Empirically Measuring the QoS Sensitivity of Interactive Online Game Players

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Outline

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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

- Graphs showing perceived quality vs round trip time and loss percentage for different game platforms (XBox, Server, Client, Quake3).
  - Upper tolerance from previous indirect studies.
Results: Stay or Leave

Results: Player Performance
Results: Game Duration (Quake3)

Results: Performance (Quake3)
- Per game separation of good and bad players
Results: Fairness (Xbox Halo1)

Results: Good vs. bad (Quake3)

- Separate good from bad players \textit{based on skill}
- Skill = total number of kills over all games
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)

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The End

Thanks for your attention!
Questions, Comments?