Survey on BitTorrent

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Mnet Lab Meeting

Outline

- Introduction
- BitTorrent Overview
- Related four Papers
- Discussion
- Conclusion

Introduction

- Analyzing BitTorrent with parallel downloading procedure.
- Discussing problems, improvements and hot issues of BitTorrent according to papers.

BitTorrent Overview (1)

- Parallel downloading with P2P

Search
- **Search file**
- **Find peers who have the file**

Download
- **File splitting**
- **Peer selection**
- **Piece selection**

BitTorrent Overview (2)

Bram Cohen

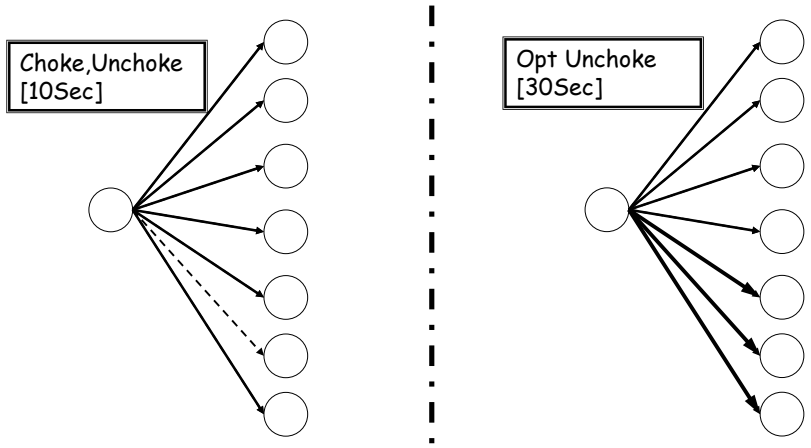
- BitTorrent core algorithm
  - **Search file** —**Search .torrent**
  - **Find peers who have the file** —**Tracker**
  - **File splitting** —**Make .torrent**
  - **Peer selection** —**Choke/Unchoke；Optimistic Unchoke**
  - **Piece selection** —**Rarest First**

BitTorrent Overview (3)

- Choke / Unchoke [10 sec]
  - Find better peers
    - High upload rate (using last 20 sec record)
    - Interested
- Optimistic unchoke [30 sec]
  - Find better peer outside
  - The probability of that new peer would be chosen as opt-unchoke peer is 3 times.

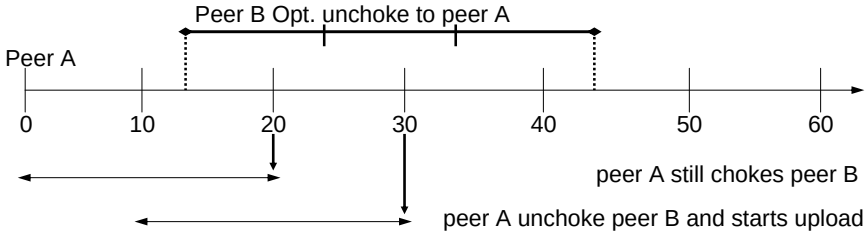
BitTorrent Overview (4)

Default： Unchoke 4+1 peer



BitTorrent Overview (5)

- A real case of tit-for-tat ： choosing the peer with better upload rate depend on the last 20 sec record.



After 30 sec , peer B's opt. unchoke is terminated ;however, peer B will judge whether choke or unchoke peer A at next Choke/Unchoke.

Related Papers (1)

Analyzing and Improving a BitTorrent Network's Performance Mechanisms , IEEE INFOCOM 2006

- Problems
  - Rate-based tit-for-tat causes Unfair.
  - Judge “Local Rarest First”
- Solution
  - Block-based tit-for-tat
  - Bandwidth-matching tracker
  - Smart Seeder – Seed serves unique blocks at first and ensure content diversity.

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

Smart Seeder effect

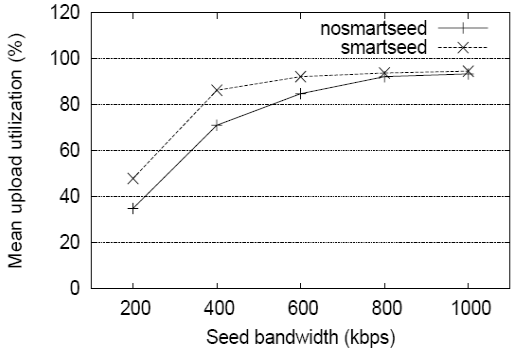
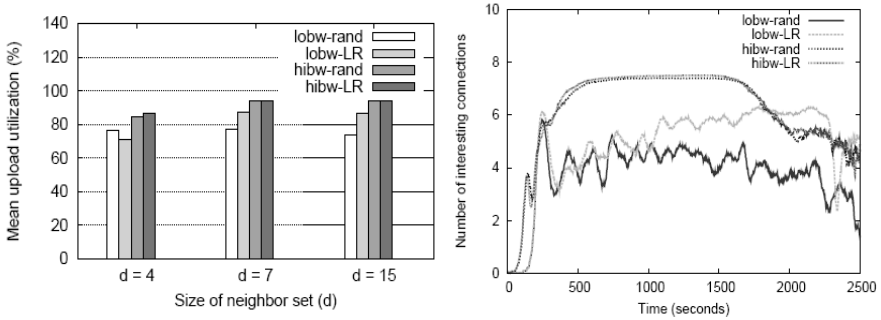


Figure 3: Upload utilization as the bandwidth of the seed is varied. By avoiding duplicate block transmissions from the seed, the “smartseed” policy improves utilization significantly.

L.R.F vs. Random (1)

Lobw-rand = Seed BW is **low**, and using **random** to select piece

LRF performs better only when the node degree is large and the seed bandwidth is low.

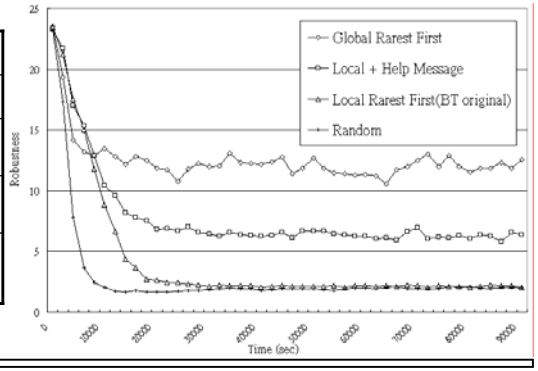


L.R.F vs. Random (2)

In dynamic environment, LRF and random are similar at Robustness.

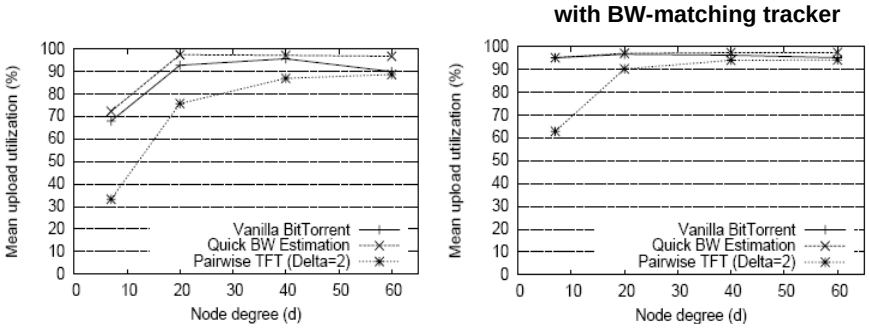
Robustness = the # of file copies with all peers’ combination.

Peer (1 seed)	50
file size	30MB
piece size	512KB
Poisson λ^{-1}	40
peer speed (KB/s)	4、8、32、64



Block –level tit-for-tat

Using block-TFT can achieve fairness but fail in performance; however, a bandwidth-matching tracker can address this problem.



Related Papers (2)

SODON: A High Availability Multi-Source Content Distribution Overlay, IEEE ICCCN.2004.

- Problems
  - Tracker load，tracker single point failure
  - Last block problem (availability)
- Solutions
  - SODON structure
  - Sub-tracker、Sub-seeder

SODON

- New role — Sub-Seeder
  - Duplicate seeder quickly
  - Sub-tracking
- New problems
  - Sub-Seeder selection
  - Pieces distribution over seed and sub-seeders

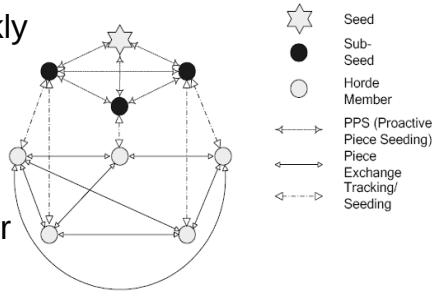
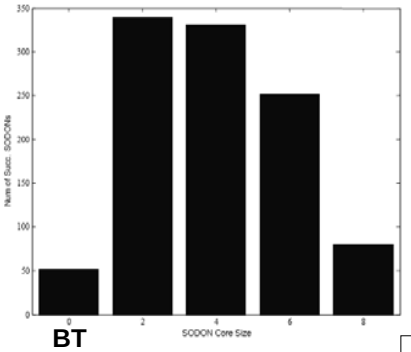


Figure 1 An example of SODON

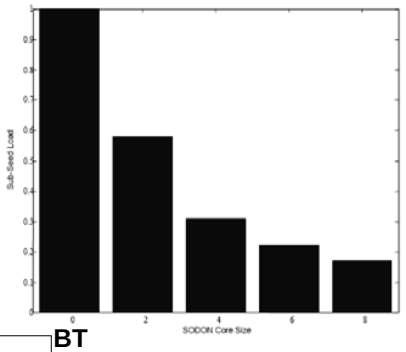
SODON – Simulation

- Improvement
  - Availability
  - Tracker load balance



BT

Figure 5 SODON availability



BT

Figure 6 Sub-tracking load balancing

Related Papers (3)

A Markov Model of a Freerider in a BitTorrent P2P Network , IEEE GLOBECOM 2005

- Problem
  - Freerider
  - Analyze freerider's behavior using a continuous time Markov Model.
- Result
  - According to Seeder's choke algorithm, freerider gets more benefits than cooperators because of the download rate of a freerider is higher than a normal peer.

Markov Model Result

$$k = n_1^{ods} + n_1^{odl} + n_1^{rs}$$

Freerider

$$\begin{cases} n_1^{ods} = 0 \\ n_1^{odl} = 1 \text{ (average)} \end{cases}$$

n_1^{ods} *The # of unchoke by peers*

n_1^{odl} *The # of opt-unchoke by peers*

n_1^{rs} *The # of unchoke by seeder*

A solution is to modify Seeder's choke algorithm, using a double ranking method.

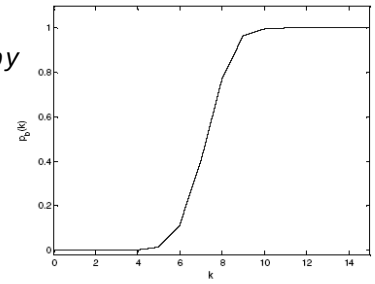


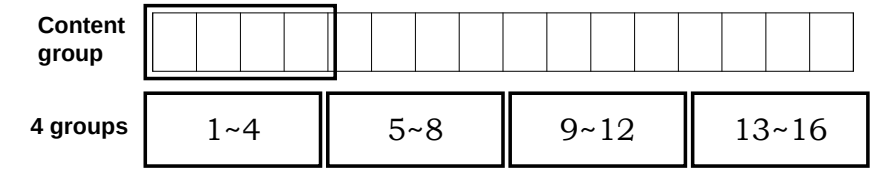
Figure 5. Probability of being choked by a seed (for $N=15$)

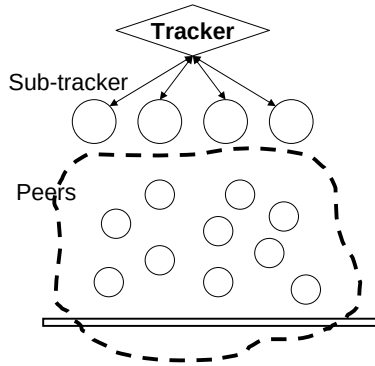
Related Papers (4)

Parallel Downloading Algorithm for Large-volume File Distribution, IEEE PDCAT 2005

- Problems
  - Tracker load
  - Change neighbor frequently
- Solutions
  - Content group
  - Magic Cube

Magic Cube





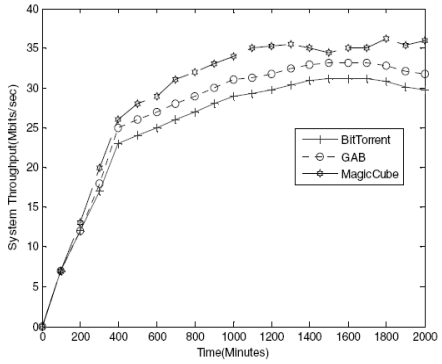
- Sub-tracker
  - Sharing tracker's load
  - Scheduling & report
- Sub-seeder
  - Peer who has whole pieces at a content group is called sub-seeder.
  - A peer could be multiple sub-seeders at the same time.

Magic Cube

- 3 Classes
  - 20% Class 1：10Mbps bi-direction
  - 50% Class 2：1.5Mbps ↓ 128kbps ↑
  - 30% Class 3：56kbps bi-direction
- Improvements
  - Reduce load of tracker
  - Keeping stable neighbor relation & reduce control message
  - Increasing system throughput

Average download complete time (min)

	BitTorrent	GAB	MagicCube
Class 1	43.78	44.70	43.82
Class 2	145.89	132.58	125.41
Class 3	3890.18	2909.47	2643.67



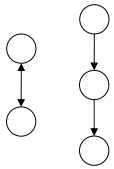
Discussion

M.S. = Microsoft INFOCOM 2006
SODON = SODON
M.C = Magic Cube
GLOBE = Markov Model

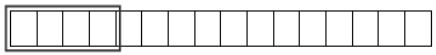
• **Search file**	
• **Find peers**	**M.S.：BW matching tracker** **SODON：Sub-tracker**
• **File splitting**	
• **Peer selection**	**SODON：Sub-seeder** **M.C：content group** **GLOBE：Seeder choke algo**
• **Piece selection**	**M.S：Smart seeder** **M.S：LRF vs. random** **M.C：content group、Sub-tracker schedule**

Conclusion

- Improving BT's performance
  - Scalability – Tracker
  - Availability – Last block problem
  - Increasing system output
  - Unfair、Free rider、 Incentive
- Streaming with BitTorrent
  - Peer selection



  - Piece selection
    - Content group



References:

- **[1]**B. Cohen, "Incentives build robustness in bittorrent," in Proc. First Workshop on Economics of Peer-to-Peer Systems, Berkeley, USA, June 2003.
- **[2]**Ashwin R. Bharambe Cormac Herley Venkata N. ,and Padmanabhan "Analyzing and Improving a BitTorrent Network's Performance Mechanisms" ,IEEE INFOCOM 2006
- **[3]**Pei Zheng , Chen Wang "SODON: A High Availability Multi-Source Content Distribution Overlay" , IEEE ICCCN.2004.
- **[4]**Mario Barbera, Alfio Lombardo, Giovanni Schembra and Mirco Tribastone "A Markov Model of a Freerider in a BitTorrent P2P Network" IEEE GLOBECOM 2005
- **[5]**Haitao Chen, Zhenghu Gong and Zunguo Huang "Parallel Downloading Algorithm for Large-volume File Distribution" , IEEE PDCAT 2005
- **[6]** S. G. M. Koo, C. S. G. Lee, and K. Kannan. A Genetic-Algorithm-Based Neighbor-Selection Strategy for Hybrid Peer-to-Peer Networks. (ICCCN'04), Chicago, IL, Oct 11-13, 2004, pp.469-474.