Design Implications of Social Interaction in Online Games*

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Abstract. While psychologists analyze network game-playing behavior in terms of players' social interaction and experience, understanding user behavior is equally important to network researchers, because how players act determines how well systems, such as MMORPGs, perform. To gain a better understanding of patterns of player interaction and their implications for game design, we analyze a $1,356$-million-packet trace of *ShenZhou Online*, a mid-sized commercial MMORPG. To the best of our knowledge, this work is the first to put forward architectural design recommendations for online games based on analysis of player interaction. We find that the dispersion of players in a virtual world is heavy-tailed, which implies that static and fixed-size partitioning of game worlds is inadequate. Neighbors and teammates tend to be closer to each other in network topology. This property is an advantage, because message delivery between the hosts of interacting players can be faster than between those of unrelated players. In addition, the property can make game playing fairer, since interacting players tend to have similar latencies to their servers. We also find that participants who have a higher degree of social interaction tend to play much longer, and players who are closer in network topology tend to team up for longer periods. This suggests that game designers could increase the "stickiness" of games by supporting, or even forcing, team playing.

Keywords: Design Recommendations, Human Factors, Internet Measurement, MMORPG, Social Interaction

1 Introduction

With an exponentially growing population and the increasing diversity of network gamers, the virtual worlds constructed by MMORPGs (Massive Multiplayer Online Role Playing Games) are gradually becoming a field for the study of social behavior [1, 2]. While psychologists analyze network game-playing behavior in terms of players' social interaction and experience, understanding user

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behavior is equally important to network researchers, because how players act determines how well systems, such as MMORPGs, perform. For example, the dispersion of players across a virtual world affects how well an algorithm performs in distributing the workload to a number of servers in terms of bandwidth usage, load balancing, and users' perceived quality of games.

To gain a better understanding of the patterns of player interaction and their implications for game design, we analyze *how players interact* from packet traces. Analyzing user behavior based on network traces is particularly useful for our purpose, since it naturally connects to network-level factors, such as IP addresses and transmission latency between participating parties. Also, it is easier for commercial game operators to adopt this strategy, because collecting network traces does not increase the load of, or require modification to, game servers. To the best of our knowledge, this work is the first to put forward architectural design recommendations for online games based on empirical analysis of player interaction.

We develop an algorithm that derives patterns of player interaction from a $1,356$-million-packet trace of *ShenZhou Online* [3], a commercial MMORPG. The inferred grouping structure is then analyzed from the following aspects: the dispersion of players in a virtual world, the correspondence of network locality and in-game locality, and the "stickiness" of game-playing in terms of social interaction. The main objective is to understand the implications of player interaction for the design of online games, especially architectural design issues.

Our major findings are as follows:

- The dispersion of players in a virtual world can be well modeled by Zipf-like distributions, where 30% of players gather in the top 1% of popular places. This implies that static and fixed-size partitioning of game worlds is inadequate for both server-cluster and peer-to-peer infrastructures [4, 5], and dynamic partitioning algorithms should therefore be used [6–9].
- Players who are neighbors or teammates tend to be closer to each other in network topology. This property is advantageous to both client-server and peer-to-peer architectures, because message delivery between the hosts of interacting players can be faster. In addition, the property improves the fairness of game playing, as interacting players tend to have similar latencies to their servers.
- Players who have a higher degree of social interaction tend to participate much longer. This suggests that game companies could increase the "stickiness" of games by encouraging, or even forcing, team playing. Furthermore, the duration of group play correlates with a group's size and the network distance between players. This implies that real-life relationships carry over into the virtual world, and/or real-life interaction plays a key role during games. The latter also suggests that enriching in-game communication would encourage players to be more involved in team play.
- Larger groups generally lead to longer collaboration due to the enjoyment derived from interaction and social bonds. This suggests that a game could be made stickier by encouraging the formation of large groups.

2 Conclusion

In order to understand the implications of player interaction for the design of network games, we analyzed the grouping structure inferred from a packet trace of *ShenZhou Online*, a mid-sized commercial MMORPG. The analysis reveals that the dispersion of players in a virtual world is heavy-tailed, which implies that static and fixed-size partitioning of game worlds is inadequate. We have shown that neighbors and teammates tend to be closer to each other in terms of network topology, a property that is beneficial to both client-server and peer-to-peer infrastructures, because message delivery between the hosts of interacting players is faster. In addition, this property makes games fairer, as interacting players tend to have similar latencies to their servers.

We have also found that participants who have a higher degree of social interaction tend to play much longer than independent or solo players. This suggests that game companies could increase the "stickiness" of games by supporting, or even forcing, team playing. Furthermore, the duration of group play correlates with the size of the group and the network distance between the players. Specifically, players who are closer in network topology tend to team up for longer periods. Larger groups generally lead to longer collaboration due to the enjoyment derived from interaction and social bonds, which suggests that games could also be made stickier by encouraging the formation of such groups.

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