Equity in P2P Networks

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Problem Description

This paper will be addressing an alternate version of fairness, focused on equality of outcomes, rather than equality of opportunity. In the context of P2P networks where upload bandwidths are normally distributed, I will aim for equality of outcomes by analysing the standard deviation of the dependent variable data yielded from the implementation of the different protocols which already exist in the field of P2P file sharing protocols. When analysing such protocols, the dependent variable identified will be primarily the avg. download time. After implementing BitTorrent, FairTorrent, and Bitmate, and analyzing the resulting data, I would like to attempt my own version of a protocol.

Background

P2P networks require a method of deciding which peers to provide resources to; this may be deciphered using an algorithm, which can optimize for different factors. The standard approach in the field of P2P file sharing, BitTorrent, follows a Tit-for-tat strategy, which is generally assumed to possess robustness.[1] There are also other alternatives, which optimize for other factors, by imposing additional checks and methodologies in order to account for freeloaders and other more malicious protocols.

FairTorrent is a protocol "that accurately rewards peers in accordance with their contribution" by locally maintaining a list of those from whom that given peer had downloaded, and uploading to them accordingly.[3] This notion of fairness mirrors the Latin phrase *"suum cuique"*, which translates to "to each his own". While such fairness ensures equality of opportunity, it does not ensure equality of outcome. This equality of outcome is typically termed equity.

Equity involves allocating the resources needed to reach an equal outcome between all members of a group. In the context of algorithmic game theory, this could manifest as a smaller value when measuring the standard deviation of a given yielding variable. One possible implementation that focuses on having lower bandwidth players collaborate, in opposition to FairTorrent is BitMate, which will also be implemented and analysed in relationship to the other protocols.[2]

Project Plan and Timeline

As a starting point, I'll be implementing BitTorrent (05/02/22), and then FairTorrent and maybe BitMate (05/04/22); afterwards, I'd analyze the resulting data. Thereafter, I will attempt to create a framework for a distributed algorithm that will attempt to shrink the standard deviation as much as possible, given the information collected from the initial analysis of BitTorrent and Fairtorrent (05/10/22).

References

[1] Bram Cohen. Incentives build robustness in bittorrent. In *Workshop on Economics of Peer-toPeer systems*, volume 6, 2003.

[2] Umair Waheed Khan and Umar Saif. Bittorrent for the less privileged. In *Proceedings of the 10th ACM Workshop on Hot Topics in Networks*, HotNets-X, New York, NY, USA, 2011. Association for Computing Machinery.

[3] Alex Sherman, Jason Nieh, and Clifford Stein. Fairtorrent: Bringing fairness to peer-to-peer systems. In *Proceedings of the 5th International Conference on Emerging Networking Experiments and Technologies*, CoNEXT '09, page 133–144, New York, NY, USA, 2009. Association for Computing Machinery.