Cloud and Peer-to-Peer Gaming

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What is P2P Gaming?

Figure 1: Client Server topology
What is P2P Gaming?

Figure 2: P2P topology
Donnybrook: P2P Gaming for FPS games

Figure 3: “Call of Duty: Black Ops 2”
How to reduce network traffic?

Figure 4: “Counter-Strike: Source”
 Metrics

- Proximity: $l_{ij}^{(1)} = \max\{(1 - \text{dist}(i, j)/D_{max})^{1.5}, 0\}$
- Aim: $l_{ij}^{(2)} = \max\{(1 - \hat{\alpha}(i, j)/45^\circ)^{1.5}\log(\text{dist}(i, j)), 0\}$
- Interaction Recency: $l_{ij}^{(3)} = \begin{cases} e^{-t_{ij}/\text{sec}} & \text{if } t_{ij} \leq 3 \text{ sec} \\ 0 & \text{otherwise} \end{cases}$
- $A_{ij} = \sum_{k=1}^{3} w_k l_{ij}^{(k)}$
Proximity

Figure 5: Metric: Proximity
Aim

Figure 6: Metric: Aim
Interaction Recency

Figure 7: Metric: Interaction Recency
Doppelgängers

Figure 8: Doppelgänger
Are we done?

Figure 9: Halo 3
Concrete numbers for Quake III

- 20 interest set updates per second
- 1 guidance update per second
- Reduction of bandwidth requirement: $\frac{20n}{20*5+n}$
  - 1000 player game of Quake III: 12 Mb/s $\rightarrow$ 670Kb/s
Does it work?

Figure 10: User evaluation
Cloud Gaming

Figure 11: Cloud Gaming
Standard cloud gaming

Figure 12: Standard cloud gaming
Navigation events

Navigation vector: $N_t = \{\delta_{x,t}, \delta_{y,t}, \delta_{z,t}, \theta_{x,t}, \theta_{y,t}, \theta_{z,t}\}$
Future input prediction

Figure 13: Outatime
Viewpoint interpolation

Figure 14: Example of viewpoint interpolation
Cube map

Figure 15: Cube map
Impulse Events

Figure 17: Speculative Rendering II
Subsampling and timeshifting

Figure 18: Subsampling example
Joint encoding

Figure 19: Joint encoding
Does it work?

Figure 20: Evaluation results
Similarities between Donnybrook and Outatime

- Obstacle: Network limitations
- Exploitation of human cognition limitations
- Exploitation of temporal and spatial locality
- Future prediction
Current state

Figure 21: Cloud gaming companies
Discussion

Metrics:
1. Proximity
2. Aim
3. Interaction recency

Figure 22: Reminders