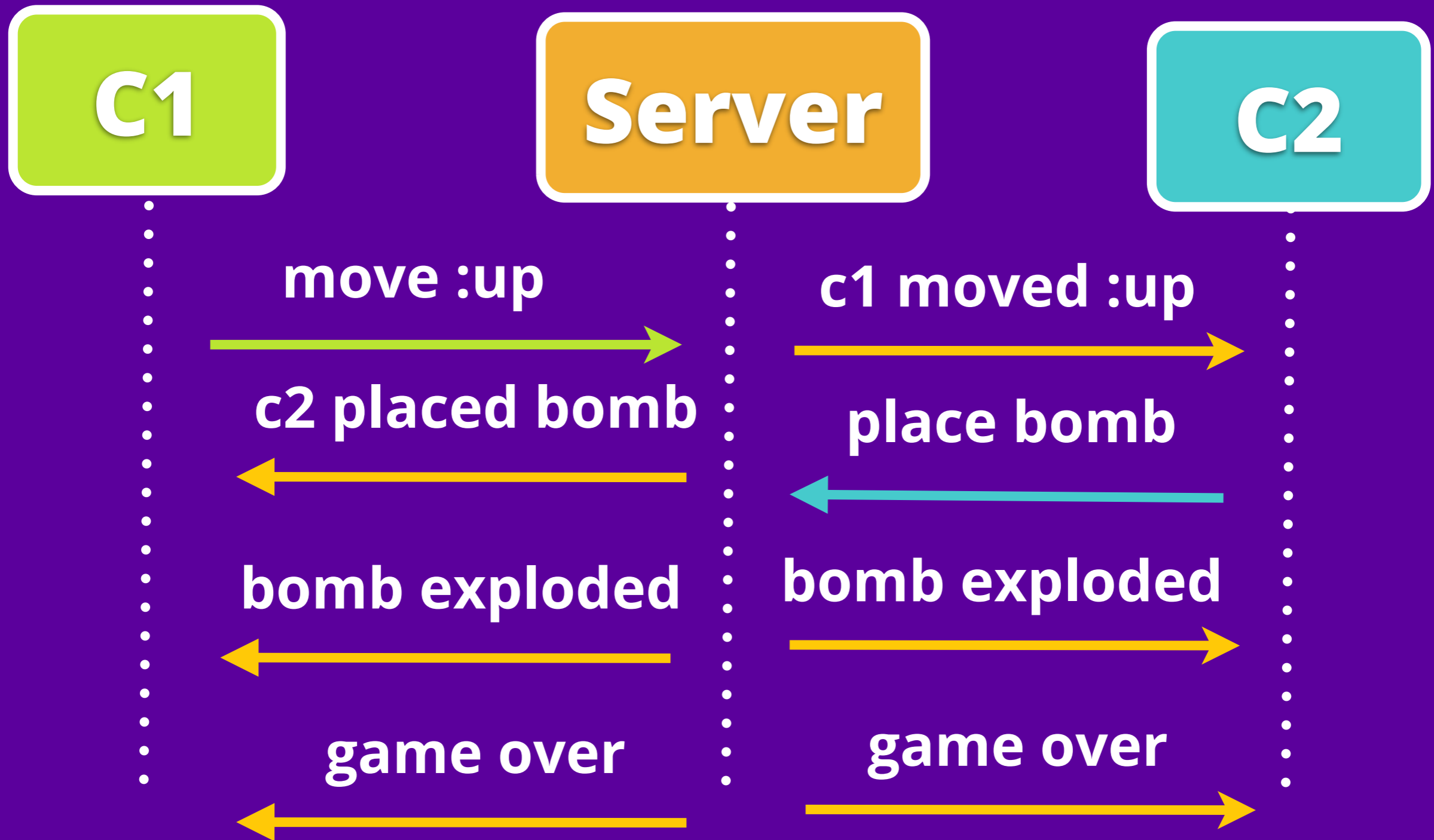


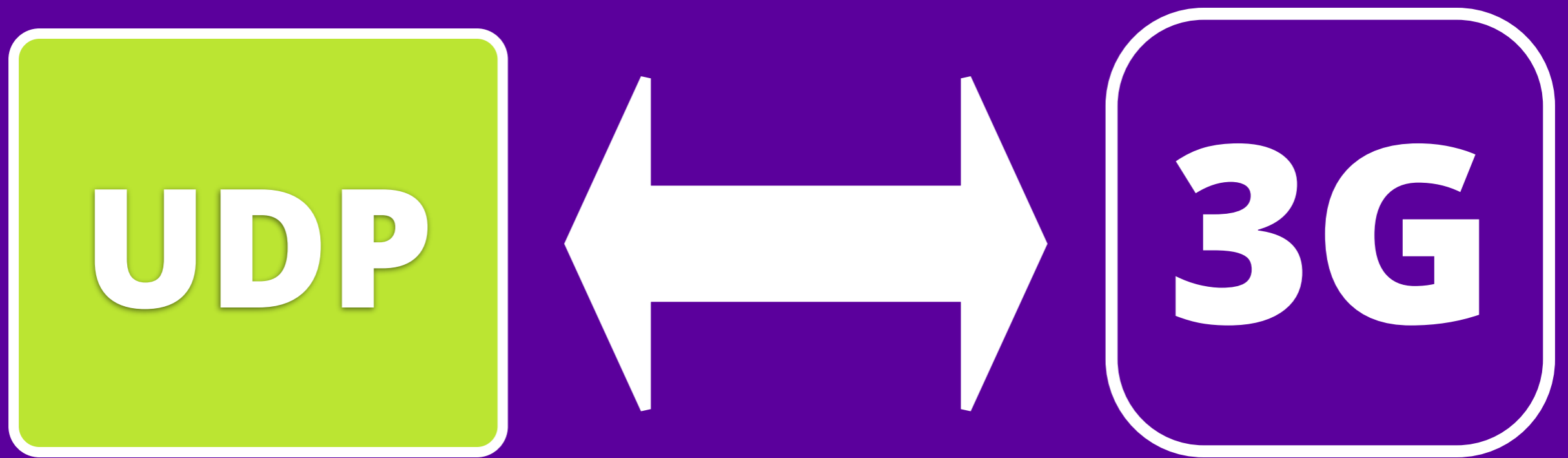
or  
**WORSE**



2

# Architecture





*Will it work?*



# Poor man's TCP

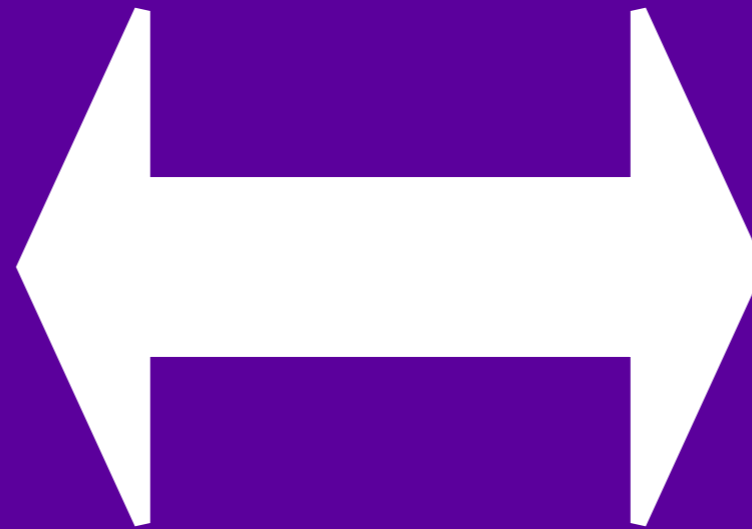
User Id	Local Seq No	Remote Seq No	Ack bitfield
---------	--------------	---------------	--------------

**JSON Payload**

- <http://gafferongames.com/networking-for-game-programmers/reliability-and-flow-control/>

# Poor man's TCP

<b>Ordering</b>	✓
<b>Acknowledge Packets</b>	✓
<b>Resending Packets</b>	X
<b>Flow Control</b>	X
<b>Congestion Control</b>	X



Tested with a few providers in Germany, Switzerland and Netherlands

**game barely  
works on Wifi**

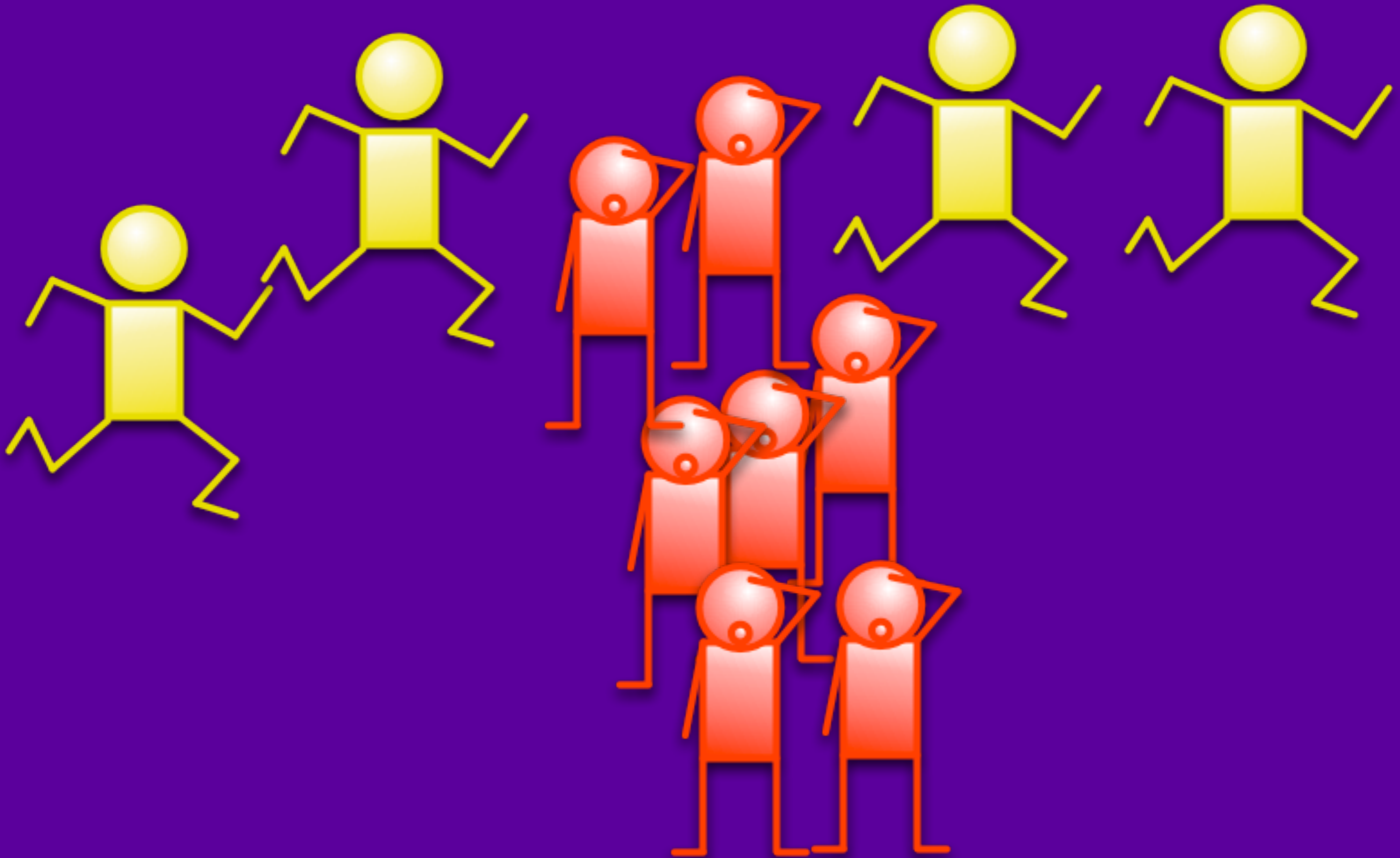




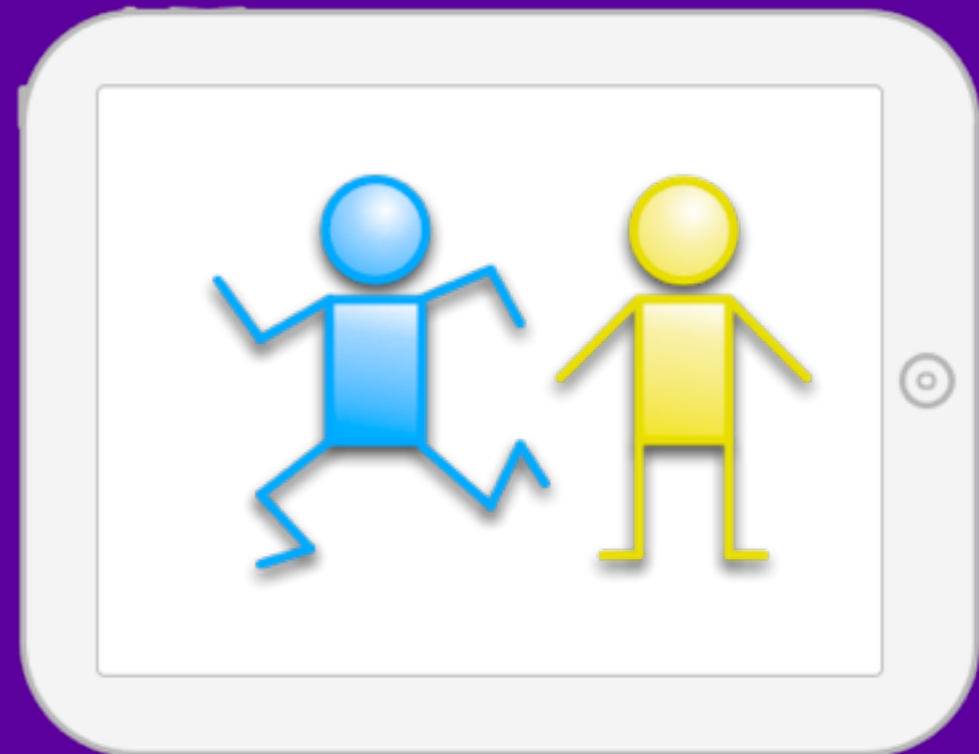
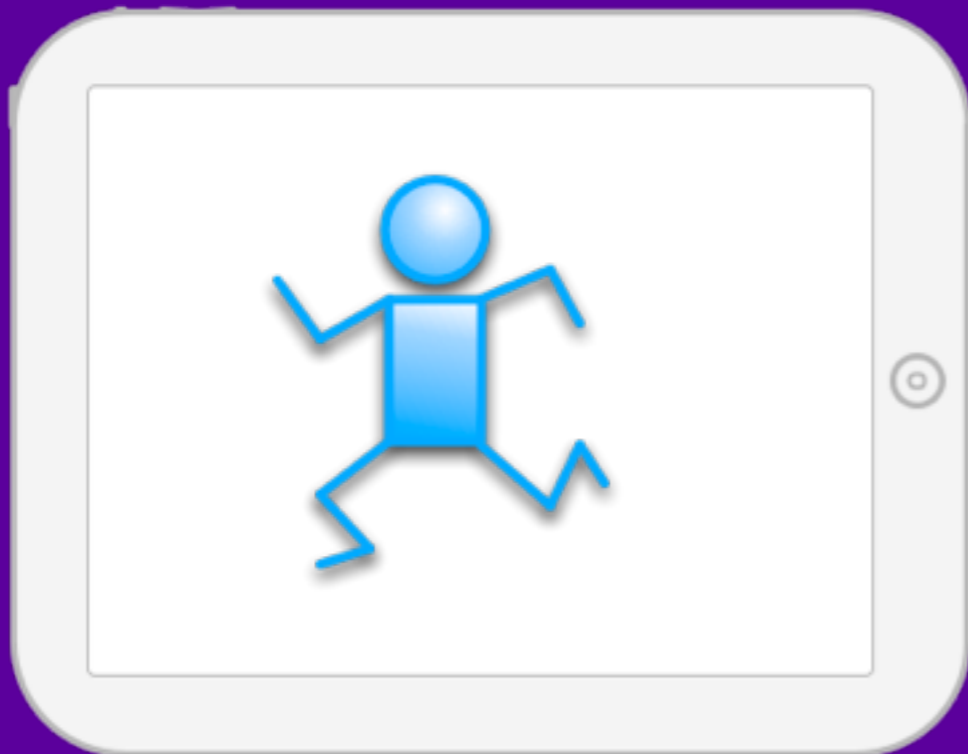
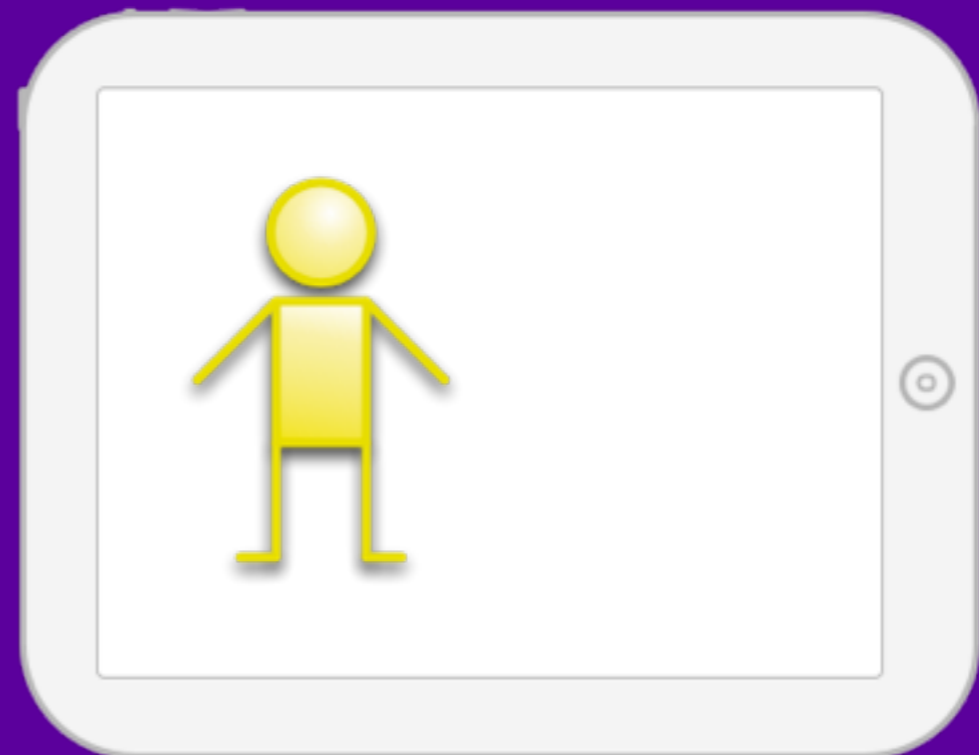
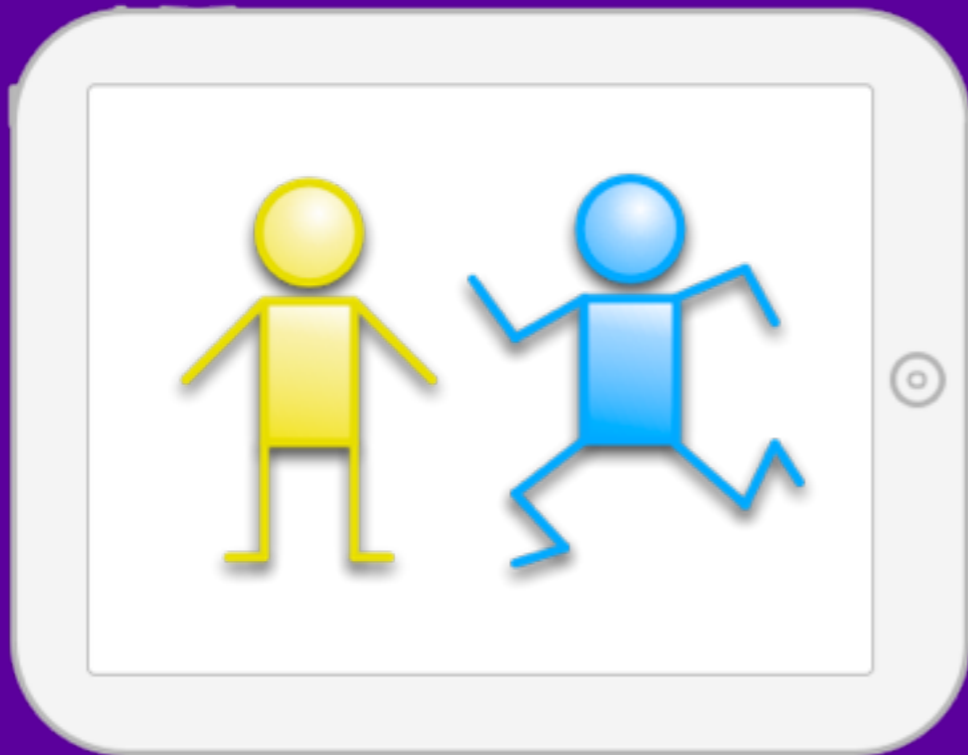
**game doesn't  
work at all on  
3G!!!**



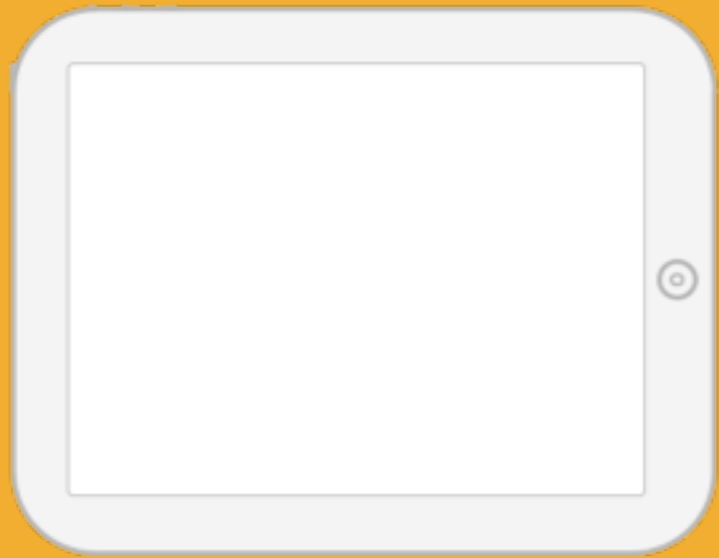
# Packet Loss



# No synchronization



**3**



*State updates*



Full State

Full State

Full State

Full State

*Send full state*

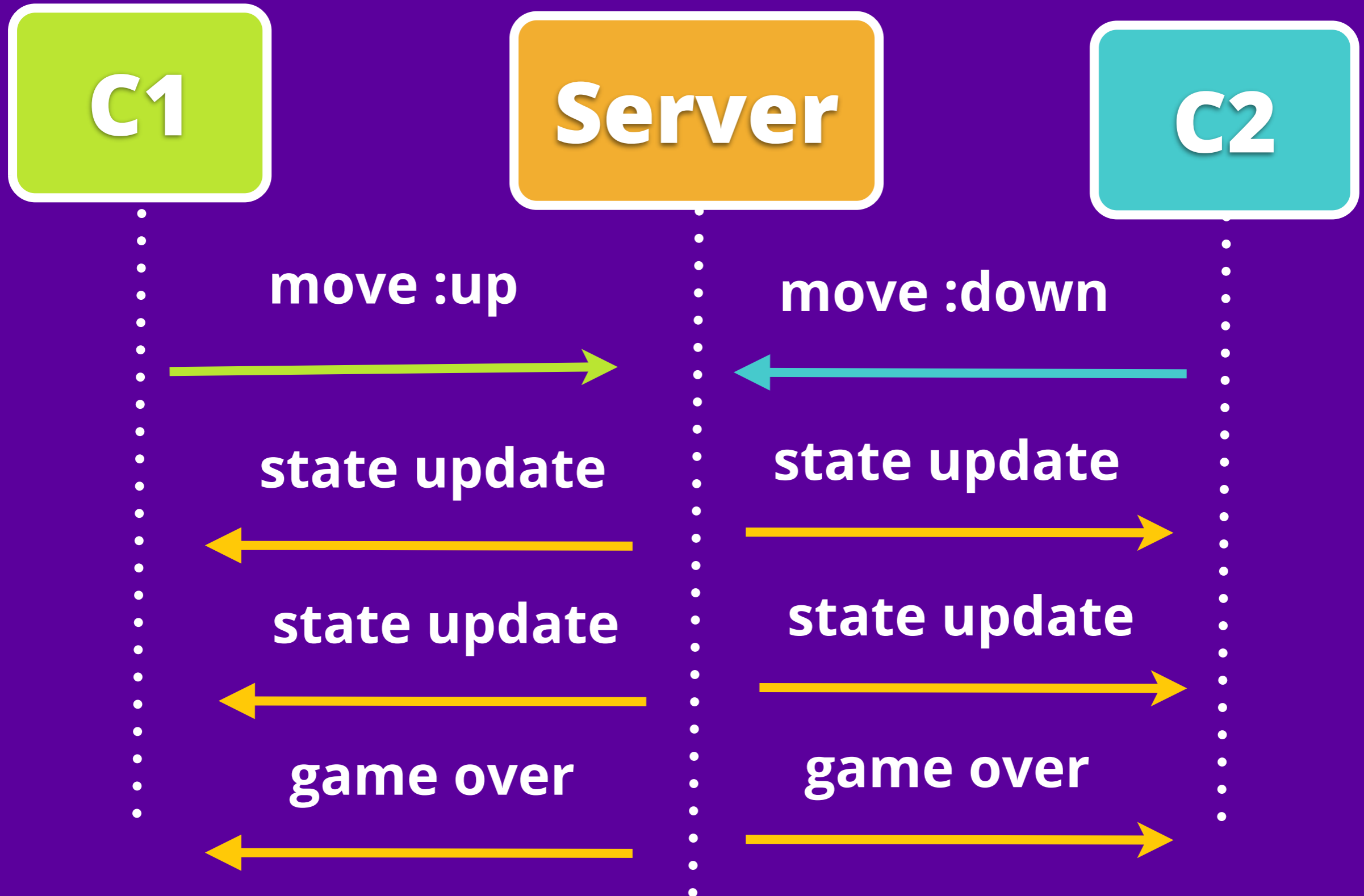
# MTU

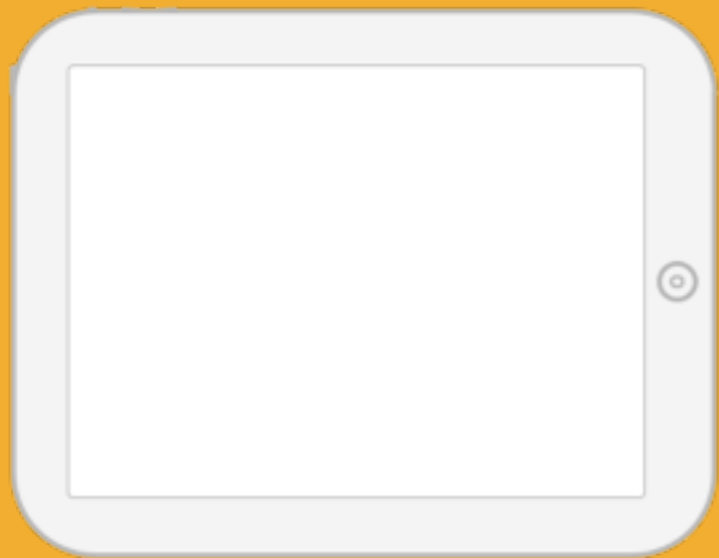
<b>Ethernet</b>	<b>1500 bytes</b>
<b>PPPoE</b>	<b>1492 bytes</b>
<b>Edge</b>	<b>1440 bytes</b>

[https://en.wikipedia.org/wiki/Maximum\\_transmission\\_unit](https://en.wikipedia.org/wiki/Maximum_transmission_unit)

[http://ipixel.org/EDGE\\_Capabilities,\\_Technology,\\_and\\_Applications\\_PDF.pdf](http://ipixel.org/EDGE_Capabilities,_Technology,_and_Applications_PDF.pdf)

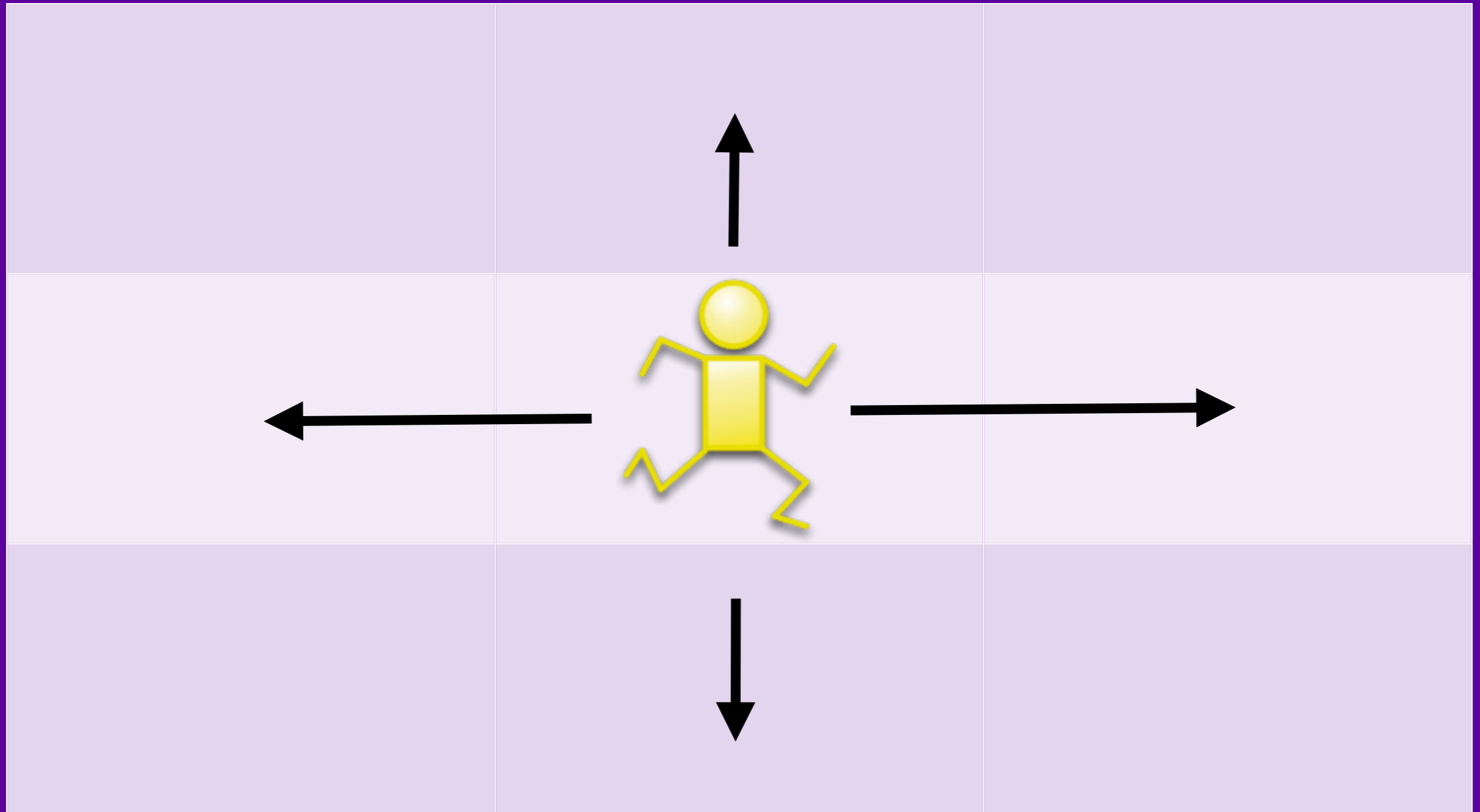
# Architecture





*10 msg/second*

# 100 ms walking speed





**Game  
works on**

**3G**

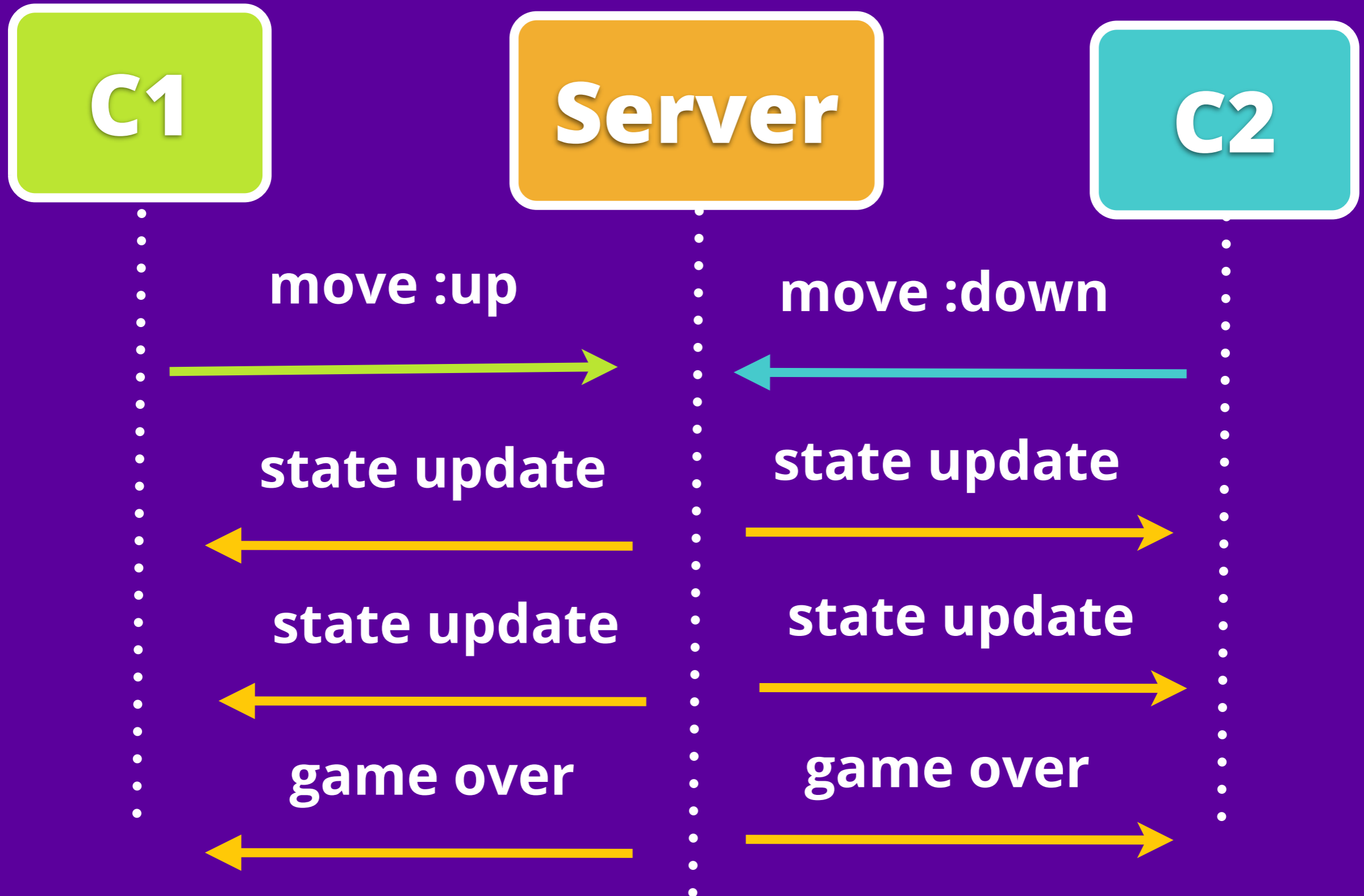


**Highscores and  
Matchmaking are  
BROKEN!**



4

# Architecture



# Different Concerns

Matchmaking

Highscores

Login/Logout

User Data

Game  
Play

**Reliable**

**Unreliable**



# Different Concerns

Matchmaking

Highscores

Login/Logout

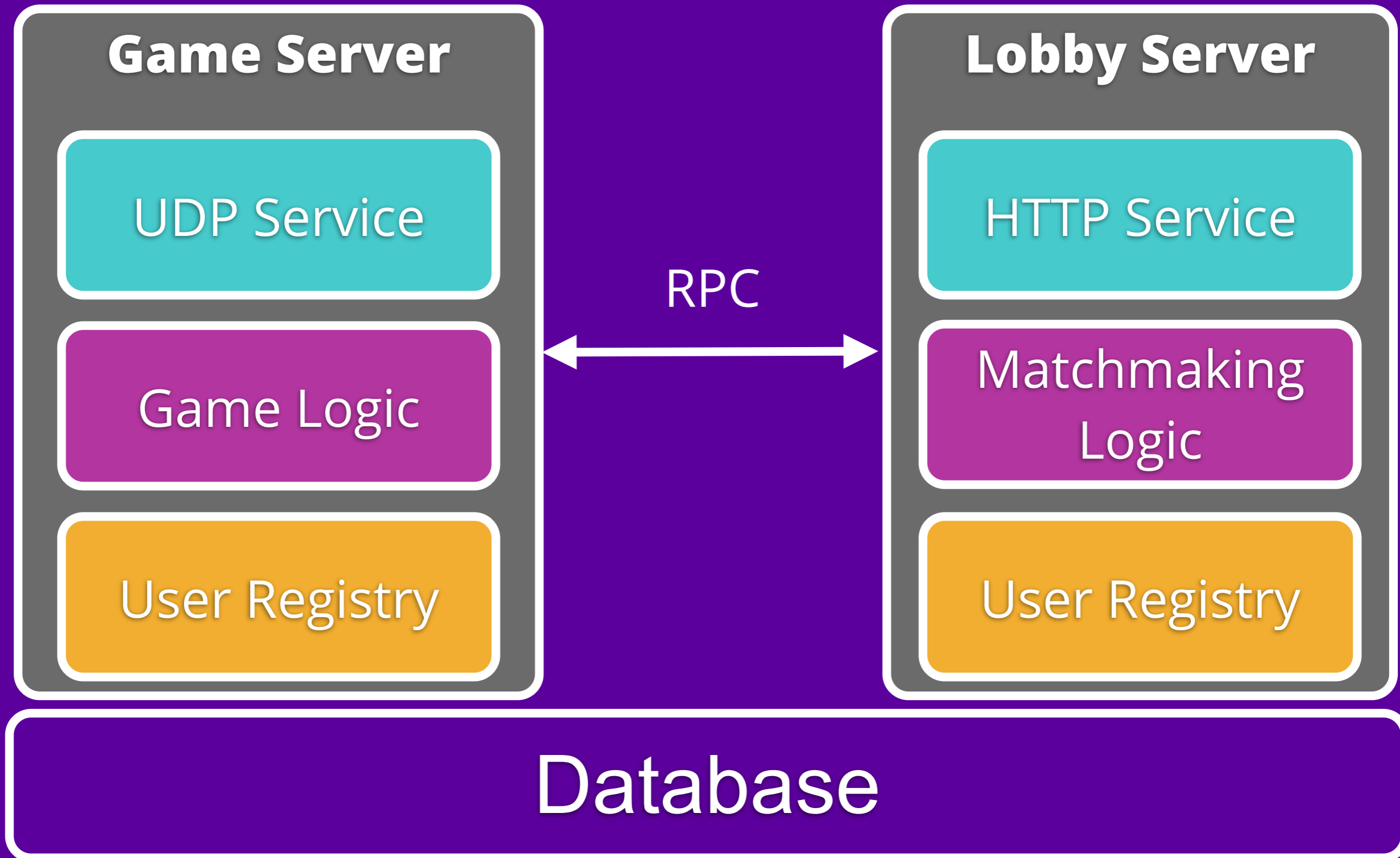
User Data

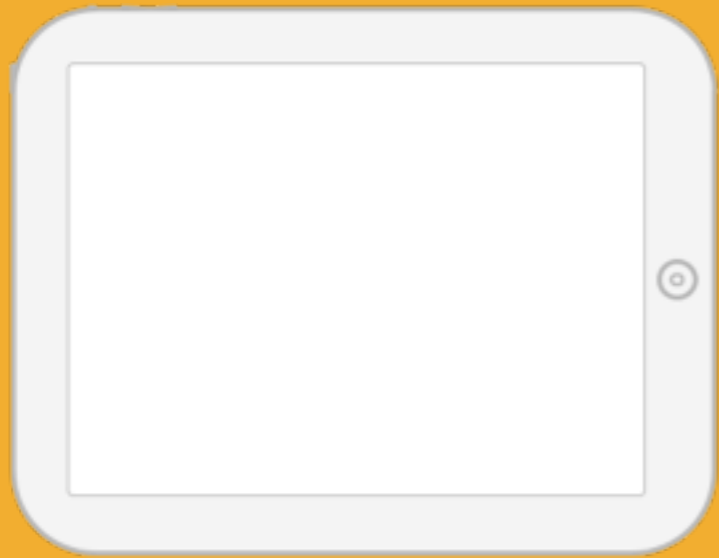
Game  
Play

**HTTP**

**UDP**

# Server architecture





UDP  
Binary



# Binary protocol

64 bit	32bit	32bit	8bit	8bit	Rest
User Id	SeqNr	Ack	Bitfield	Command	Payload

144 bits

18 bytes

944 bits

118 bytes

# 2 Player State update



~  
**136 bytes**

**10 msg/second**  
**1.420 KBps**

**56K Modem**  
**7 KBps**



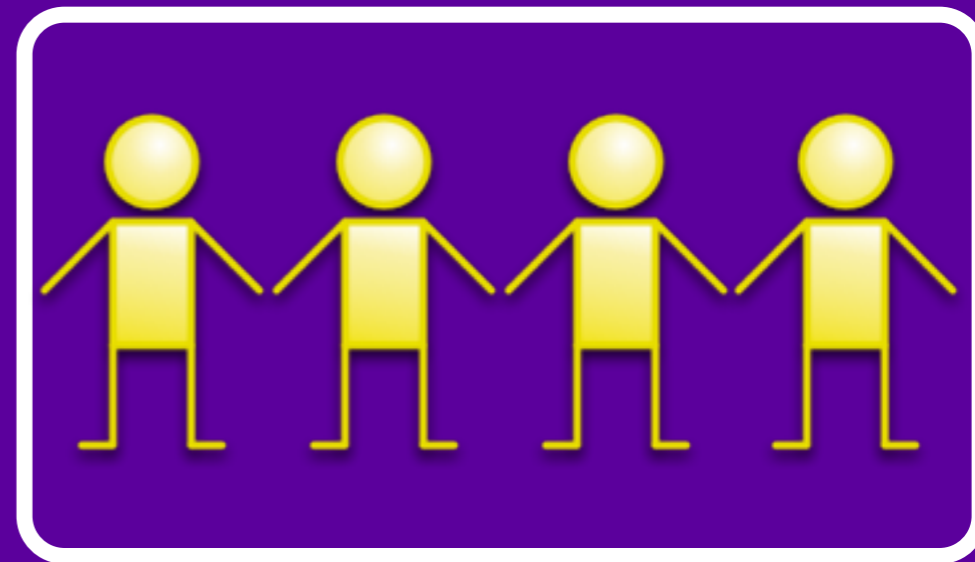
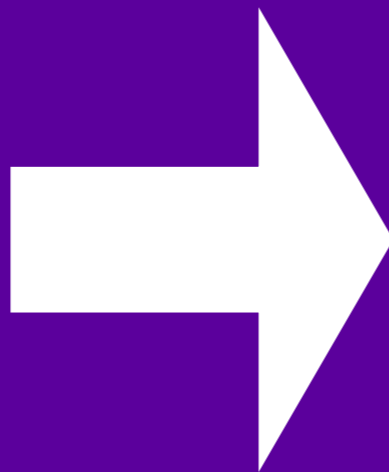
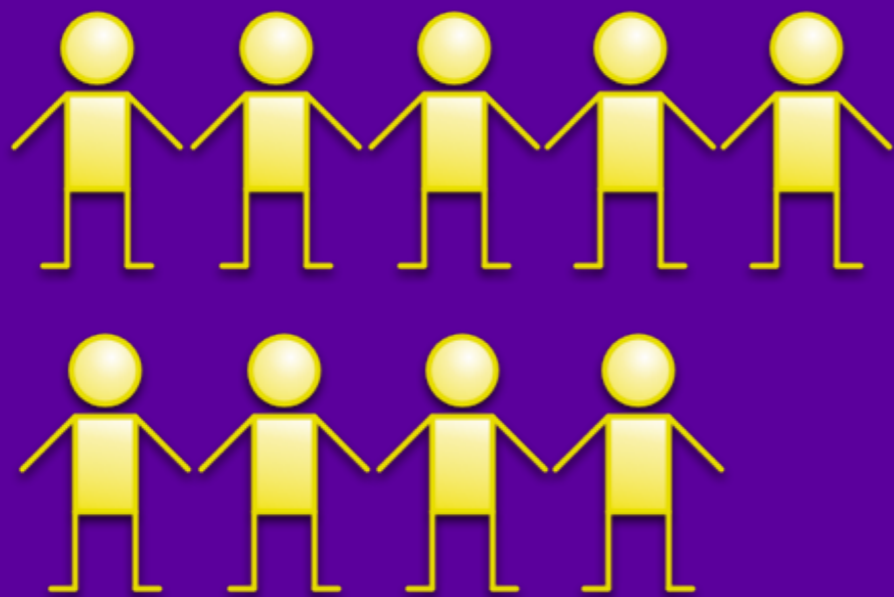


# Improved Gameplay

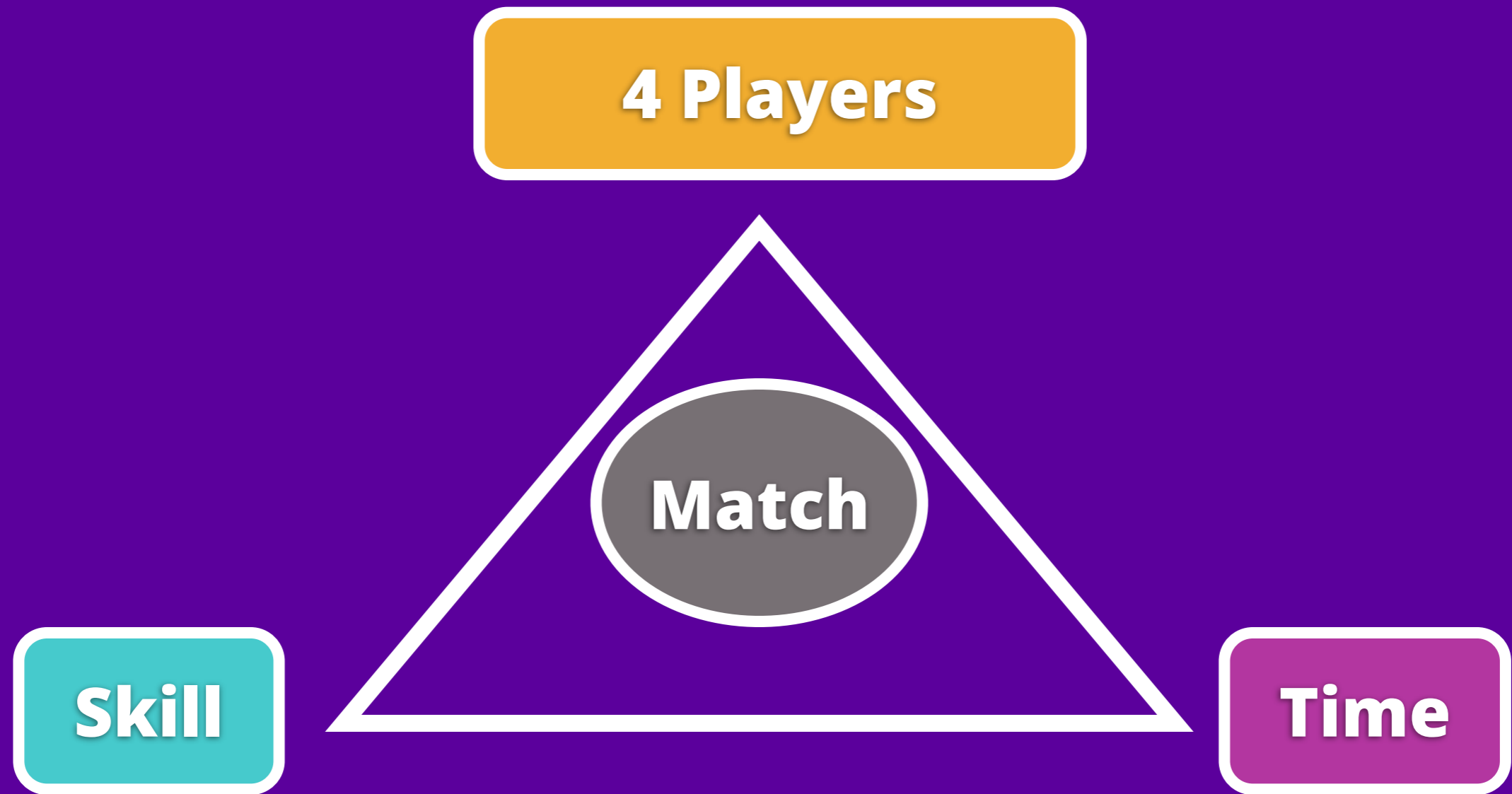


5

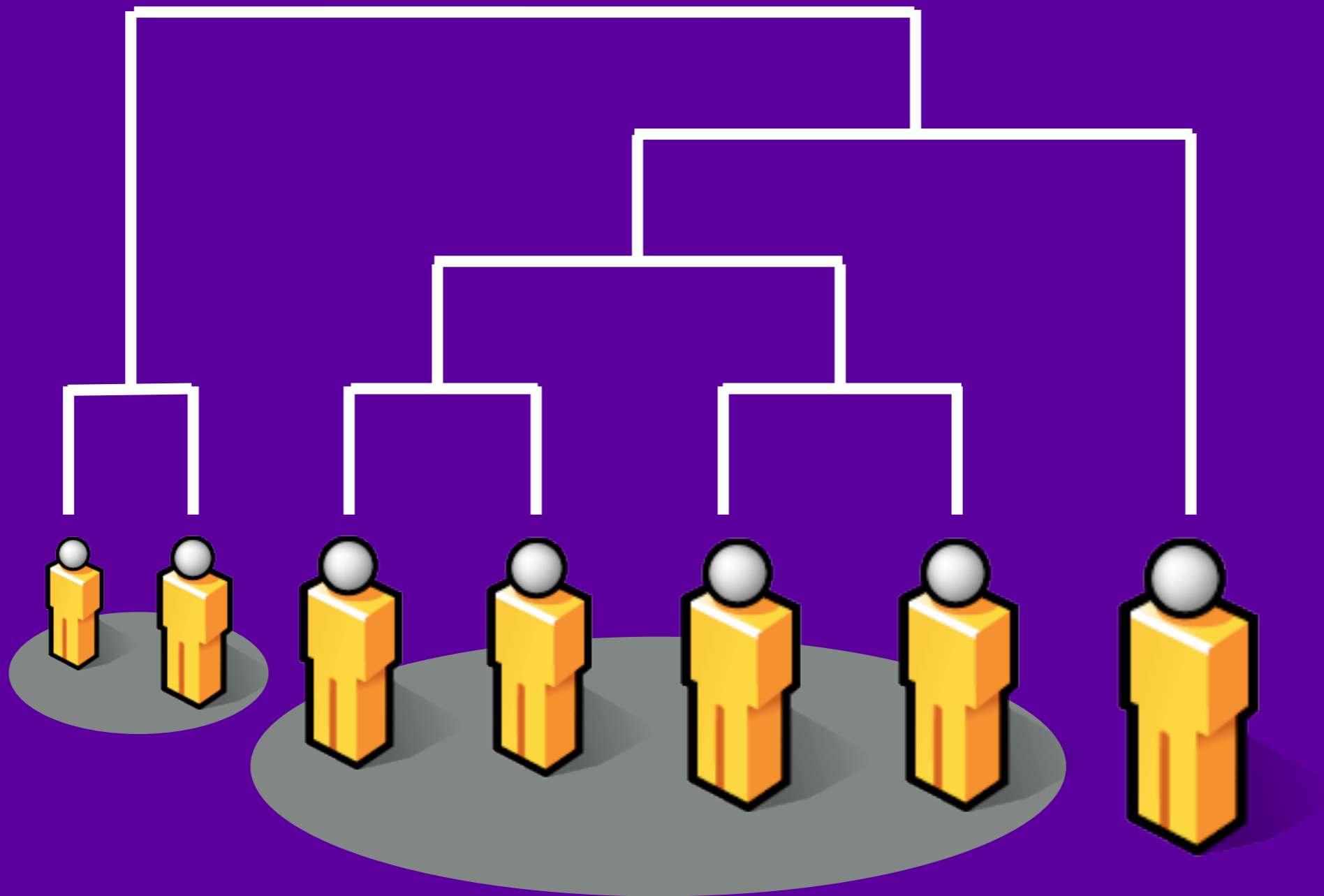
# FIFO with timers



# Casual Matchmaking



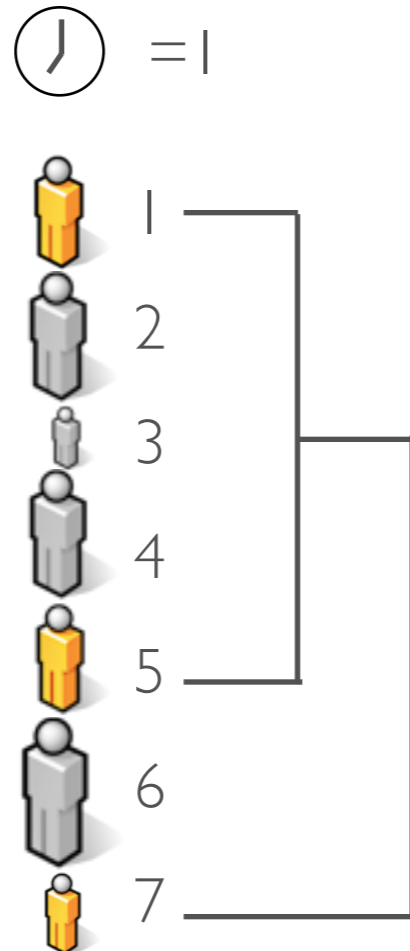
# Hierarchical Clustering



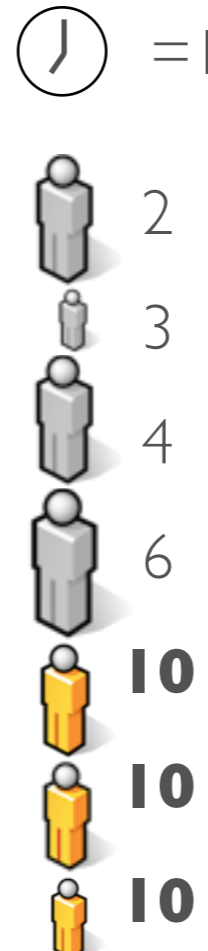
# Better Matchmaking



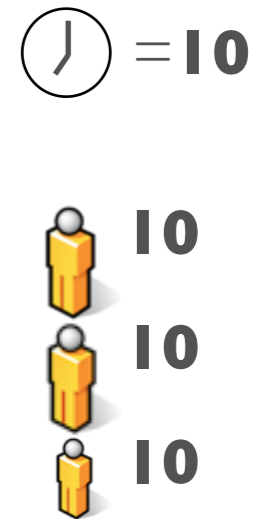
Queueing



Find Matches



Reschedule



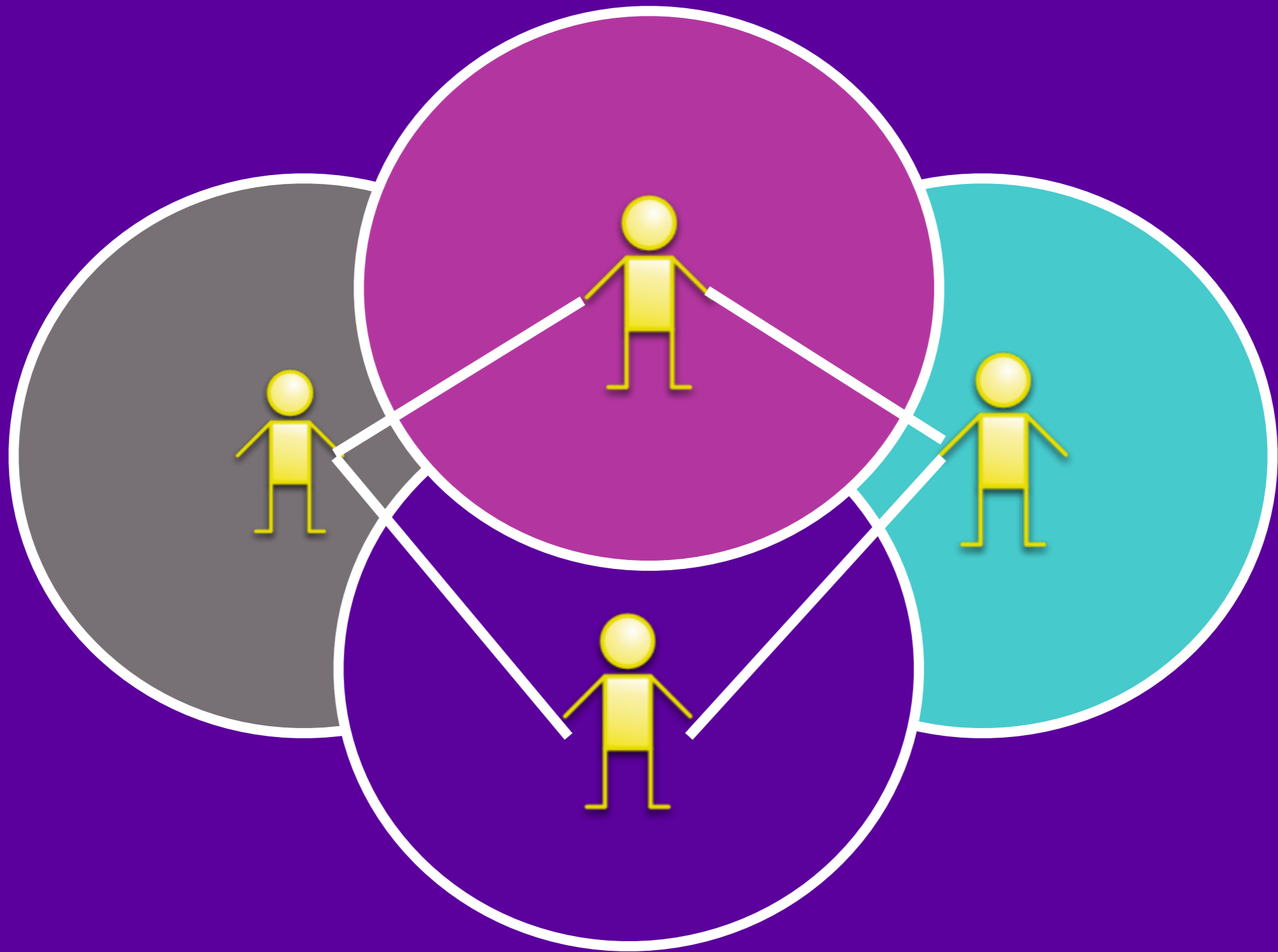
Start Game



# Better Matchmaking



# Geo Matching



**Play**

**Locally**



# Debugging

```
→ terminal_client git:(master) x ./bin/term -n 2
```

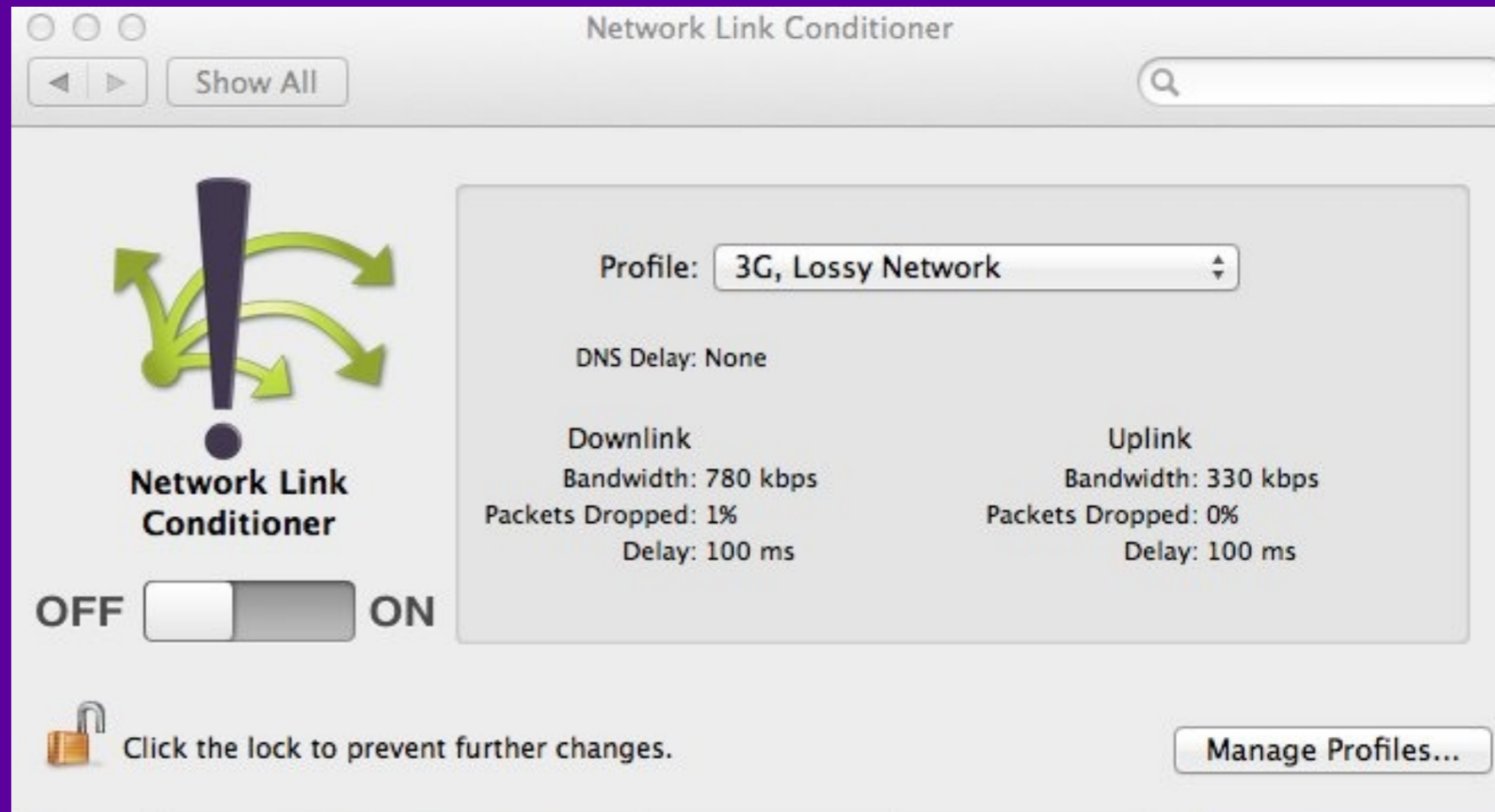
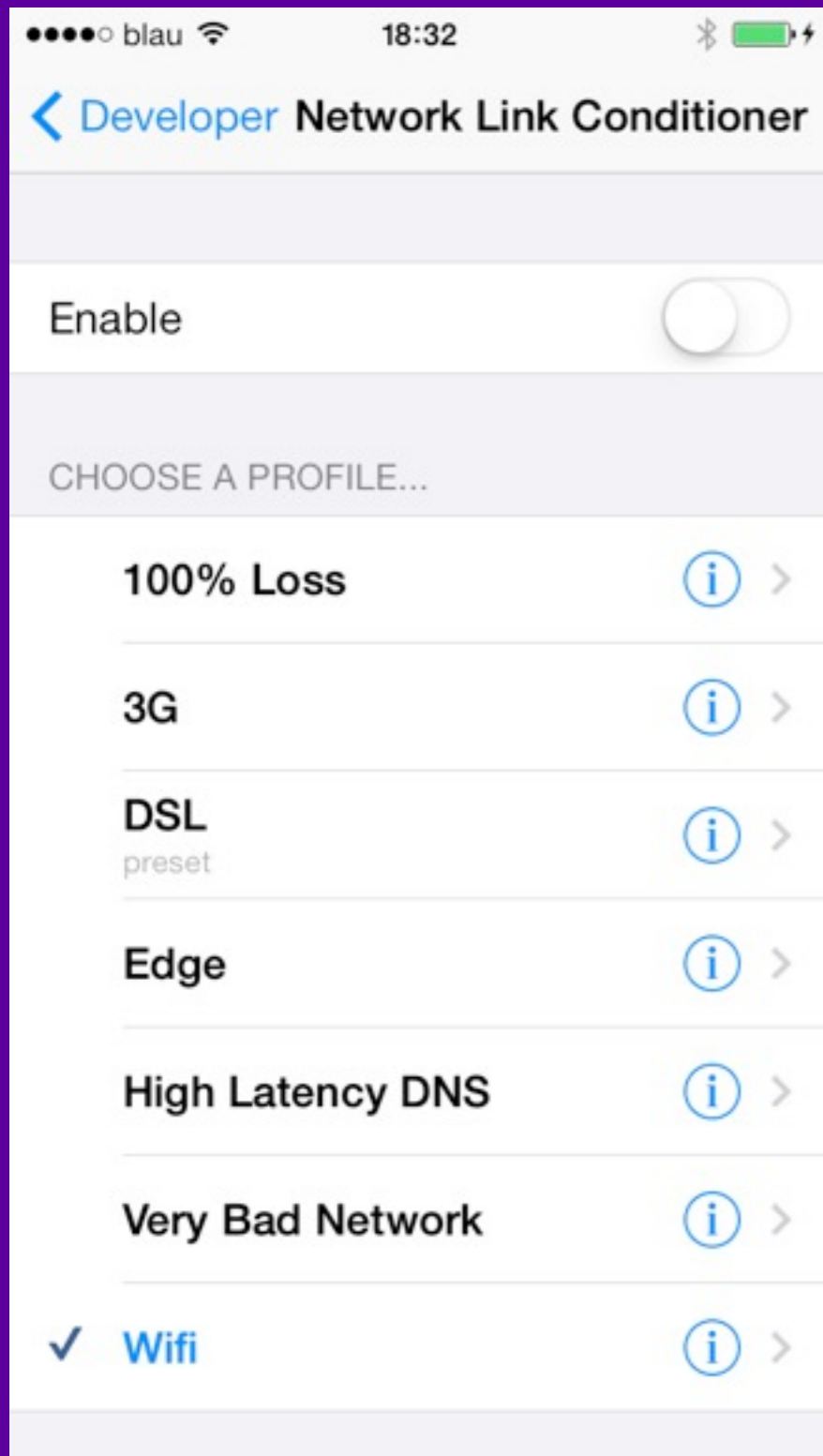
# Terminal Client

# Bots





# Network Link Conditioner



# Erlang tools

**Remote Shell**

**Hot Code  
Reload**

**WX  
Widgets**

**erlscript**

Level 4:

**Finished**

**mobile multi player**

# User interaction



# Questions?

@phuesler @jriri

<http://wooga.com/jobs>