Improving Efficiency and Fairness in P2P systems with Effort-based incentives

Jaehoon Jeong

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Rameez Rahman, Michel Meulpolder, David Hales, Johan Pouwelse, Dick Epema, and Henk Sips

Deft University of Technology

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Contribution based incentives vs. Effort based incentives

- Most P2P systems that have some kind of incentive mechanism reward peers according to their contribution

Contribution based incentive

- Fastest peers reap the highest benefits

Effort based incentive

- Take contribution relative to capacity
Contribution based incentives vs. Effort based incentives

- This paper presents the results of simulations in which they apply principles from Parecon to two popular real-life systems.

### Contribution policy

- **High Peer**
- **Slow peer**

### Effort policy

- **High Peer**
- **Slow peer**

### Simulation

- **BitTorrent**
- **Credit based enforcement schemes**
Two Mechanisms

**BitTorrent**
- Popular file sharing protocol

Seed : Upload

Leech : Download

Swarm : Uploader and Downloader

Tracker server : peers are tracked and connected

**Credit**
- A peer can only continue downloading if it has a positive credit
- That makes more contribute P2P system
Efficiency, Fairness and Incentives

**Question**: What do system designers consider P2P systems?

**Answer**: A. More Cooperation and less selfishness
- To contribute peer’s resource to the network

B. More efficiency and less wastefulness
- Pareto optimality: A change from one allocation to another that can make at least one individual better off without making any other individual worse off

C. More equity and less unfairness

**Participatory Economics**
Payment according to effort and sacrifice. This suggest that people should be rewarded for the efforts and sacrifice that they put into their work, rather than being paid for their output
Efficiency and fairness in BitTorrent

$r_j$: peer j’s value

$b_{ji}$: the amount of bytes uploaded by peer j to peer i

$U_j$: the upload capacity of peer j

**Contribution Policy**

\[ r_j = b_{ji} \]

**Effort Policy**

\[ r_j = \frac{b_{ji}}{U_j} \]
Efficiency and fairness in BitTorrent

The download speed of slow peers can increase up to 63% at only a slight loss for fast peers: a 4% reduction in speed.
Simulation results in BitTorrent

✓ Figure (a) presents polarized in contribution policy and fast peers can achieve as much as 60% higher than slow peers, whereas 5% in effort policy.

✓ Figure (b) presents that gather peers, it would have low average download speed in contribution policy.
Simulation results in BitTorrent

![Graph showing average upload speed versus number of peers with two types of markers: contribution based and effort based.]
Efficiency and fairness in Credit mechanism

**In contribution policy**

Each peer earns credit based on its upload speed

-> So if a peer has an upload speed of x units per time unit, then it earns x units if it seeds a file for one time unit.

**In effort policy**

All peers earn the same credit for seeding for one time unit,

-> regardless of their upload capability
Efficiency and fairness in Credit mechanism

Right figure shows the somewhat surprising result that the performance of both fast and slow peers goes up under the effort policy.

✔
Efficiency and fairness in Credit mechanism

✓ Gini coefficient is a number ranging from 0 to 1 that characterizes inequality with 1 being the most unequal and 0 being complete equality.
Conclusion

This paper introduces new incentive ‘Effort based incentive’

They proved effectiveness effort based incentive through a simulation

“...It is very good solution to be fair and to ensure maximization of the social welfare while being efficient at the same time...”
Thank you for listening & Q&A