

CENTRE FOR ADVANCED INTERNET ARCHITECTURES

Achieving Fairness in Multiplayer Network Games through Automated Latency Balancing

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Overview



- Motivation
- Fairness Approach
- Implementation
- Client-site Bots
- Evaluation Results
- Conclusions and Future Work



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Motivation



- Multiplayer network games have become very popular and have evolved into some kind of sports
 - Competitions and leagues are very popular and comparable to sporting competitions
 - □ Professional gamers earn their living just by gaming; they have fans and TV shows
 - ☐ Many people playing on amateur level take it seriously
- Games requiring fast player reactions are very sensitive to the Quality of Service (QoS) of the underlying computer network(s)
- Fairness is very important
 - ☐ Game design (we do not talk about this)
 - □ Network QoS differences



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Motivation cont'd



- Focus on fast-paced games e.g. first person shooters where fast player reactions are crucial
- Focus on latency/delay (also called lag)
 - ☐ Influence of jitter has not been sufficiently studied
 - ☐ Influence of packet loss is much smaller
- Previous work has shown that
 - ☐ Efficiency of players decreases with increasing latency
 - □ Latency differences cause unfairness
- Latency differences are caused by
 - □ Network access technology
 - □ Distance between client and server (propagation delay)
 - □ Congestion in the network



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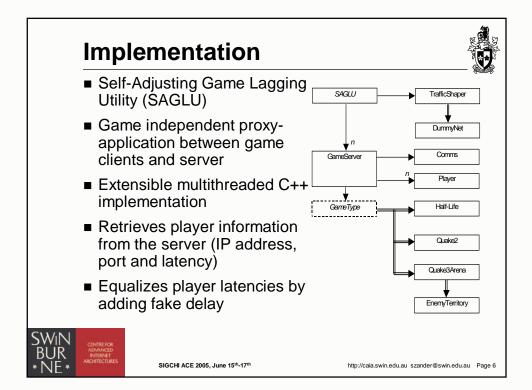
Fairness Approach



- Implement tool that automatically equalizes players latency by adding artificial lag
- Evaluate effectiveness of approach using human or computer players
 - ☐ Compare 'objective' performance metrics (e.g. kill rate) for players (player groups) with different latencies
 - ☐ Use hypothesis testing to determine if differences are significant
 - ☐ If differences are significant there is unfairness
 - ☐ Eliminate factors other than delay



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Implementation cont'd



- Delay adjustment algorithm
 - ☐ How to determine amount of additional artificial delay?
 - □ How to add the delay?
 - ☐ How frequently to measure player's network delay and adapt the additional delay?
- Implemented simple algorithm

for (i in 1:#Players)

P[i].NetDelay = getNetDelay()

for (i in 1:#Players)

P[i].AddDelay = min(max(P[1:#Players].NetDelay), MaxTolerableDelay) - P[i].NetDelay

if (P[i].AddDelay > 0) setAddDelay(P[i].IPAddress, P[i].Port, P[i].AddDelay) sleep(AdaptationIntervalTime)



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Client-side Bots



- Usability trials with human players
 - □ Necessary for conclusive evaluation
 - ☐ Human responses are highly unpredictable (very difficult to eliminate all unwanted factors)
 - ☐ Resource and cost intensive (time, equipment, money)
- Client-side computer players (bots)
 - ☐ Easy to eliminate unwanted factors e.g. bots behave identical, do not get tired, do not change playing style etc.
 - ☐ Far less resources needed
 - □ Bots are different from humans
 - ☐ Incapable of complex navigation (only line of sight)
 - □ Very effective delay compensation (movement prediction)
 - □ **But** send real network traffic and therefore should be affected by network delay



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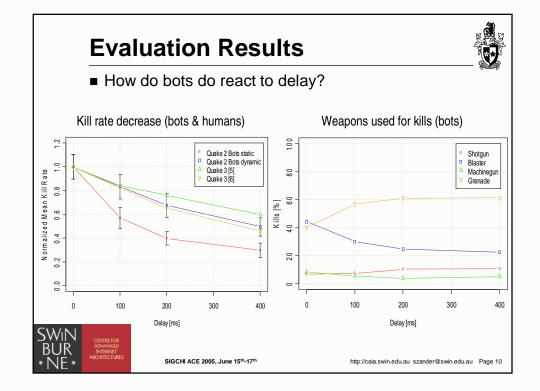
Evaluation

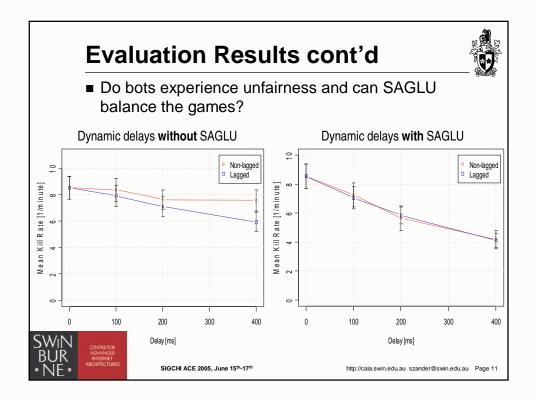


- FreeBSD PC with 2.4GHz and 1.25GB RAM
- Emulate network delay using *dummynet*
 - □ Static
 - ☐ Dynamic (changing every second with exponential distribution)
- Small simple map without obstacles (e.g. lava pits, elevators) and powerful explosive weapons
- 4 bot players (same configuration)
- SAGLU adaptation interval of 5 seconds
- Experiments
 - □ How do bots react to delay?
 - □ Do bots experience unfairness?
 - □ Can SAGLU balance unfair games?
- Average results over 15 games (15 minutes duration)



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Conclusions and Future Work



- Client-side bots behave similar to humans
 - ☐ Kill rate decreases and weapons with area effects become more effective with increasing delay
 - □ Experience unfairness because of delay differences
 - ☐ But performance (kill rates) cannot be directly compared
- SAGLU effectively balances the game (http://caia.swin.edu.au/genius/tools/saglu-0.1.tar.gz)
- Usability trials with human players in real networks
 - □ Refine delay adjustment algorithm
 - □ Optimize parameters (e.g. adapt. interval, tolerable delay)
- Measure performance and overhead



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Thanks for your attention!



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