

Empirically Measuring the QoS Sensitivity of Interactive Online Game Players

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Outline

- Motivation
- Approach
- Experimental Results
- Conclusions
- Future Work



Motivation



- Substantial growth in the popularity of network games in recent years
- Game traffic requires stricter quality of service (QoS) than traditional applications (e.g. web, mail, file transfer etc.)
- Game players are very demanding and driver for new technology → premium Internet services could be potential new source of revenue for ISPs
 - Must know network load caused by game traffic
 - **Must know upper bounds on performance metrics (e.g. network delay) players can tolerate**

Motivation cont'd



- Previous work on player sensitivity based on indirect measurements – setup public game servers and correlate observed user affinity
 - Easy to collect large data sets
 - Difficult to ensure that a wide variety of network conditions are explored
 - Indirect method: cannot ask the players about their opinion
- Our work: empirical measurement of the QoS sensitivity of players using direct measurements

Experimental Approach

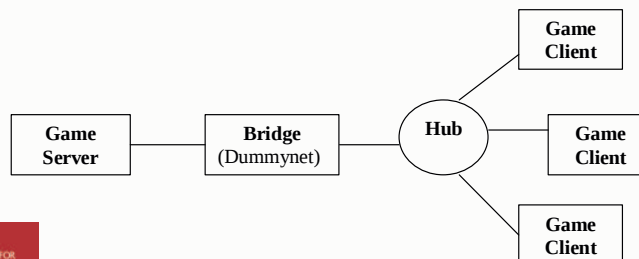


- First Person Shooter (FPS) Games
 - Quake3: popular Internet game
 - Xbox Halo1: LAN game but several solutions for playing over Internet
- Network Performance Metrics
 - Constant symmetric **network delay** and **packet loss** (unrealistic but sufficient for studying effects on players)
- Player Questionnaire
 - Perceived quality from 1 (bad) to 5 (excellent)
 - Opinion whether to continue playing or leave the game
 - Number of kills and deaths
 - Client or server (Xbox only, dedicated server for Quake3)

Experimental Approach cont'd



- Kill-limit (15) games on same simple map
 - Quake3: 6 players, 15 setting, 4 trials → 60 games
 - Xbox Halo1: 8 players, 12 settings, 4 trials → 48 games
- Players
 - Volunteers (occasional to regular players)
 - Never knew real network conditions
 - Base perceived quality on network conditions only

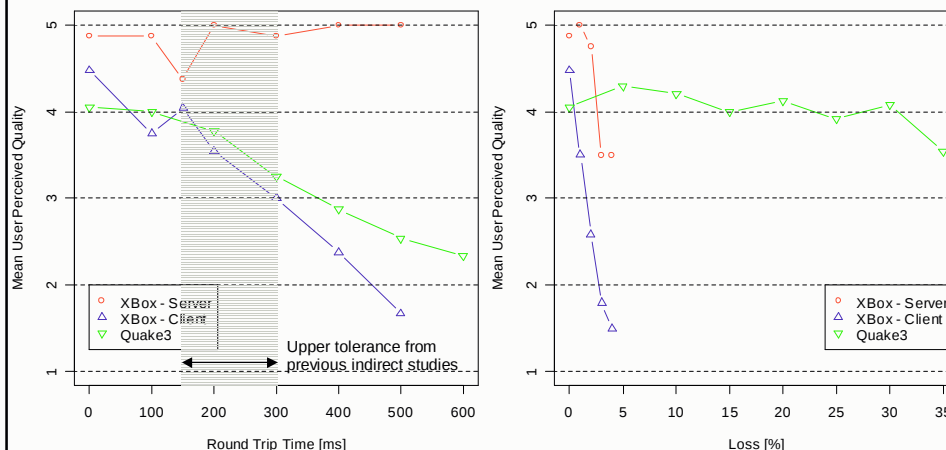


Results: Related Work

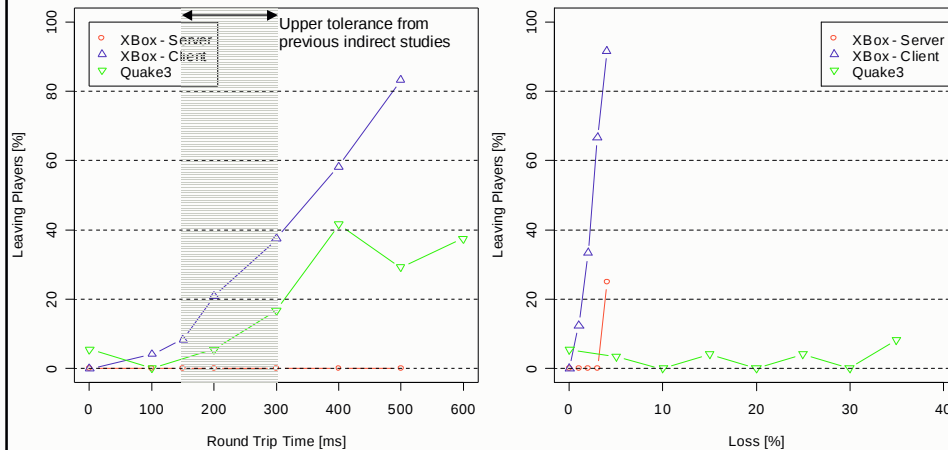


- Indirect measurements found players would not play if delay >150-180ms (Quake3) or >225-250ms (Half-Life)
 - But how to determine threshold from delay distribution (mean, x percentile, maximum)?
 - Potentially biased towards lower values because players server selection strategy is to minimize delay given constraints (e.g. map, game type, number of players)
- Indirect measurements adding artificial delay at server during game found that even with mean delay of 300ms players would not leave (Half-Life)
 - Potentially biased towards higher values because players are engrossed in the game

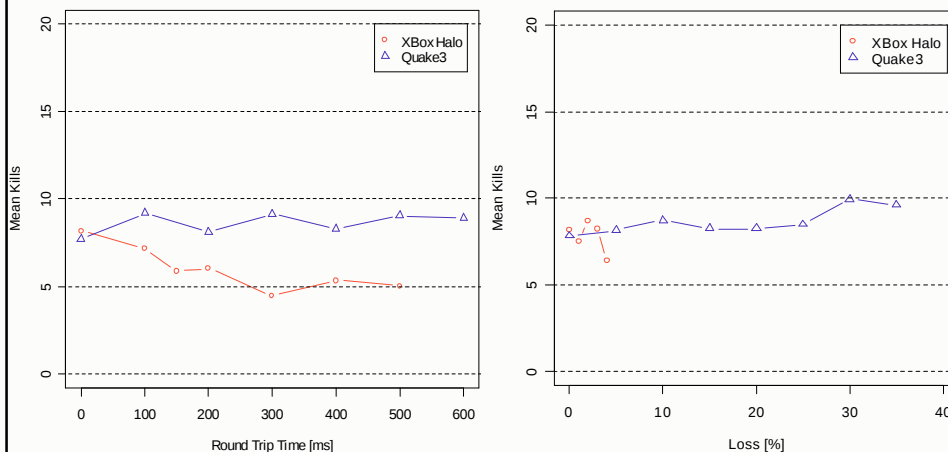
Results: Perceived Quality



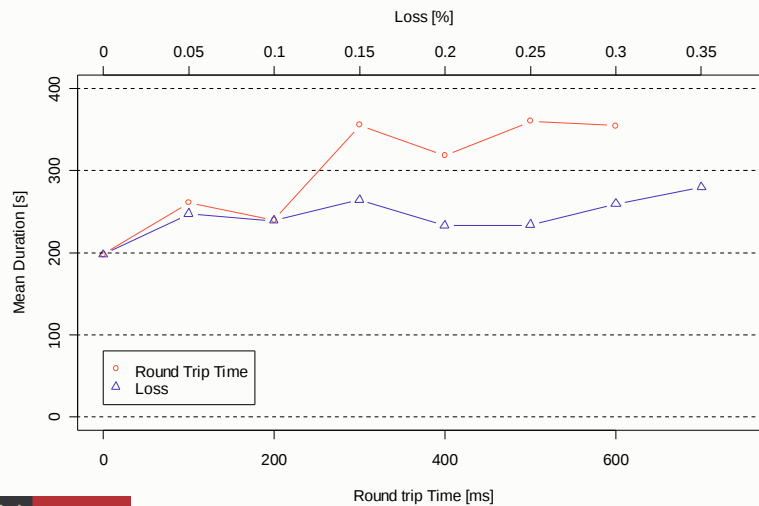
Results: Stay or Leave



Results: Player Performance



Results: Game Duration (Quake3)



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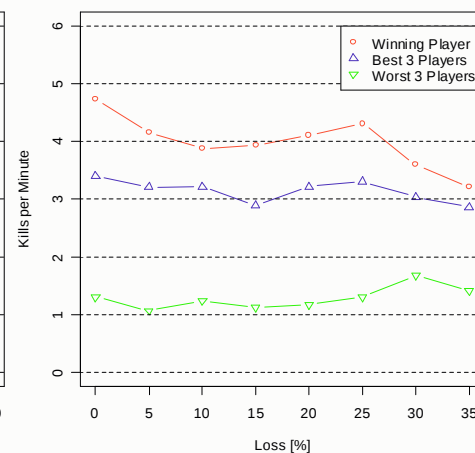
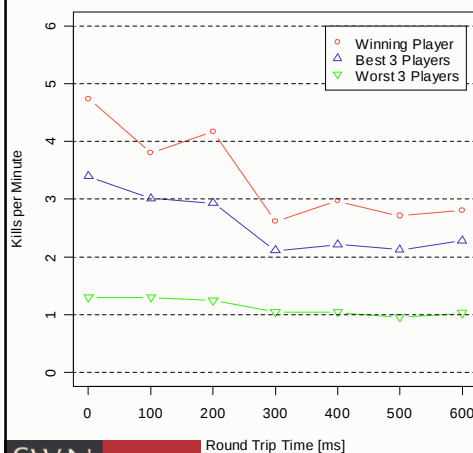
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Results: Performance (Quake3)



- Per game separation of good and bad players



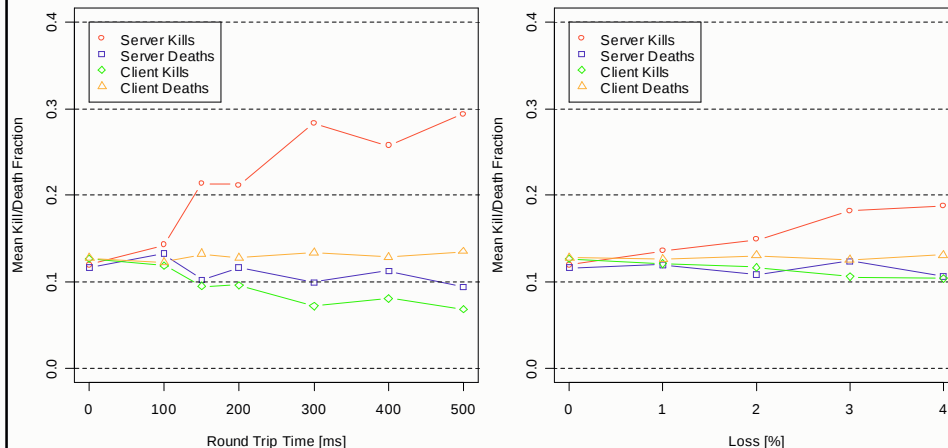
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Results: Fairness (Xbox Halo1)



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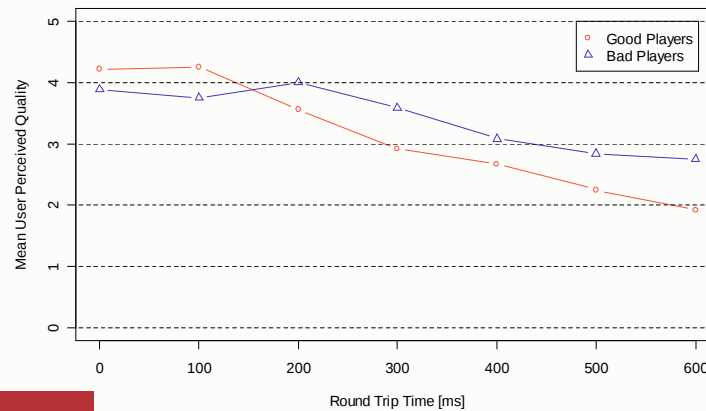
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Results: Good vs. bad (Quake3)



- Separate good from bad players **based on skill**
- Skill = total number of kills over all games



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Conclusions



- Different QoS clearly leads to unfairness or imbalanced games
- LAN games behave quite poorly if naively tunnelled over Internet (without mechanisms like client-side prediction)
 - Low perceived quality even if no influence on player's performance
- Player perceived quality is not sole predictor of their likelihood of immediately leaving a game server
- Delay has much larger impact on perceived quality and performance than loss ('typical' Internet values)

Conclusions



- Influence of delay and loss on kills/minute depends on player's actual performance
 - Negative impact is larger for better players than for worse players
- More successful (and presumably more experienced) players are more aware of QoS degradation than less experienced players, but the differences are slight and not significant
- Results broadly consistent with results from previous indirect measurements

Future Work



- Collect larger data set for stronger statistical results
 - Determine number of players beforehand
 - Huge effort: 50+ players needed doing 10+ games each
- Investigate influence of packet jitter
- Collect more information (self assessment of player's skill, relationship between players, game duration, time of day, ...)
- Perform isolated tests: single player vs. bots
- Investigate team-based games with strategic objectives
- New games and different game types (e.g. car racing)

Acknowledgments



- Tanja Lang
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The End



Thanks for your attention!
Questions, Comments?

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