

Do incentives build robustness in BitTorrent?

Michael Piatek, Tomas Isdal, Thomas Anderson, Arvind
Krishnamurthy, Arun Venkataramani

Overview

- BitTorrent: P2P file distribution tool designed with *incentives for contribution*
- Users need to contribute resources (upload capacity) to receive good performance.
- *Main question:* Can we cheat?

How BitTorrent works



Content provider

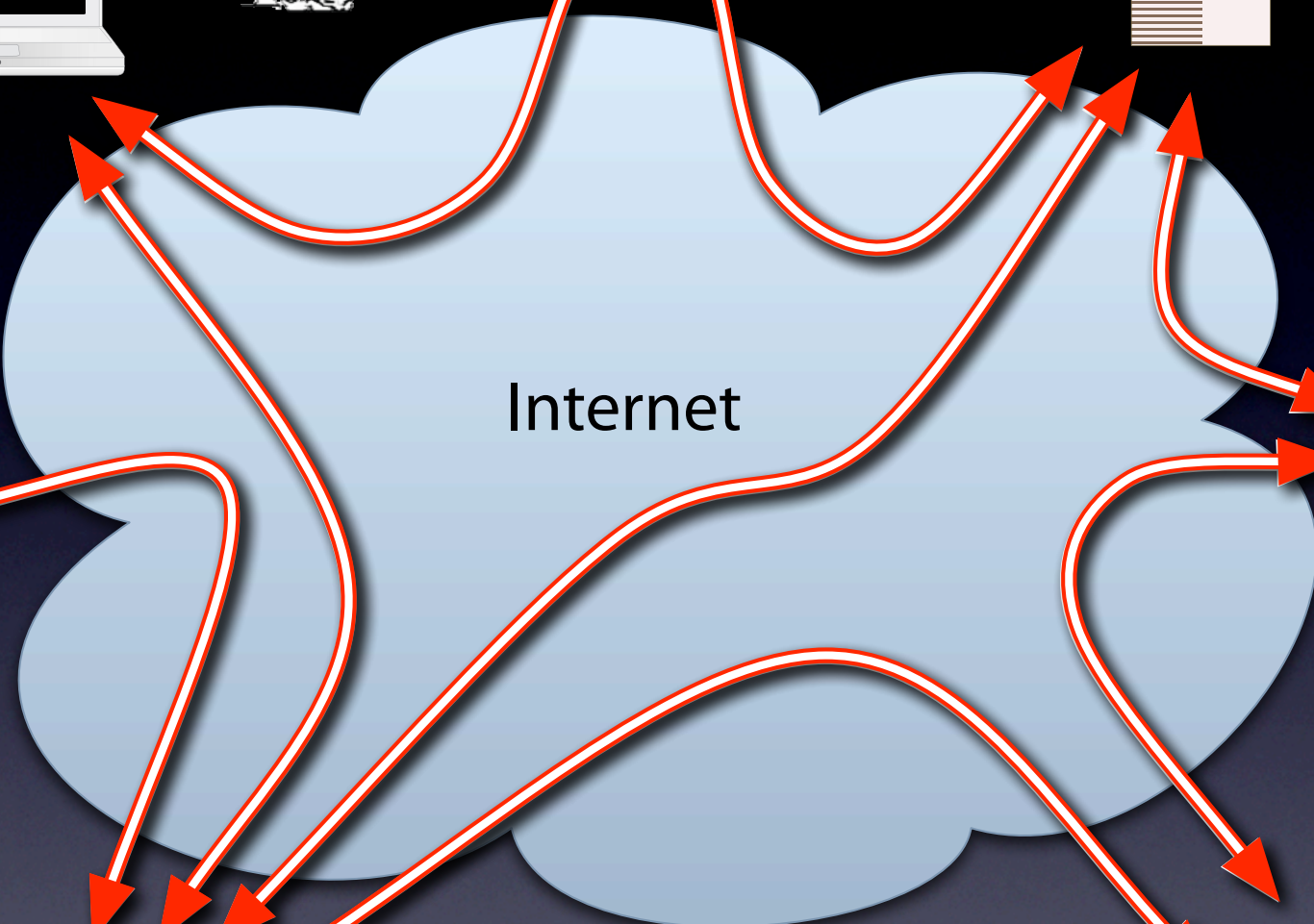
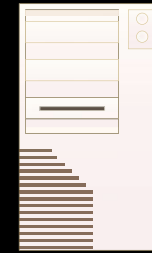


A big file



Broken
into pieces

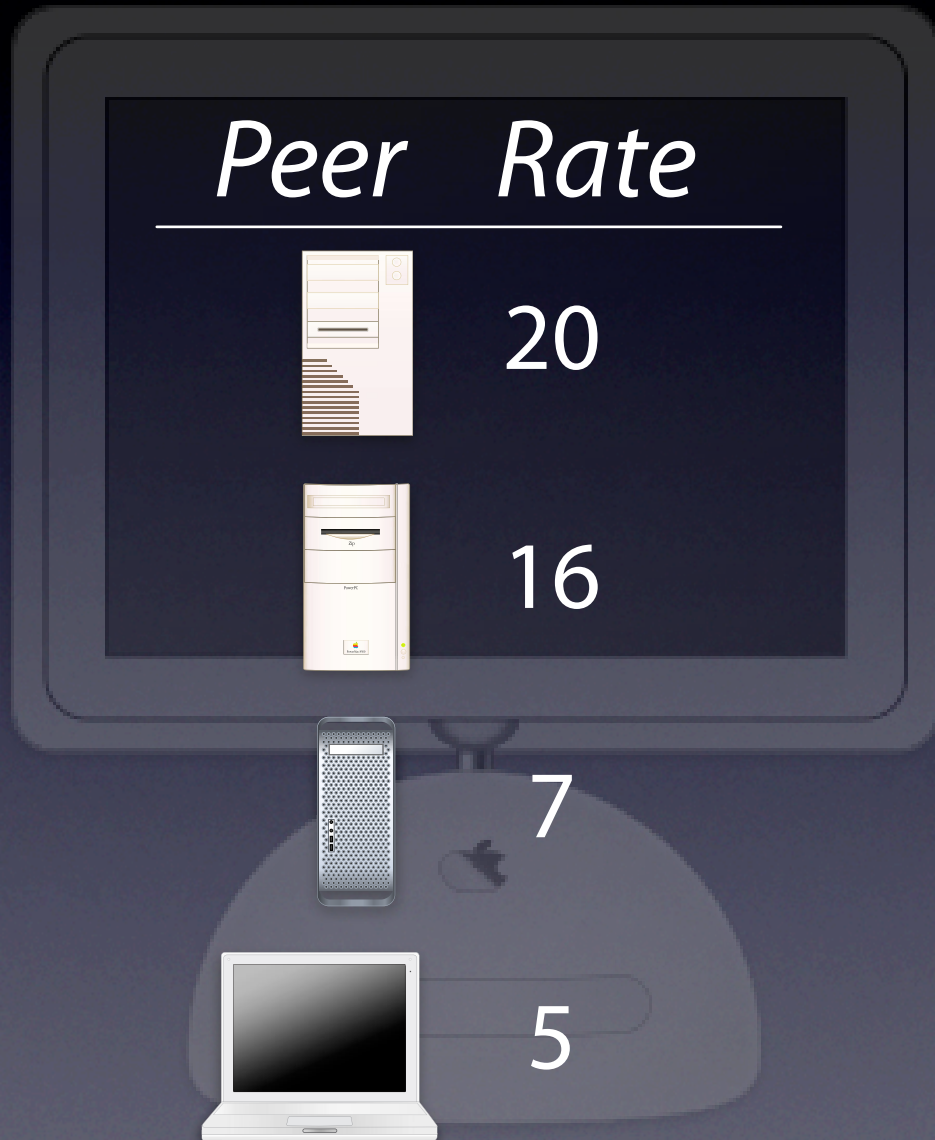
Content provider



Internet

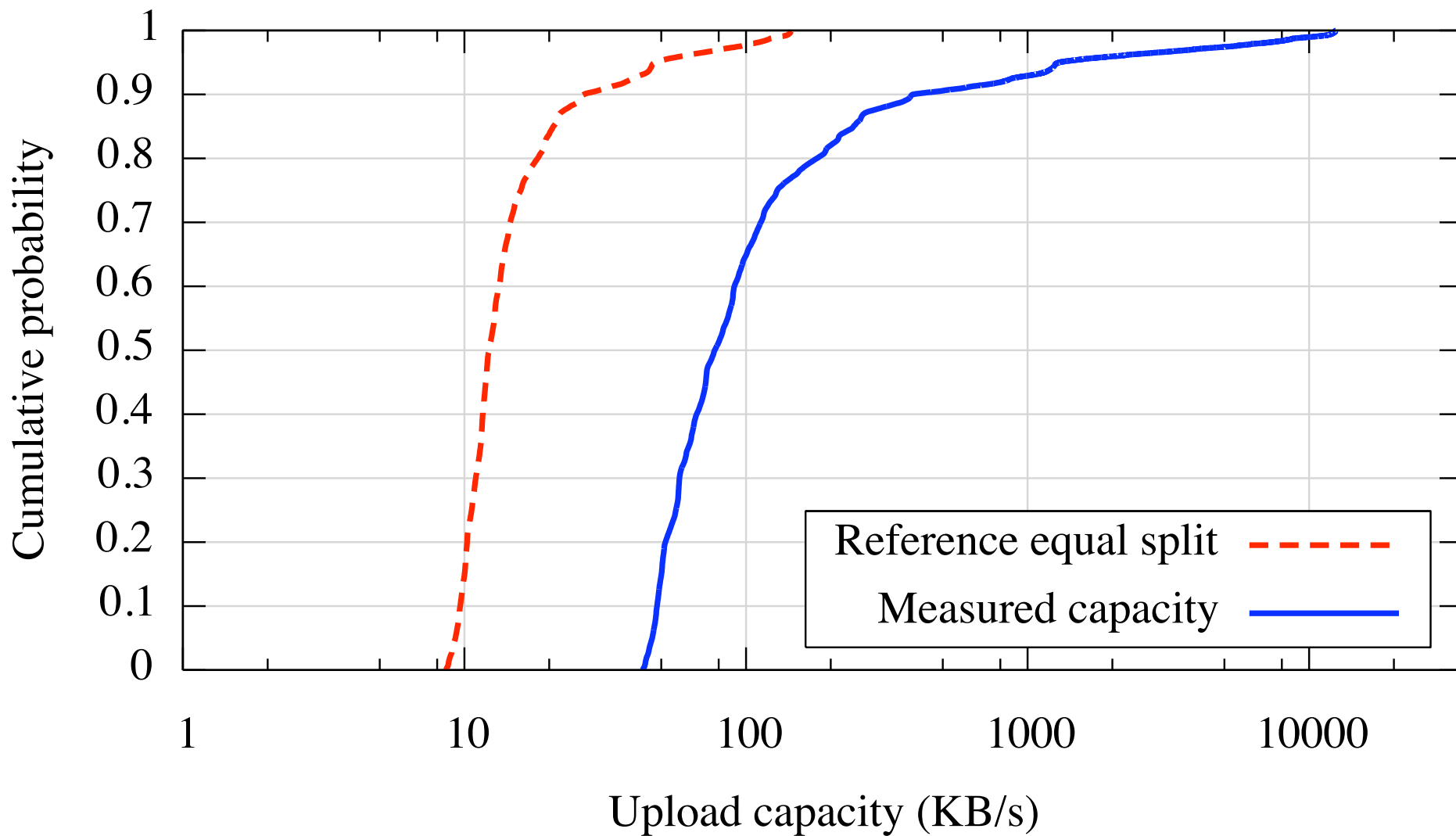


Incentives

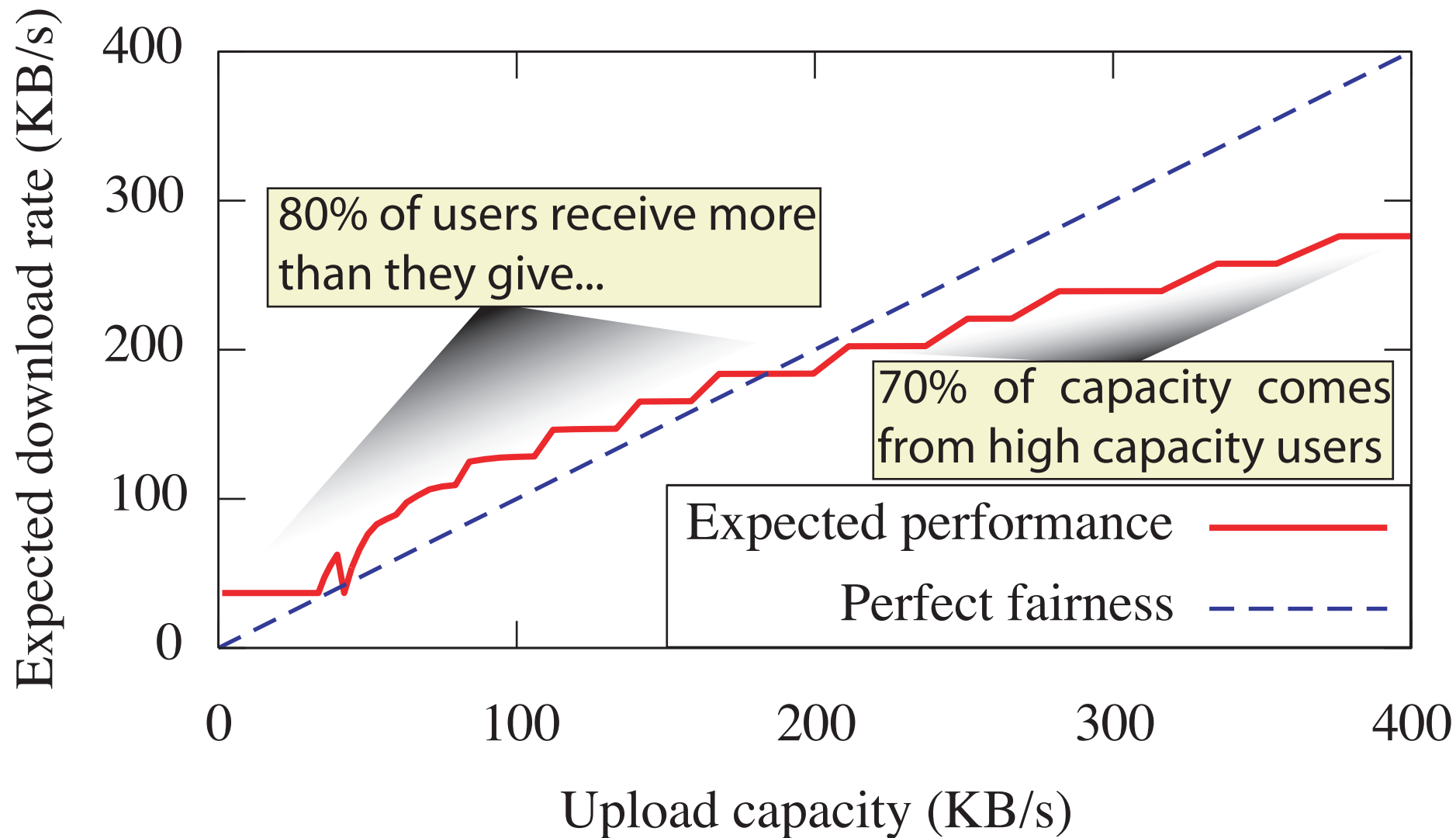


- Decisions about which peers to send data are made by each peer individually following a *tit-for-tat* policy:
- I'll send data to you if you've been sending data to me.

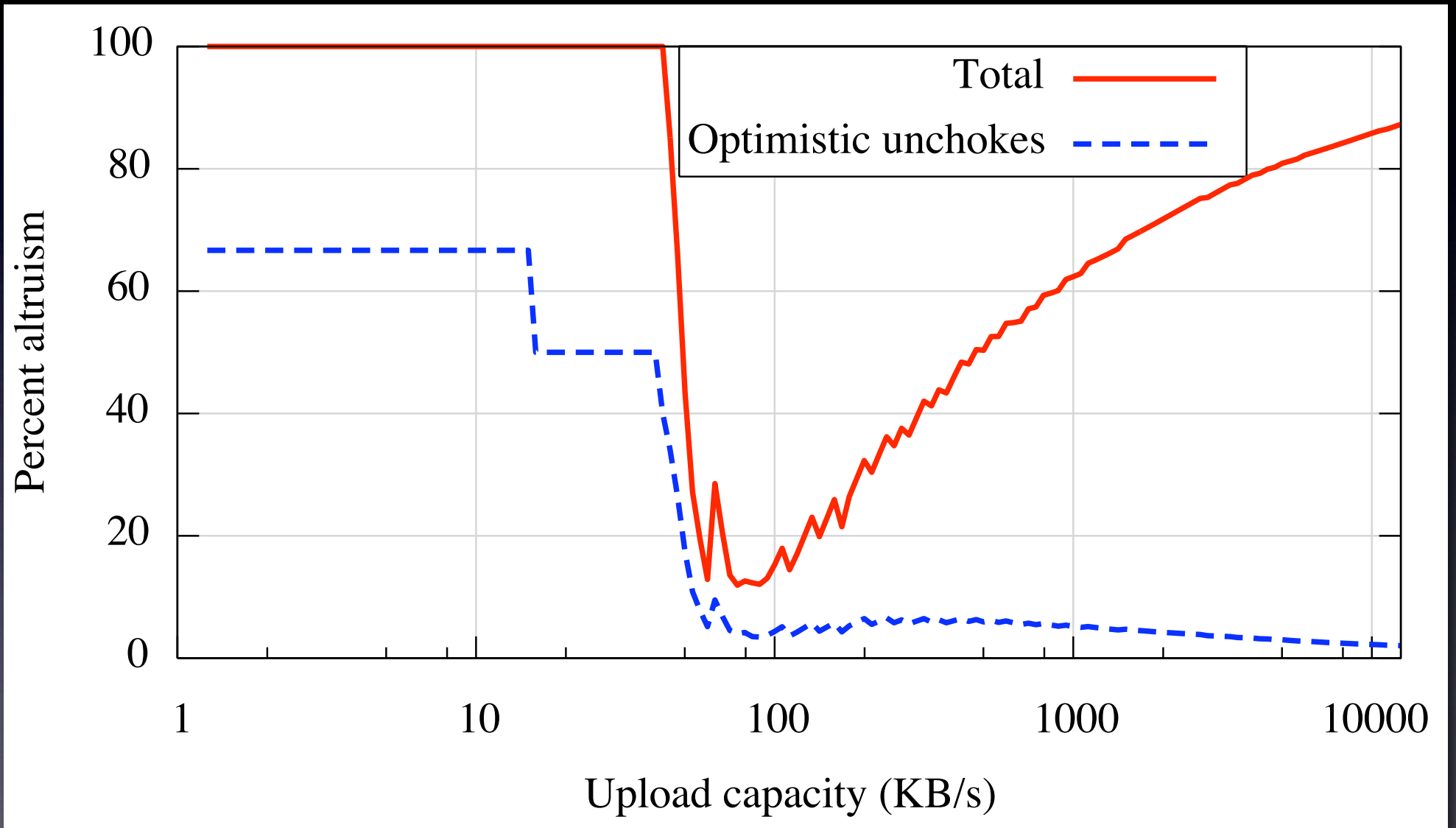
Real users



Fairness



Altruism



Building *BitTyrant*

- Can altruism in existing BitTorrent swarms be exploited by a selfish client? – Yes.
- *Key idea:* strategic selection of which peers and at what rates to send data

Core algorithm

Each round, rank order each peer p by the ratio d_p/u_p , and choose those of top rank until the local upload capacity is reached.

$$\underbrace{\frac{d_0}{u_0}, \frac{d_1}{u_1}, \frac{d_2}{u_2}, \frac{d_3}{u_3}, \frac{d_4}{u_4}}_{\text{choose } k \mid \sum_{i=0}^k u_i \leq \text{capacity}}, \dots$$

choose $k \mid \sum_{i=0}^k u_i \leq \text{capacity}$

At the end of each round for each unchoked peer:

If peer p does not send data: increase cost estimate, u_p .

If peer p has unchoked us for the last minute:
reduce cost estimate, u_p .

Results

- BitTyrant improves average download performance by 70%.
- Regardless of capacity, using BitTyrant is in the selfish interest of every peer individually.
- When all peers behave selfishly, average performance degrades for all peers, even those with high capacity.