Network Game Design:

Hints and Implications of Player Interaction

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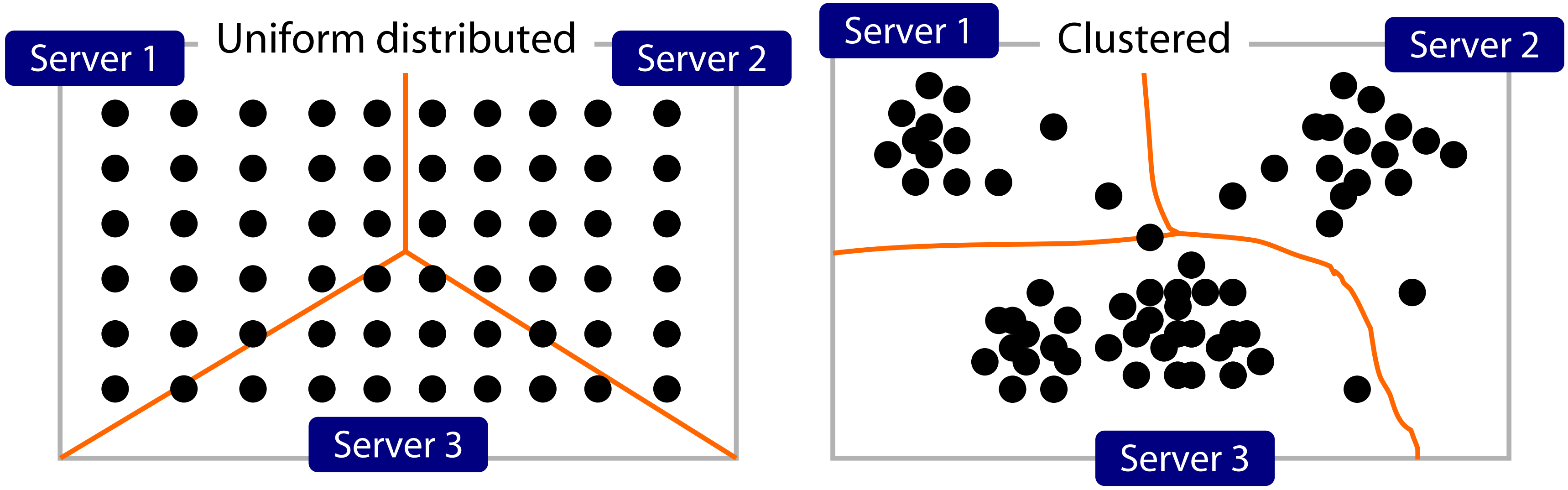
Observation

User behavior is a key factor of how well a network system performs (and how should a system be designed)

Example: Virtual World Partitioning Problem



If game players tend to be clustered in the game world
⇨ dynamic and adaptive partitioning of the game world would be required.

Motivation

Drawing Design Implications

from Players' Interaction

for Designing More Responsive &

Scalable Online Games

What We've Done

1. Collecting game traces (packet-level)

2. Inferring user interaction from game traces
   - Who are interacting?
   - Where are the players?
   - How do they interact? (stay together or team up)

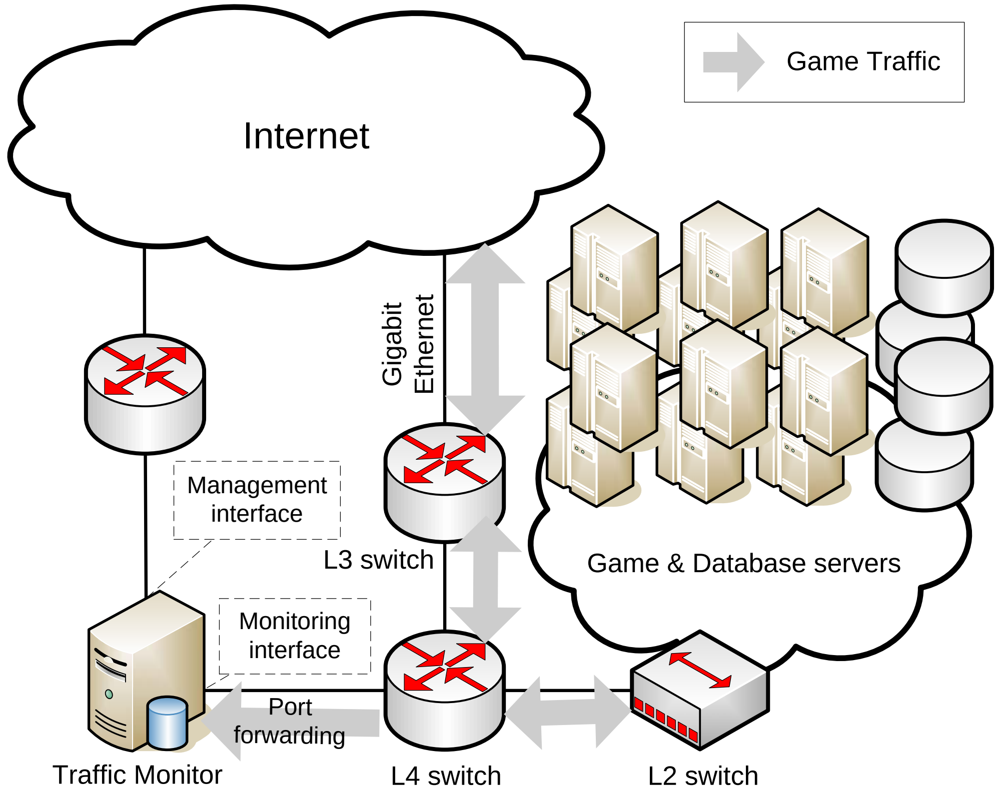
3. Studying the implications of user interaction on game design

Talk Outline

- The question
- Trace collection
- Deriving user interaction
- Analysis of user interaction (and its implications)
- Conclusion

Game Studied -- ShenZhou Online

Game Trace Collection



trace	conn. #	packets (in/out/both)	bytes (in/out/both)
N1	57,945	342M / 353M / 695M	4.7TB / 27.3TB / 32.0TB
N2	54,424	325M / 336M / 661M	4.7TB / 21.7TB / 26.5TB

Why We Use Packet-Level Traces?

Packet-level traces are much easier to obtain

- no modification to game servers is required
- recording packet traces does not increase the workload of game servers

Player behavior inferred naturally connects to network-level factors, e.g., IP addresses and network latency

Extraction of Player Interaction

We would like to know …

- whether any two players are at the same place
- whether any two players are teammates

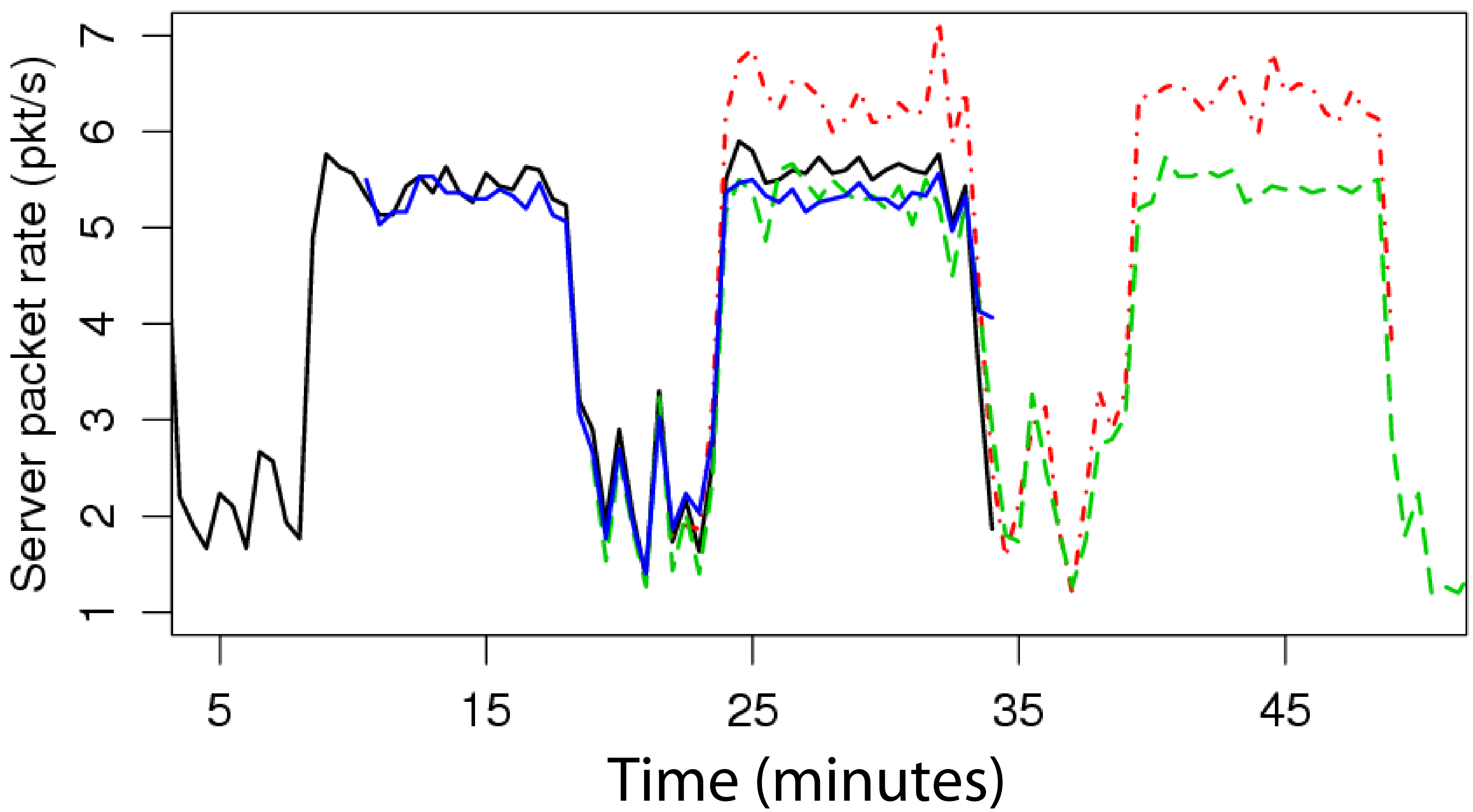
For each player (game session), we have …

- a client packet arrival process
- a server packet arrival process

We've proposed an algorithm

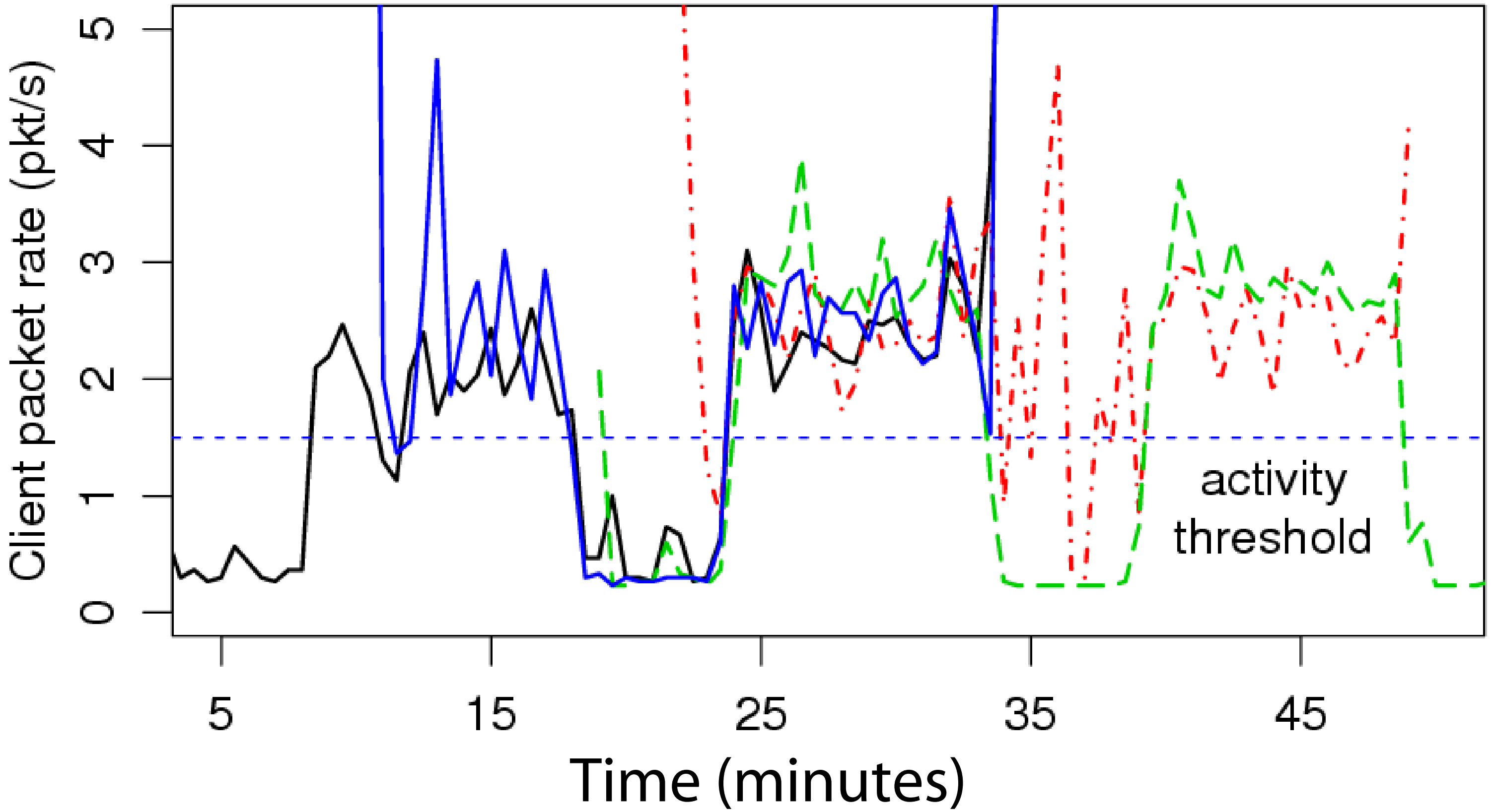
- based on the correlations between the packet arrival processes

Example: Four Neighbors



- Server packet rates imply the degree of PC/NPC activities around the avatar

Example: Four Teammates



- Client packet rates imply the degree of game play activities of the avatar

Talk Progress

- The question
- Trace collection
- Deriving user interaction
- Analysis of user interaction (and its implications)
  - player dispersion
  - network proximity
  - social interaction
- Conclusion

Dispersion of Players

The dispersion of players in the game world:

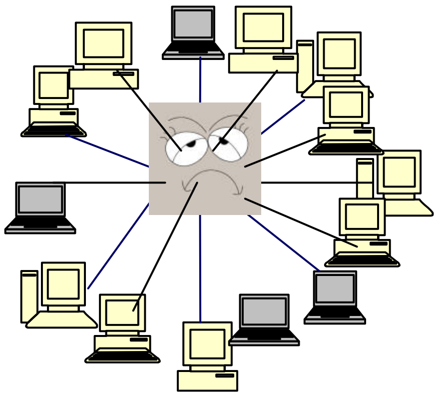
- well modeled by Zipf distributions
- 30% of players gather in the top 1% of places

Implications:

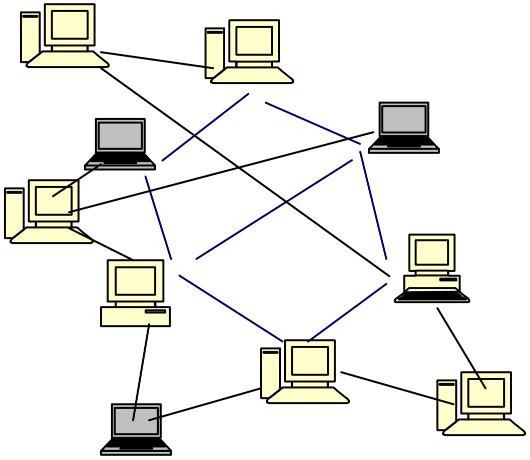
- static and fixed-size partitioning of the game world might be insufficient
- dynamic and adaptive partitioning algorithms should be used

Peer-to-Peer Games

- Reducing server load ⇨ more scalable
- Faster response time
- Audio/video communications

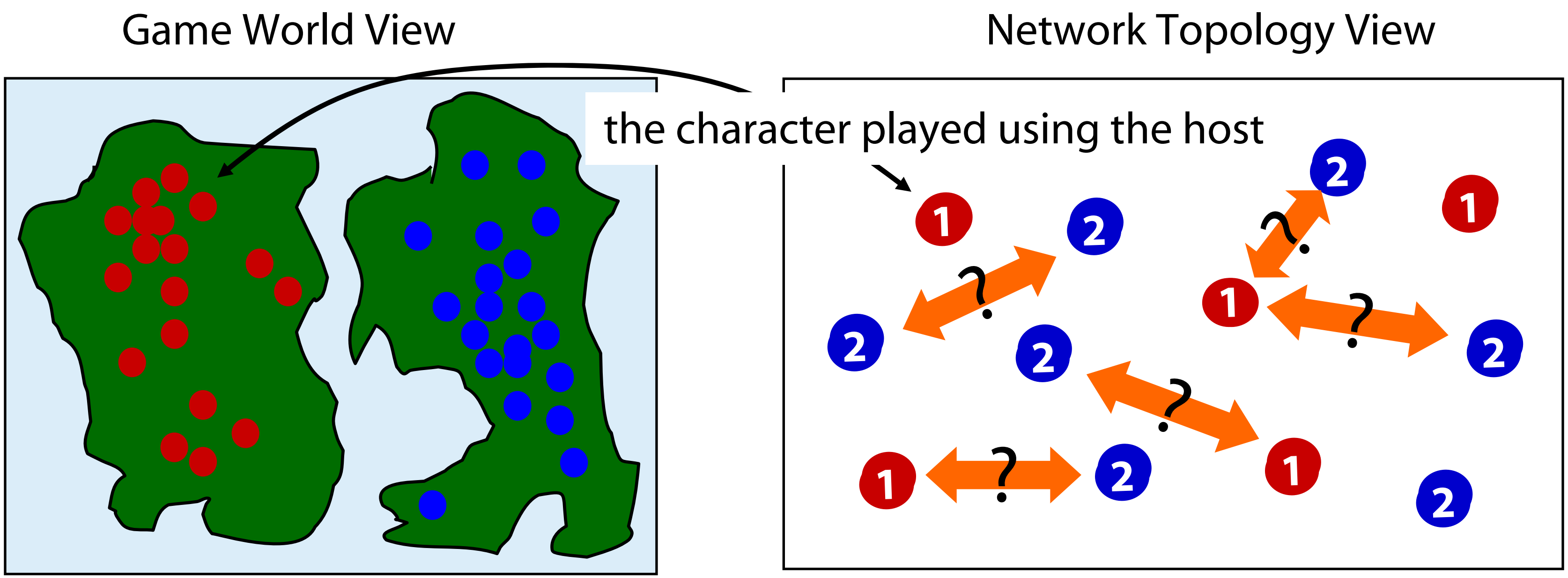


Client-server architecture



Peer-to-peer architecture

Overlay Construction



How to construct overlay networks?

Goal: to optimize the overall transmission latency

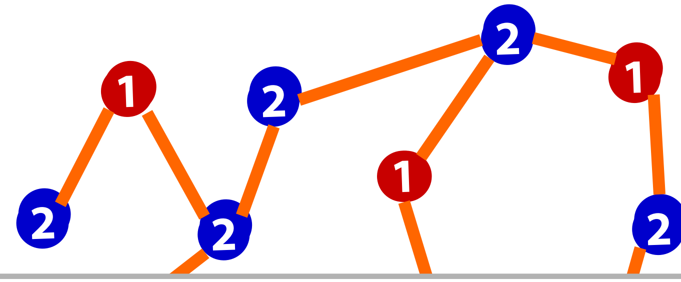
i.e., how to pass information between the peer nodes?

Overlay Construction Alternatives

Design 1:

by network distance

(optimize network
laten

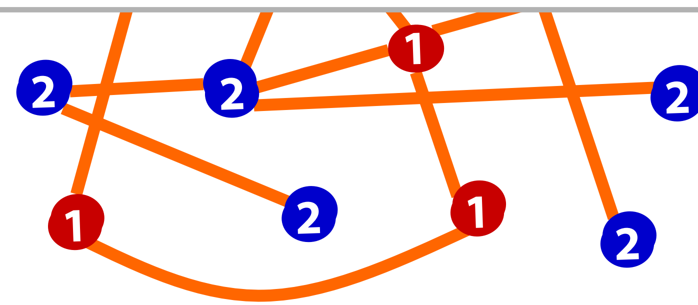


Which design leads to more efficient overlays for online games?

Desi

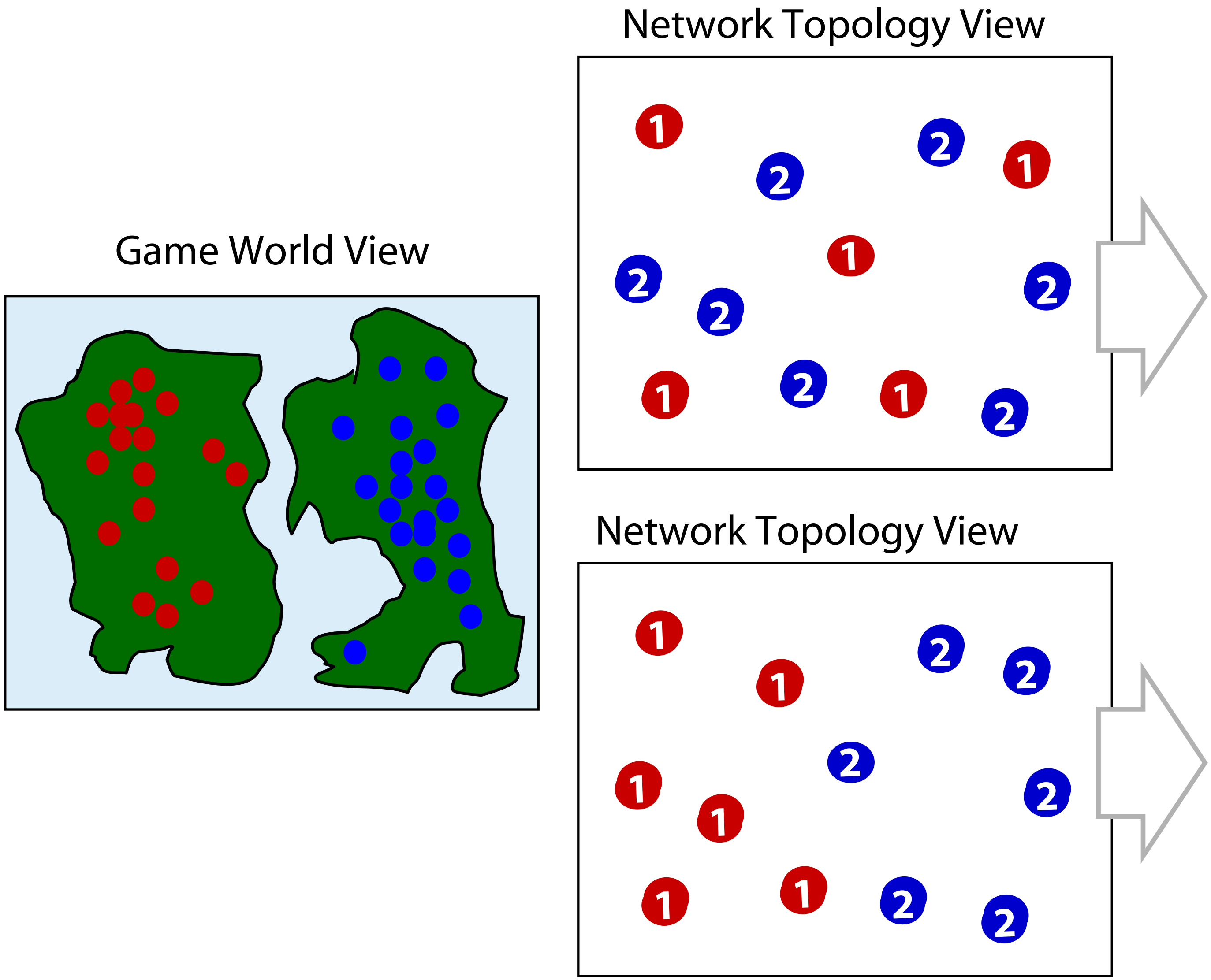
by vi

(connect frequently
contact nodes)



Network Topology View

Similarity between The Two Approaches?



two approaches lead to different overlays

two approaches lead to similar overlays
➔ either approach is OK

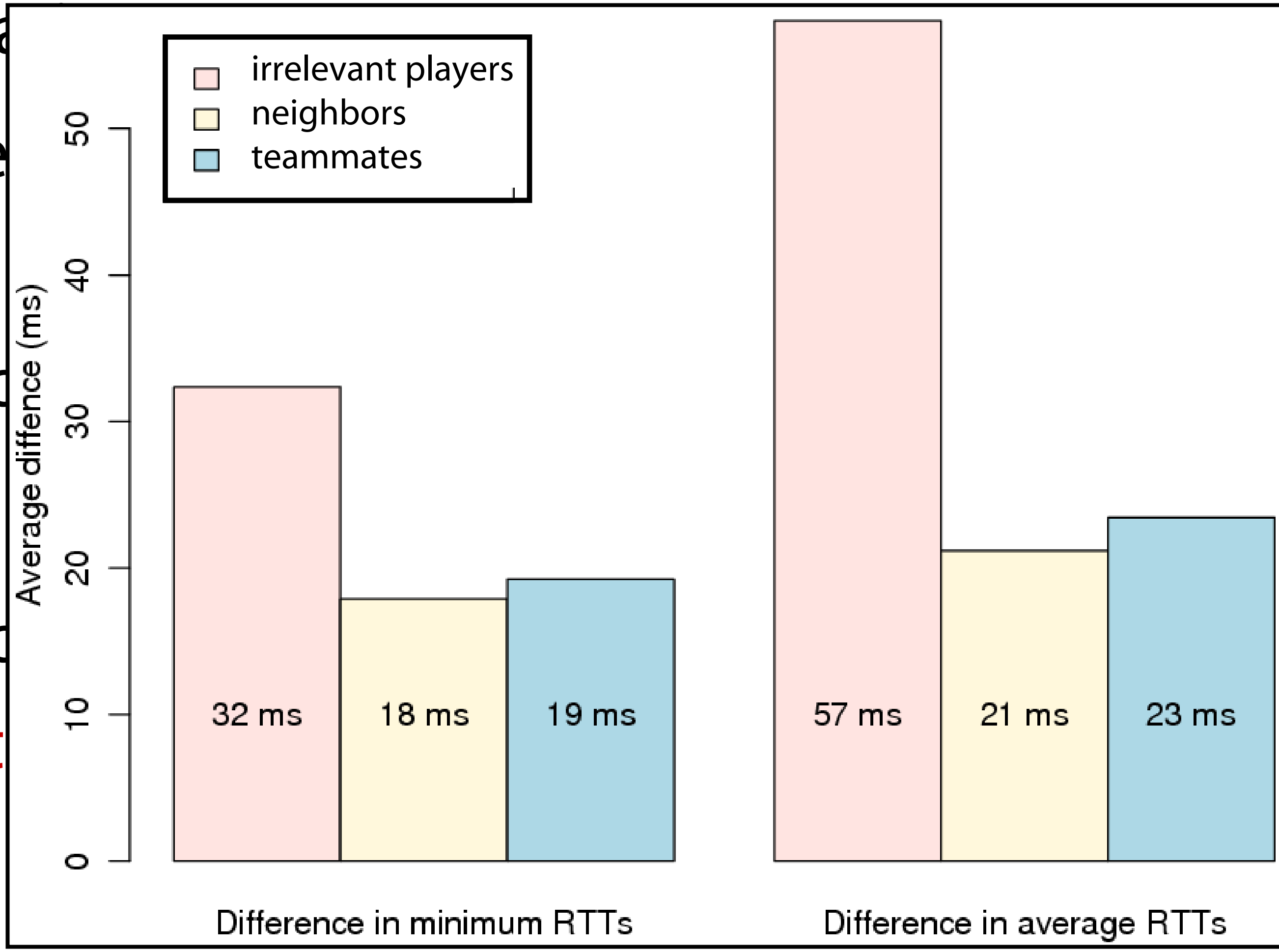
Correspondence between Network Distance and Virtual World Distance

Observa

- Playe … o be close

Evidenc … have close

Evidenc … have short



Implications of Network Proximity

For client-server architecture

- improves the fairness of game playing, as interacting players tend to have similar latencies to their servers

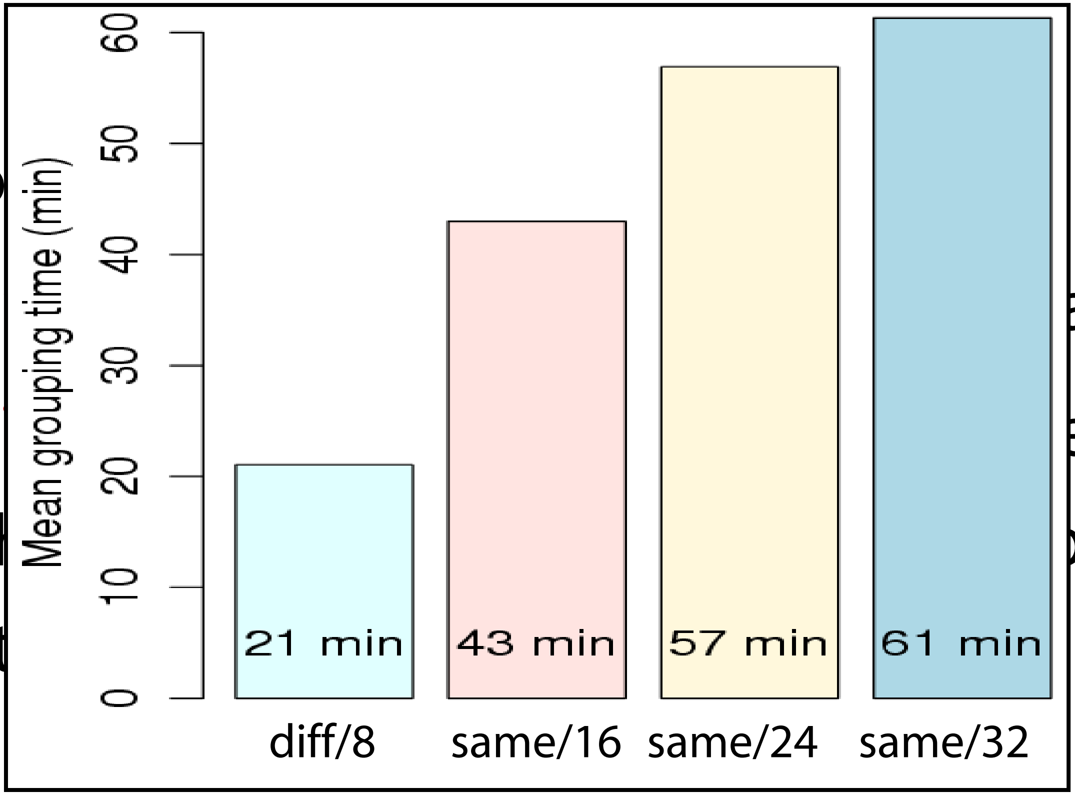
For peer-to-peer architecture

- message delivery between the hosts of interacting players is faster
- opportunities for optimizing network latency between interacting players

Effect of Network/Physical Distance

Observation (for a group of players):

- network distance ↓ team play time ↑



Explanatio

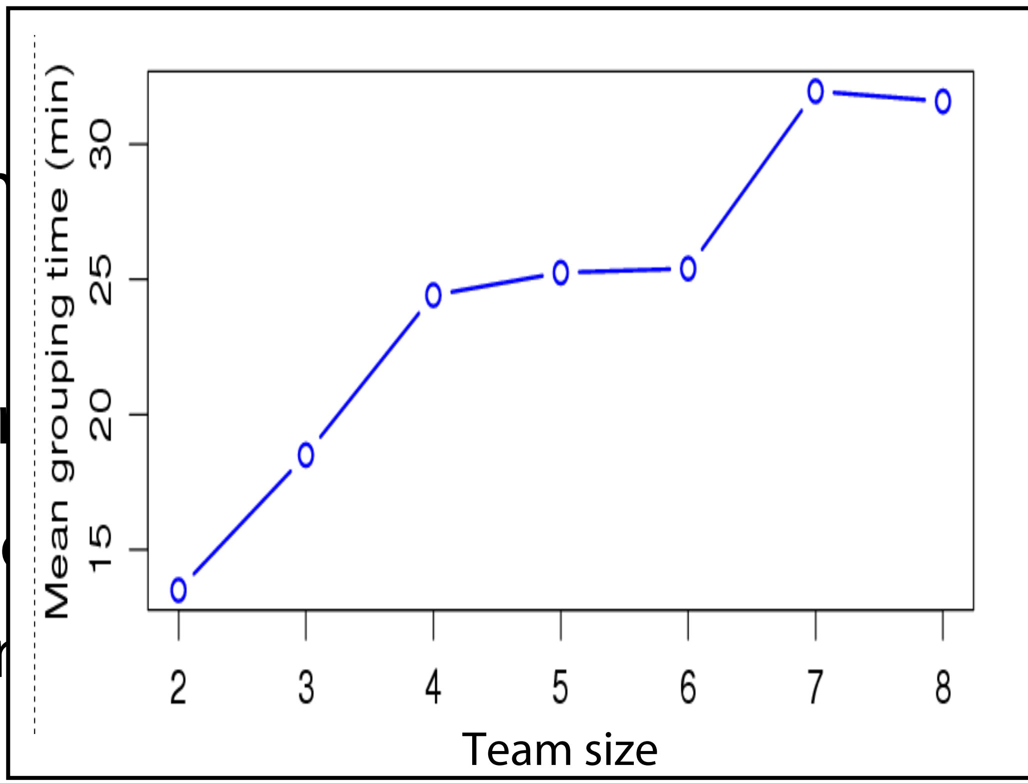
- real-life ame;
- real-life e play

⇨ enric ourages players t

Effect of Social Interaction

Observation:

- degree of social interaction ↑ game play time ↑
- team size ↑ team play time ↑



Explanation

- due to th ... tion and social bo
- a game c ... ging the formatio

Conclusion

Packet-level traces

- easier to obtain
- feasible to extract user interaction

Findings summarized

- partitioning of the virtual world should be dynamic
- network proximity of interacting game players
- games could be made more sticky by supporting in-game communication and encouraging team playing

Thank You!

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