Analyzing and Improve BitTorrent Performance

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Outline

- I . Introduction
- II . BT Overview
- III. Simulation Metrics
- IV. Experiments
- V . Conclusion
- VI. My Research

I. Introduction

- A simulation-based study of BitTorrent
- Discuss the BT original core algorithm
- Provide some new methods to improve BT performance

II. BT Overview

- BitTorrent Algorithm
- Keyword Definition

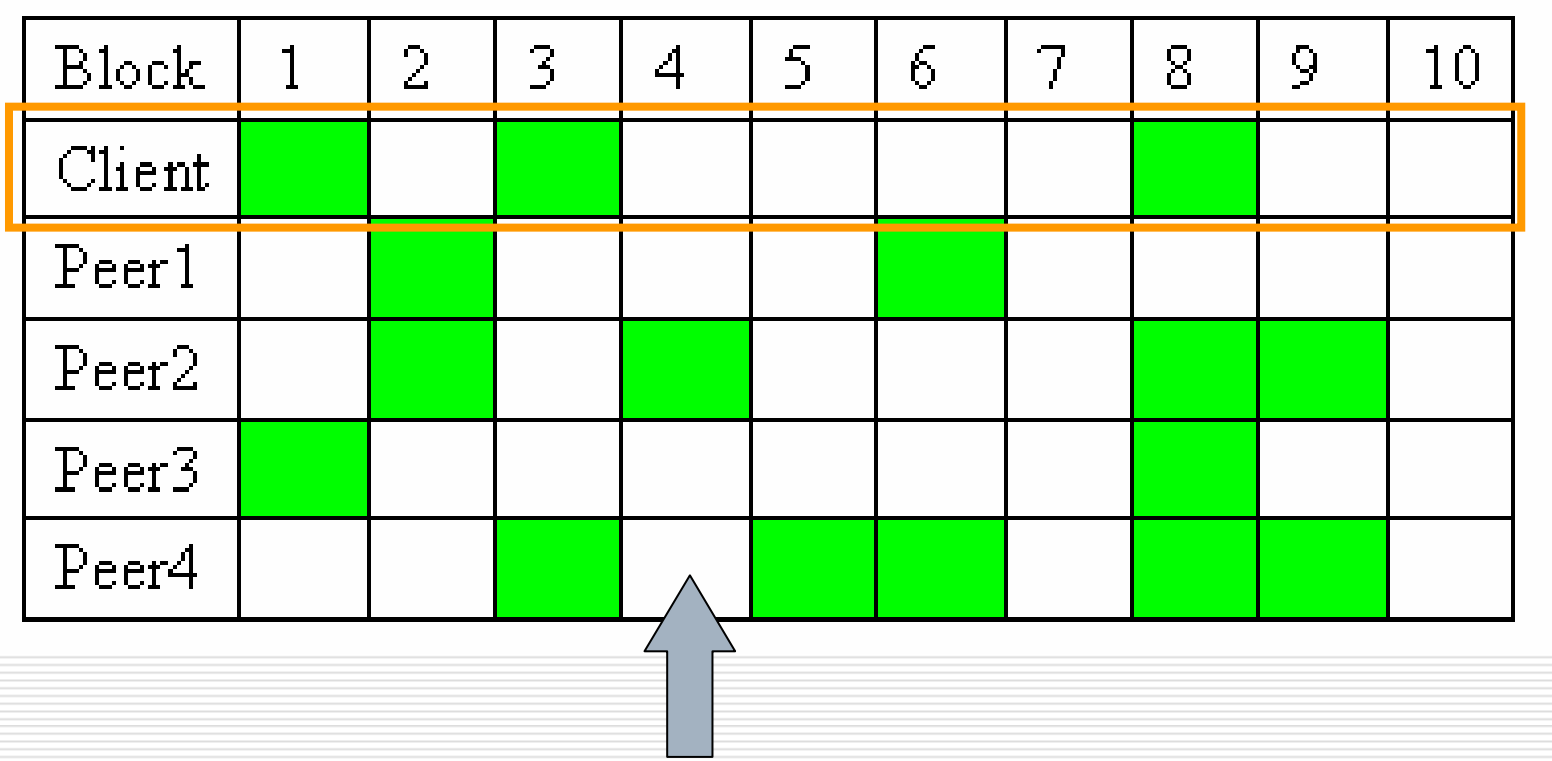
BitTorrent Algorithm

- Downloading procedure
  - Client get a .torrent file
  - Client → Tracker
  - Tracker → Client [peer list]
  - Client → peers (neighbors)
- BT core algorithm
  - Choke / un-choke [10 sec]
  - Optimistic un-choke [30 sec]

Keyword Definition

- TFT
  - Tit-for-tat
    - Choke/ un-choke
- LRF (BT 4.0.3 remove this policy)
  - Local Rarest First
  - Client will choose the fewest block to download first
- Block
  - block = piece

Local Rarest First



III. Simulation Metrics

- 5 Metrics

Metrics

- Link Utilization
  - Uplink
  - Downlink
- Mean download time
- Content diversity
  - LRF
- Load on the seed
- Fairness

IV. Experiments

- First Experiment
- Homogeneous Environment
- Heterogeneous Environment

Workload Derived from a Real Torrent

- Parameters
  - Node arrival pattern

    ➔Using Tracker log

  - Uplink and downlink bandwidth

    ➔Using Gnutella clients' speed

First Experiment

Metric	Vanilla BitTorrent
Uplink utilization	91%
Normalized seed load	127.05
Normalized max. #blocks served	6.26

Unfair!!

Table 2: Performance of BitTorrent with arrival pattern from Redhat 9 tracker log, and node bandwidths from Gnutella study.

Homogeneous Environment

- To verify
  - Is BT robust? Scalable?
  - Effect of Seed's bandwidth
  - Performance of BT's algorithm
- Experiment parameter
  - 1 Seed , bandwidth 6000Kbps
  - All nodes join during a 10 sec period
  - Peers bandwidth (D:1500/U:400 Kbps)

Homogeneous Environment (1)

Number of nodes

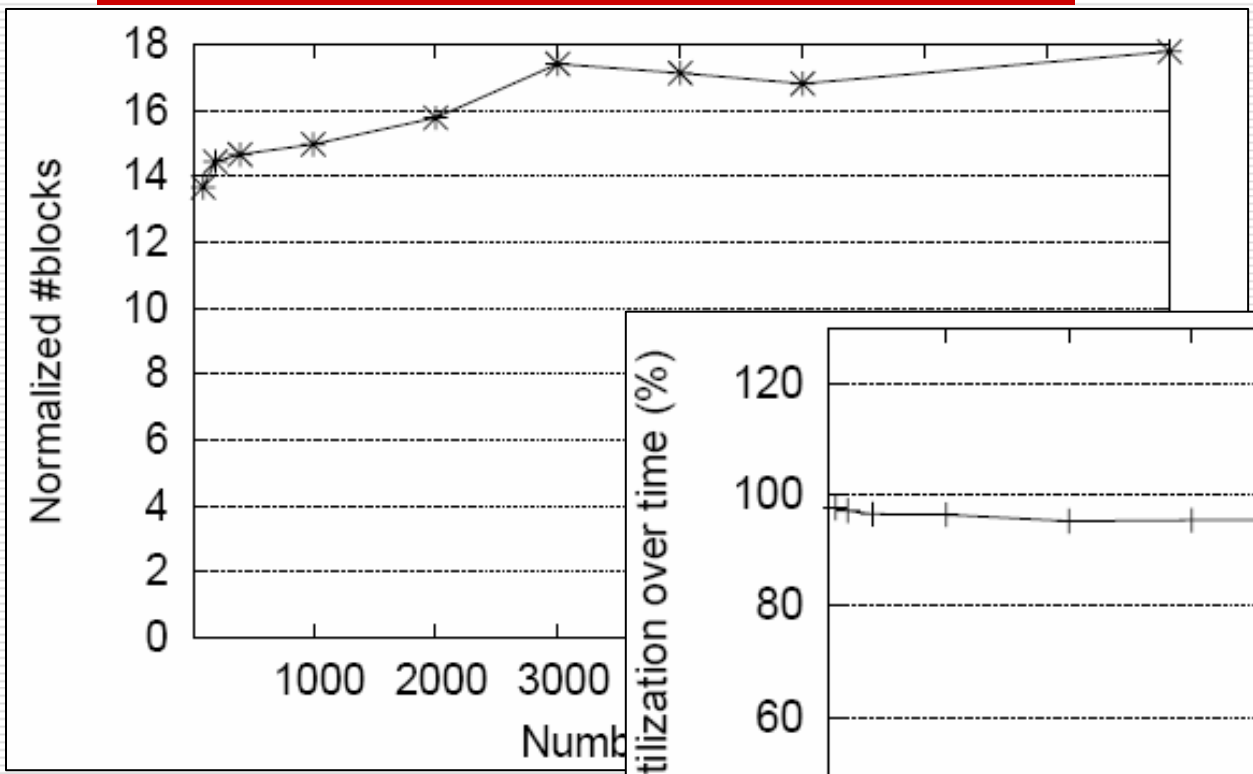
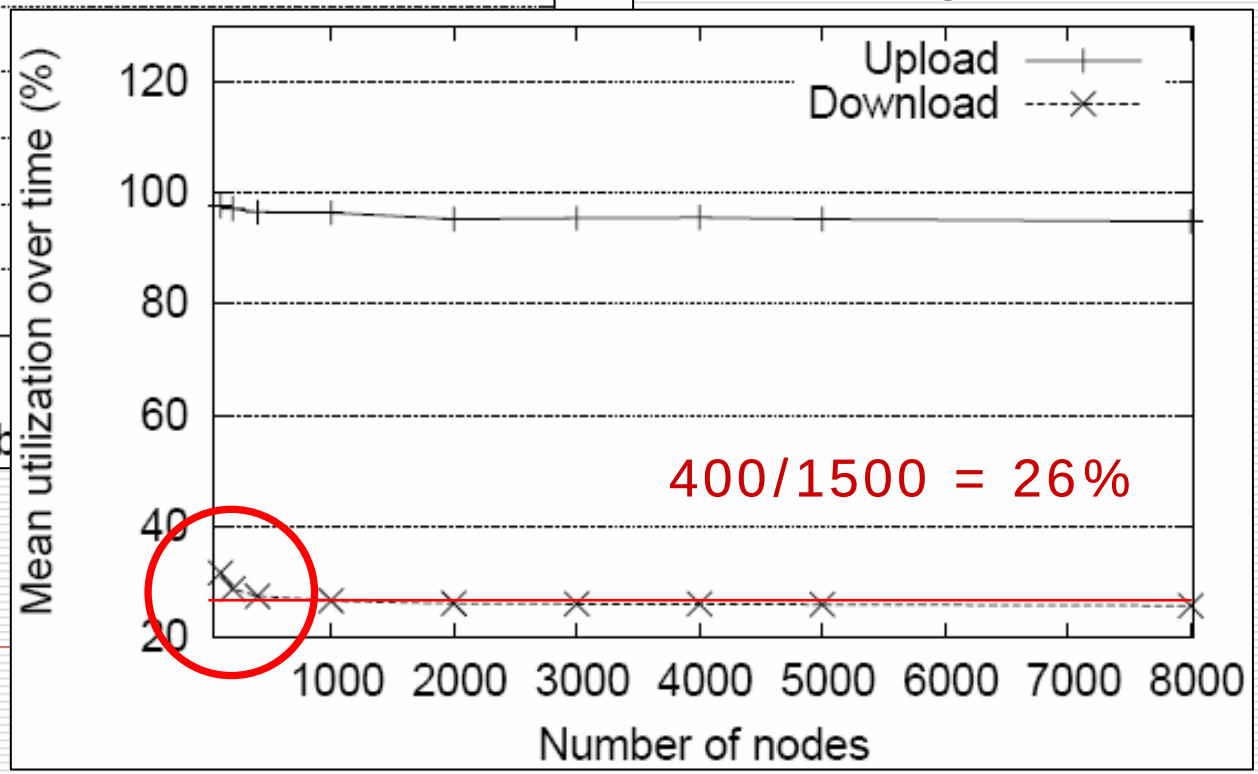


Figure 2

Figure 1



Homogeneous Environment (2)

Seed Bandwidth (kbps)

What is “mean upload utilization” ?

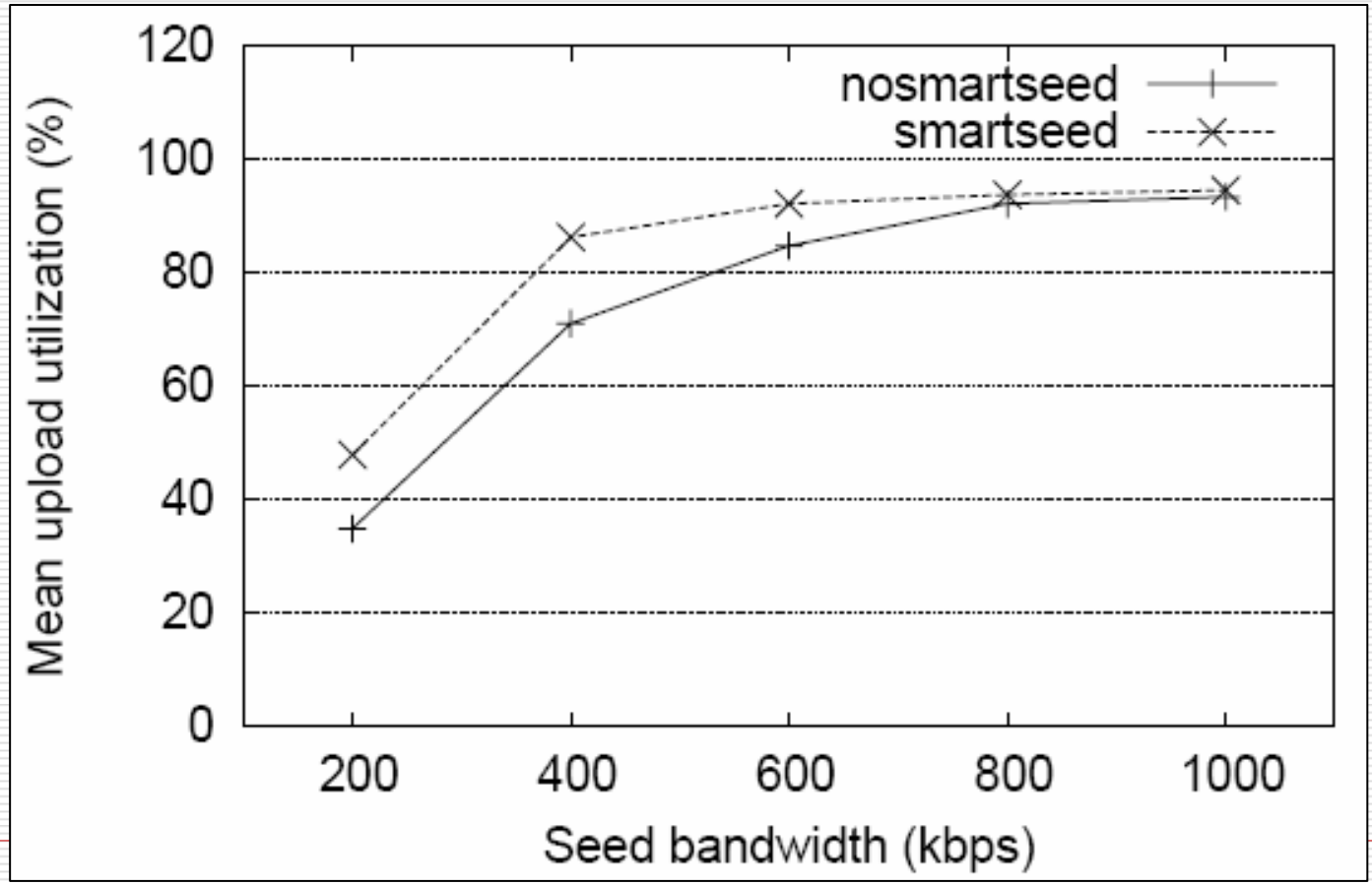


Figure 3

Smart seed policy

- The seed does not choke a leecher to which it has transferred an incomplete block.
- The seed serves the one that it has served the least.

Homogeneous Environment (3)

Smart Seed Effect

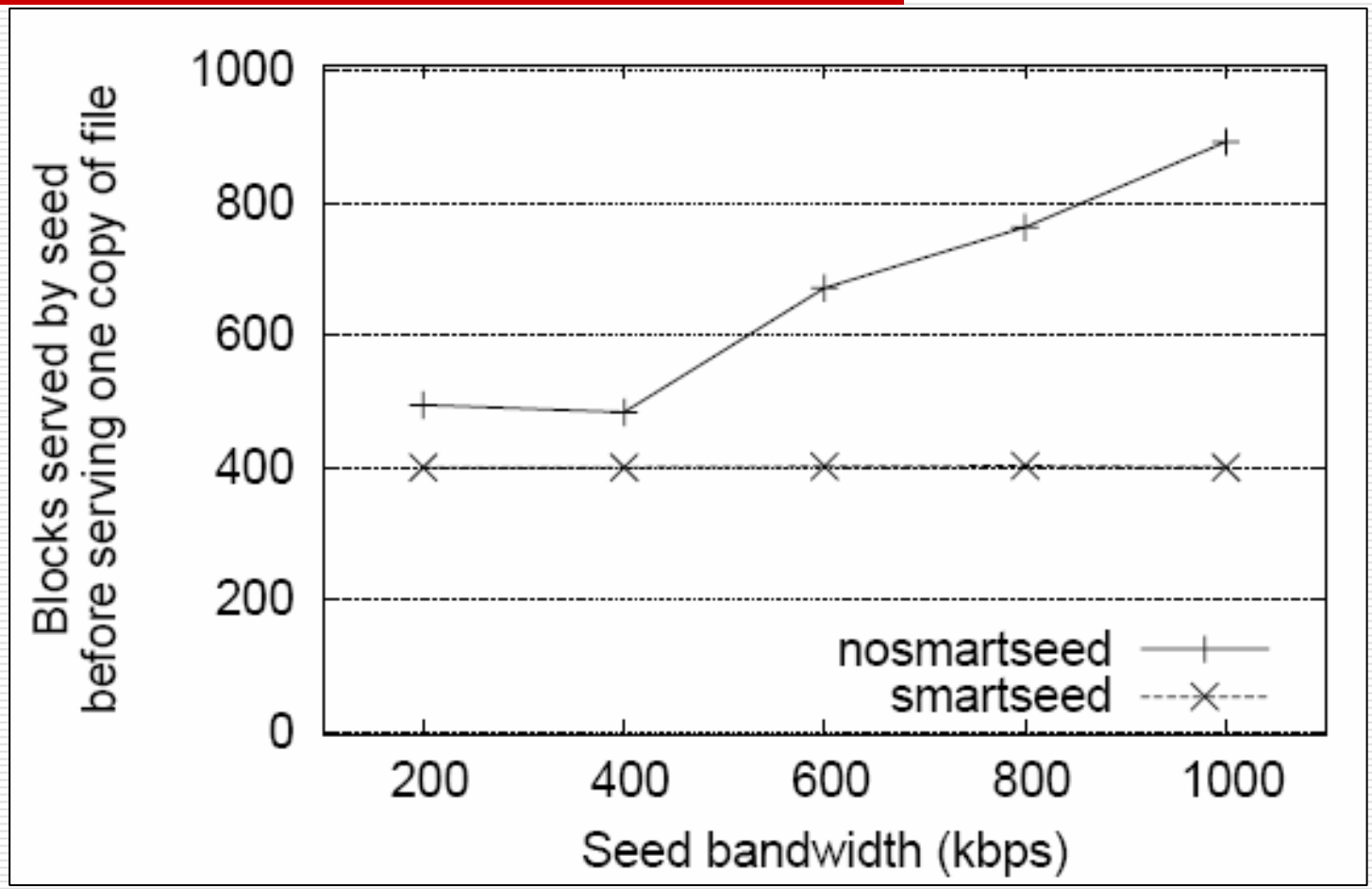


Figure 4

Homogeneous Environment (4)

LRF vs. Random & High vs. Low (Seed)

Figure 6

Homogeneous Environment (5)

LRF vs. Random @ time & interesting

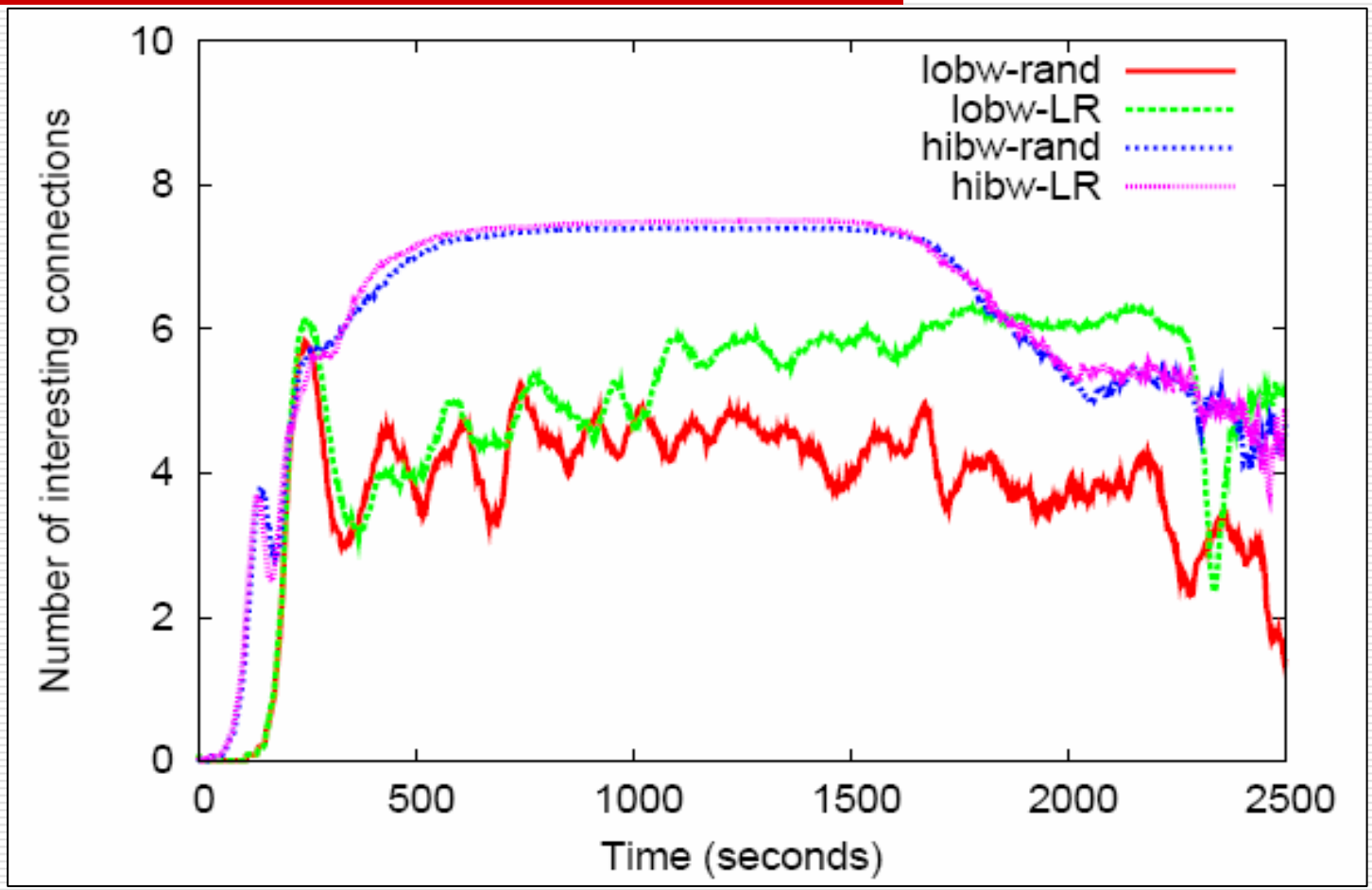


Figure 7 **(d = 7)**

Heterogeneous Environment

- New Concepts
  - Quick bandwidth estimation (QBE)
    - 1. Using lightweight schemes based on the packet-pair principle
    - 2. Peers can get neighbors speed quickly
    - 3. Optimistic un-choke wouldn't be needed
    - 4. Ignore overhead
  - Pairwise block-level TFT
    - 1. *A* allows a block to be uploaded to *B* if and only if $Uab \leq Dab + \Delta$

Heterogeneous Environment

- Parameters
  - Flash crowd
    - 1000 nodes join at first 10 sec
  - 3 type of nodes [Kbps]
    - High-end cable modem (D:6000 / U:3000)
    - High-end DSL (D:1500 / U:400)
    - Low-end DSL (D:784 /U:128)
    - Number of the 3 type peers are equal
  - Seeder always uses “smart seed” policy

Heterogeneous Environment (1)

BT , QBW ,block TFT

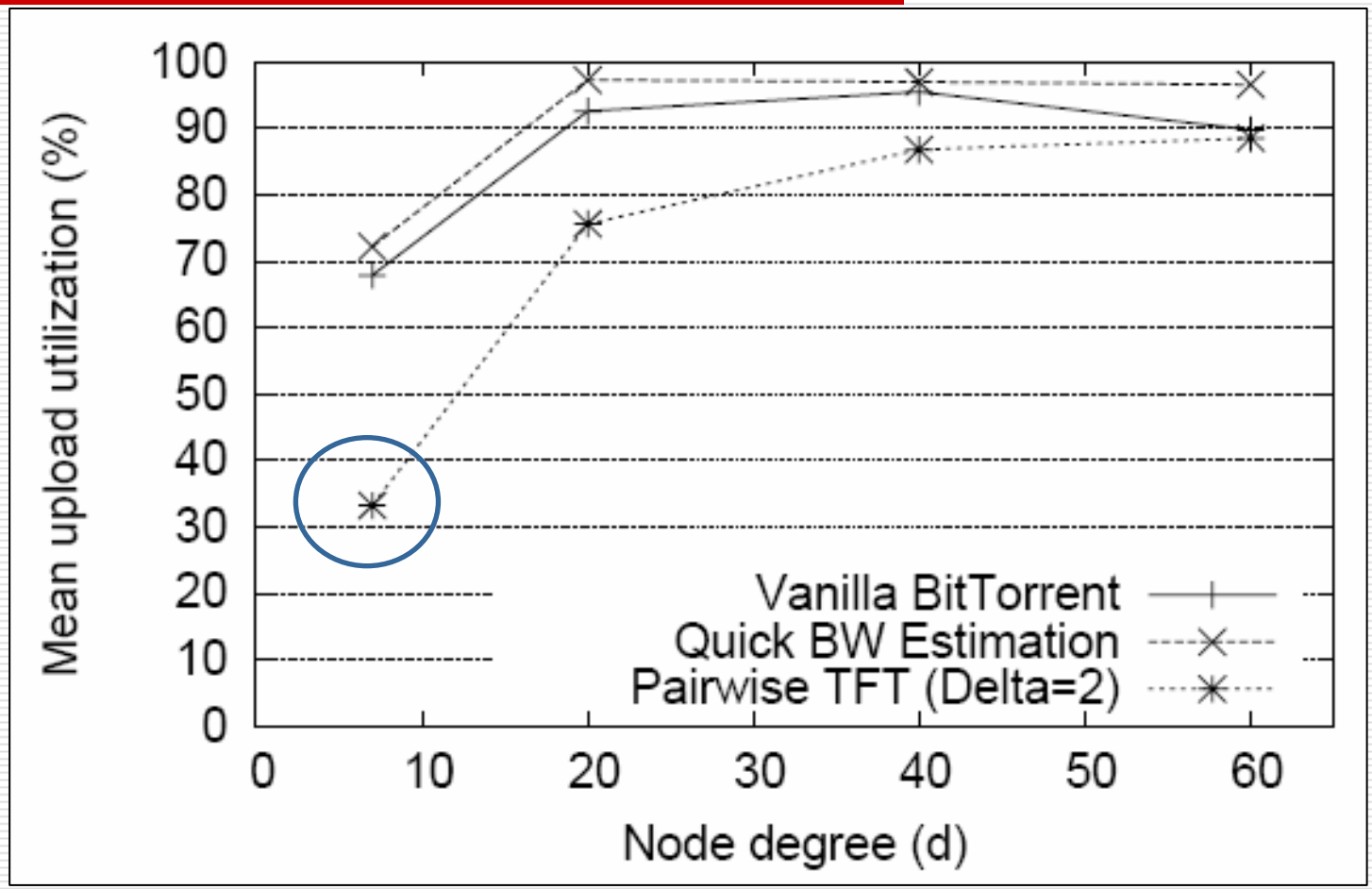


Figure 10

Heterogeneous Environment (2)

BT , QBW ,block TFT

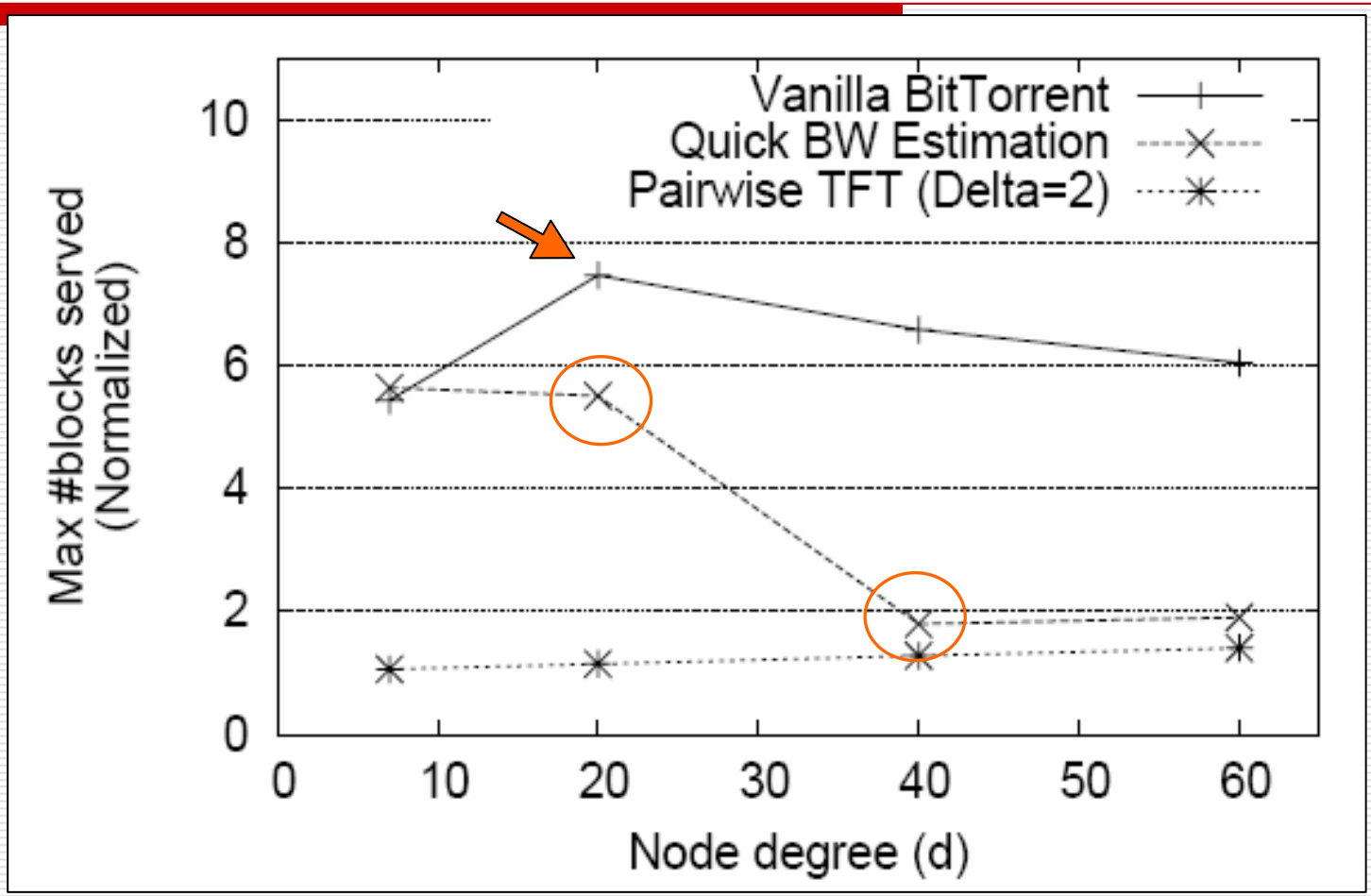


Figure 11

The problem is NOT match!!

Heterogeneous Environment (3)

+Bandwidth-matching tracker

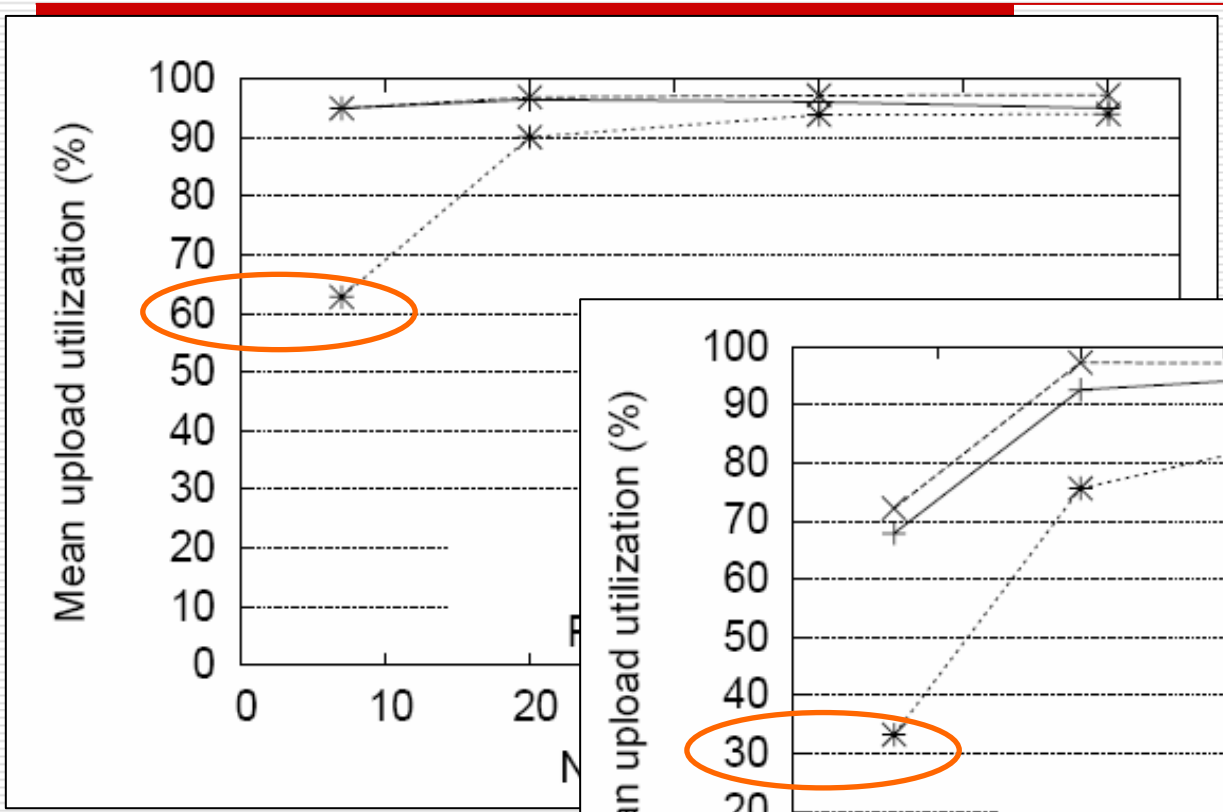
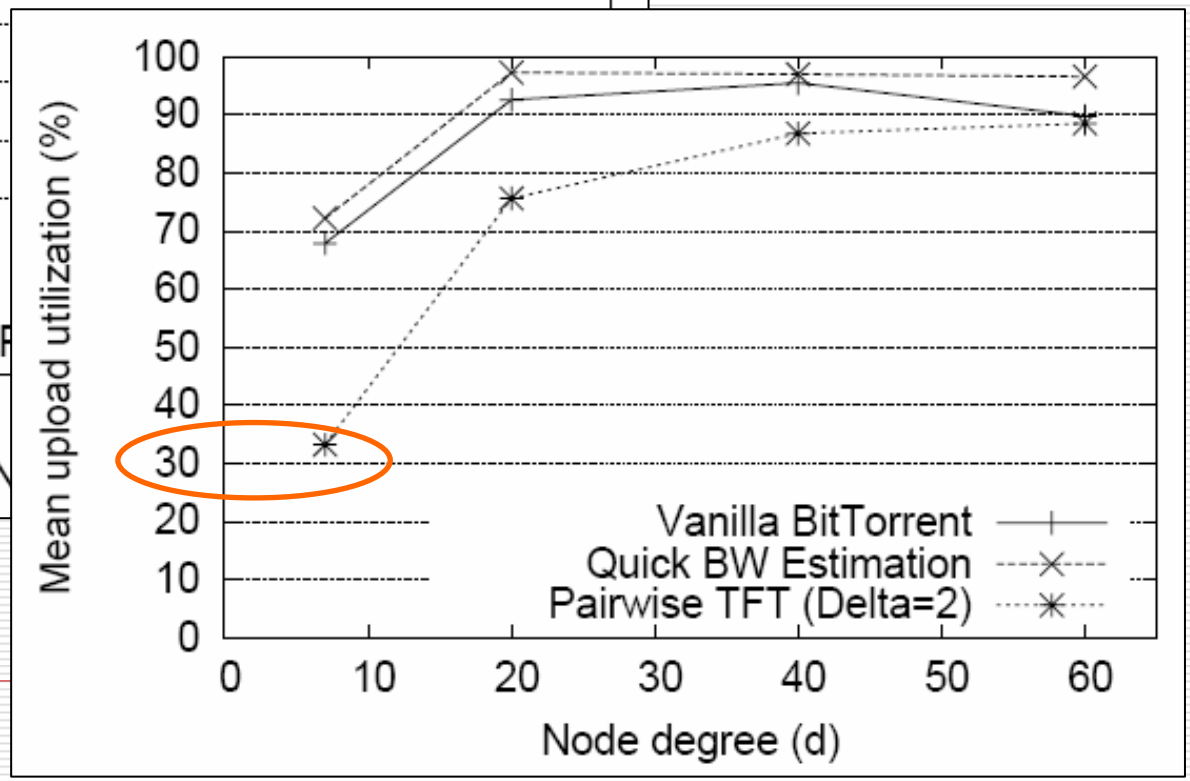


Figure 12

Figure 10



Heterogeneous Environment (4)

+Bandwidth-matching tracker

Figure 11

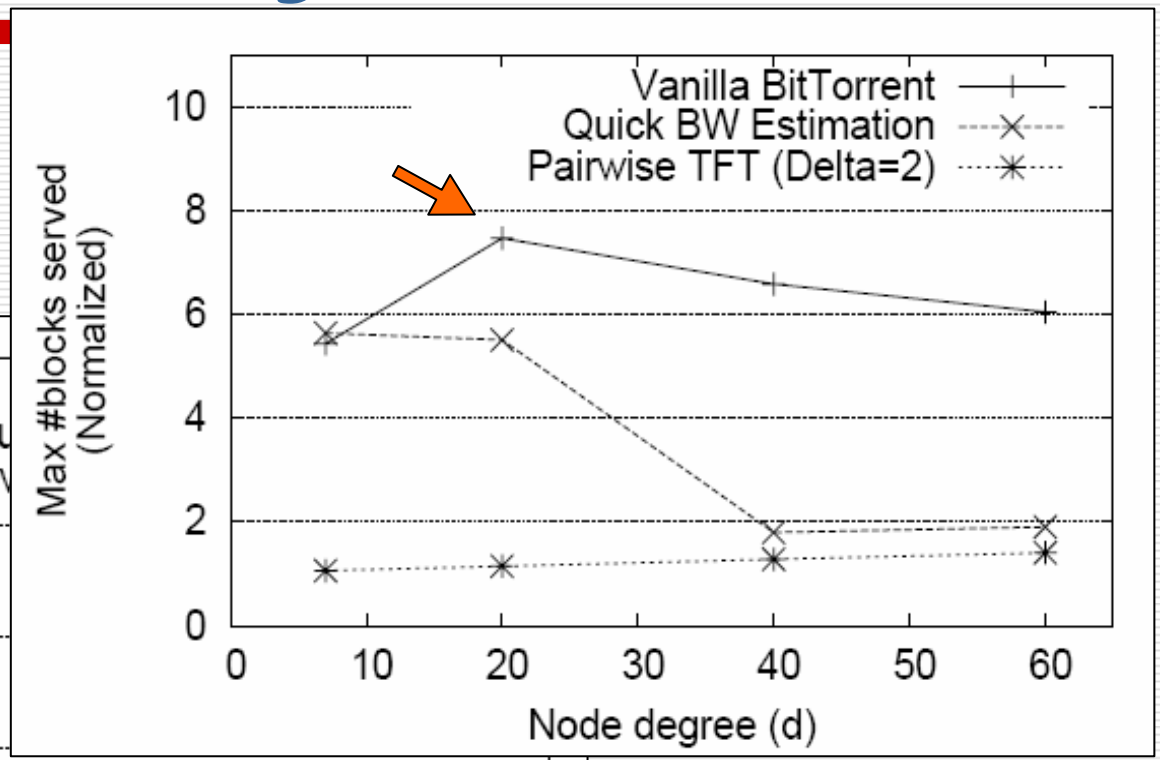
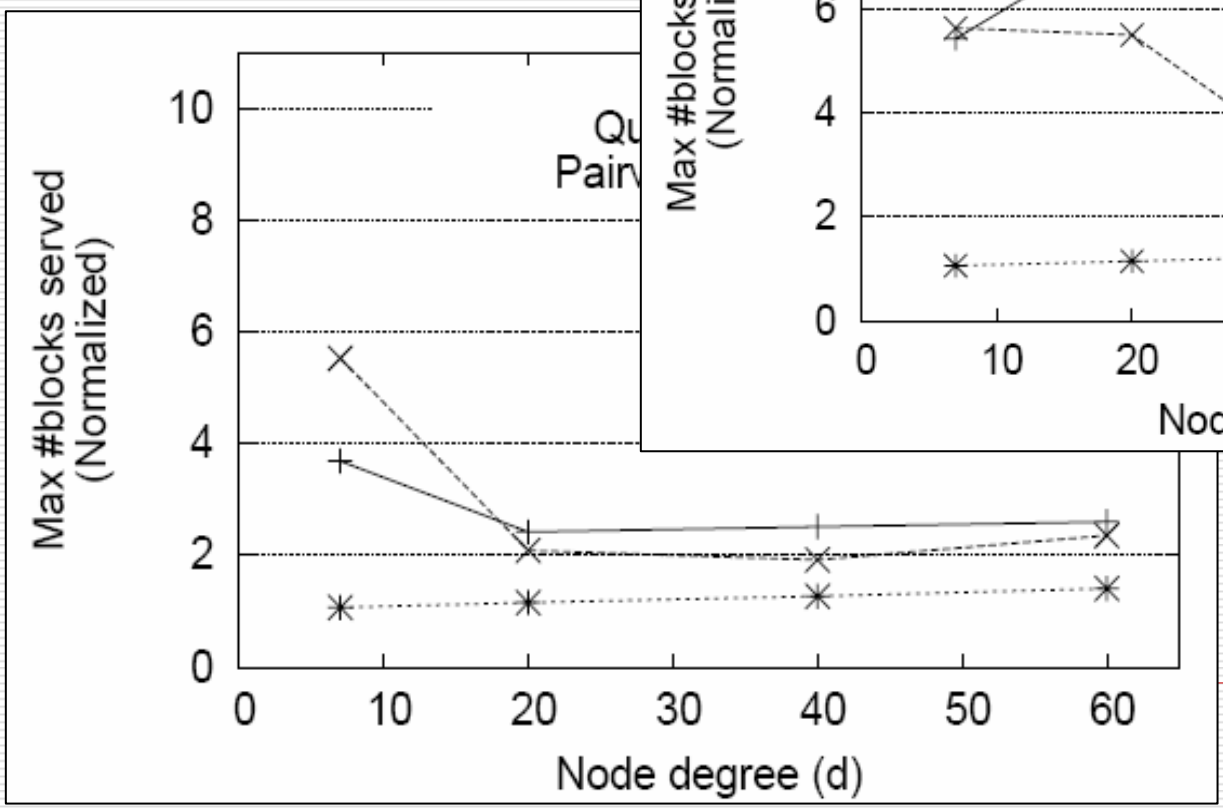


Figure 13



V. Conclusion

- Experiment results
- New ideas

Experiment results

- BitTorrent TFT policy is unfair ,especially when high BW peers connect low BW peers.
- Seed bandwidth is critical, and it should choose different blocks to serve.
- LRF policy is important for “last block” problem.

New ideas

- Smart Seed policy
- Quick Bandwidth Estimation
- Block-Level TFT
- Bandwidth-matching Tracker

VI. My Research

- Content diversity

Content diversity (Spread)

- Original BT
  - LRF
- This Paper
  - Smart Seed → only send once
- My Research
  - Plus a new message @ node

Reference

- Analyzing and Improving BitTorrent Performance
  - http://research.microsoft.com/~padmanab/papers/msr-tr-2005-03.pdf
- Some Observations on BitTorrent Performance
  - *SIGMETRICS'05*, June 6–10, 2005, Banff, Alberta,

    Canada.ACM 1-59593-022-1/05/0006.