Increasing availability in BitTorrent system with “HELP” messages

Kun-Yo Lin
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Mnet Lab Meeting

Outline

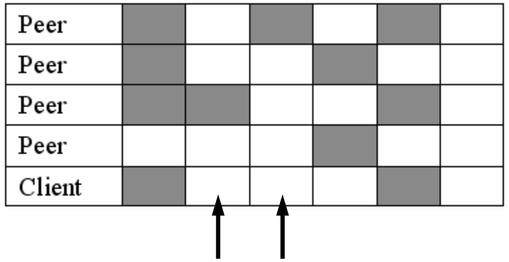
- □ Introduction
- □ BitTorrent Overview
- □ Problem Definition
- □ Related Work
- □ “HELP” mechanism
- □ Hierarchical BT with HELP
- □ Performance Simulation
- □ Conclusion

Introduction

- □ BitTorrent
  - ■ BitTorrent has received great attentions for file distribution p2p model.
  - ■ It was confronted with last block problem due to dynamics of peers.
- □ The HELP message
  - ■ This paper introduces the HELP mechanism that is adding a specific message to BitTorrent to address the problem.

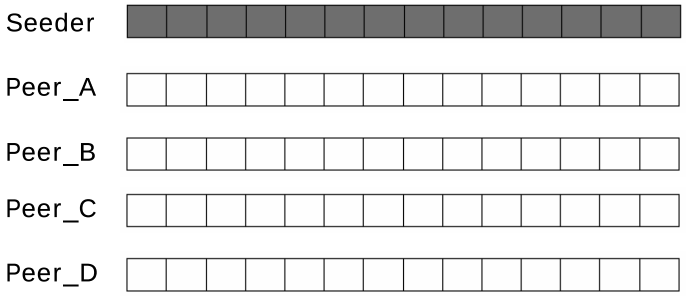
BitTorrent Overview

- □ Characteristics
  - ■ Tracker
  - ■ Seeder
  - ■ Peer
    - → Local group
- □ File distribution
  - ■ Cut the file into pieces
  - ■ Rarest First → Local Rarest First

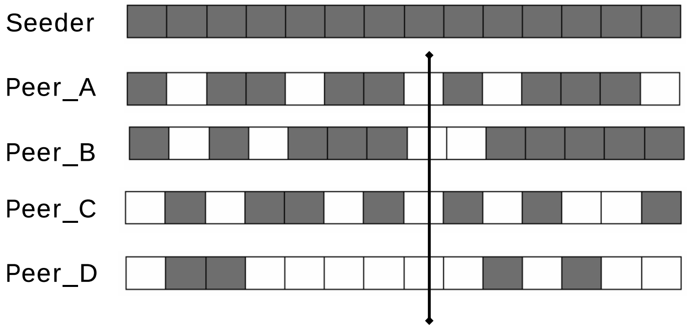


Peer	▨		▨		▨	
Peer	▨			▨		
Peer	▨	▨			▨	
Peer				▨		
Client	▨				▨	

Problem Definition
last block problem



Problem Definition
last block problem



Last block problem

Related Work

- □ Distribute pieces
  - ■ Local Rarest First [1]
  - ■ Smart Seeder [2]
- □ Stable seeders
  - ■ SODON [3]

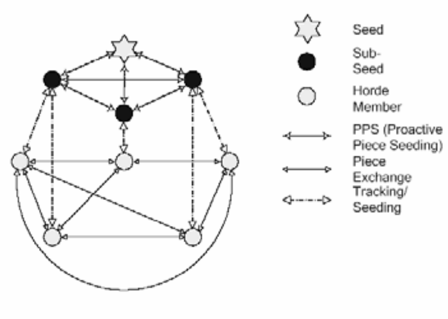


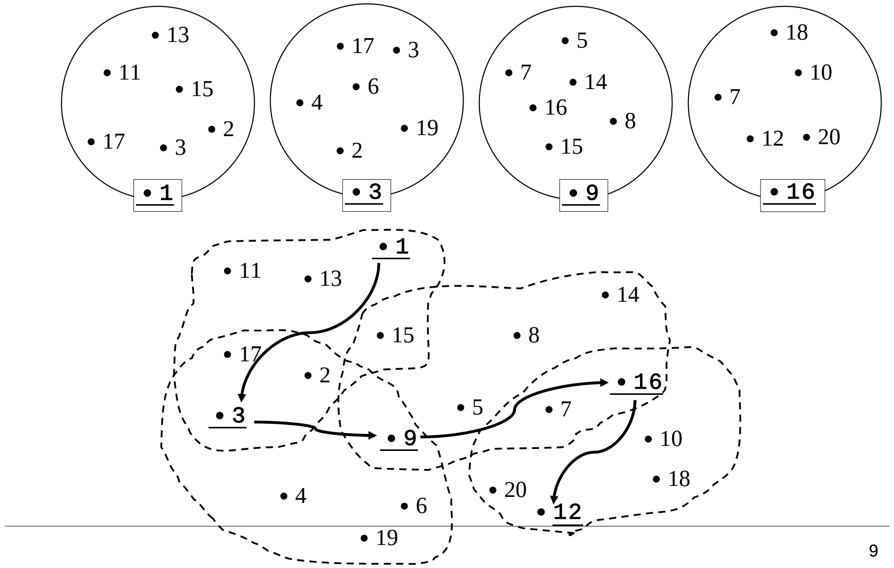
Figure 1 An example of SODON

"HELP" mechanism

Peer	▨		▨		▨	
Peer	▨			▨		
Peer	▨	▨			▨	
Peer				▨		
Client	▨				▨	↑

- □ Two steps of HELP mechanism
  - ■ Step 1：Send out a HELP message
  - ■ Step 2：Retrieve the rare piece

A simple example of a HELP message route



The problems might be caused by HELP messages

- □ Loop
  - ■ Attach the sender’s unique ID to HELP messages
- □ Endless
  - ■ Seeder(s) in network
    → HELP messages will pass to seeder(s) at last
  - ■ No Seeder
    → Cap the number of hops that HELP message passed
- □ Flooding with HELP messages
  - ■ Cap the number of active HELP messages sent by each peer

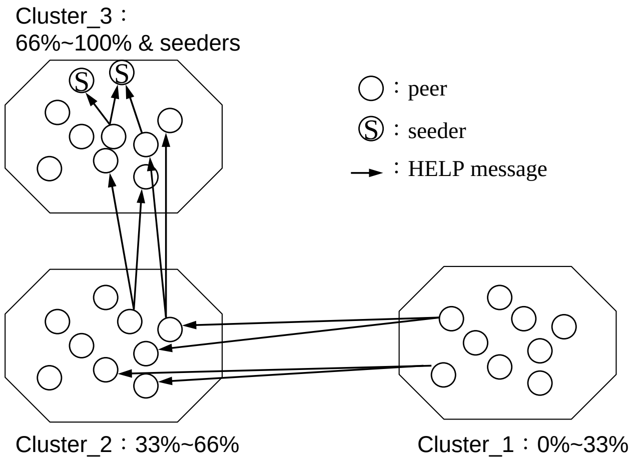
Active HELP messages

- □ When a peer sends out a HELP message, the message remains active before it receives the piece.
- □ How many active HELP messages should we limit?
- □ Step 2：retrieve the rare piece
  - ■ Share upload bandwidth to downloaders
  - → Share upload B.W. to (downloaders + HELP message sender)
  - ■ By the simulations, we found that concentrating on sending one rare piece is better than sending several.
  - ■ The amount of active HELP messages is capped at 2, and the two steps in HELP mechanism work like pipeline does.

Hierarchical BT with HELP message

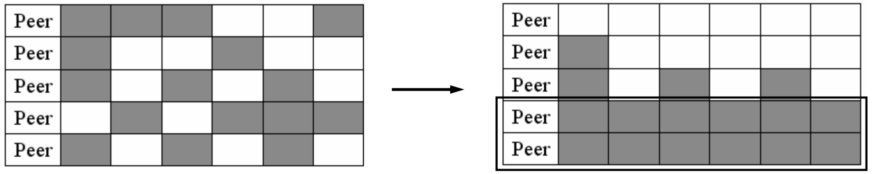
- □ Alternative solution to the problems caused by HELP messages
  - ■ Peers with similar completion percentage are assigned to the same cluster.
  - ■ Peers will send out HELP messages to the higher cluster.
  - ■ The structure addresses the loop and endless problems at the same time.

Hierarchical BT with HELP message



Performance Simulation

- □ Performance metrics
  - ■ Robustness



Peer	▨	▨	▨			▨
Peer	▨			▨		
Peer	▨		▨		▨	
Peer		▨		▨	▨	▨
Peer	▨		▨		▨	

→

Peer						
Peer	▨					
Peer	▨		▨		▨	
Peer	▨	▨	▨	▨	▨	▨
Peer	▨	▨	▨	▨	▨	▨

Robustness = 2 + 3/6 =2.5

  - ■ Number of seeders

Performance Simulation

- □ Algorithms
  - ■ Global rarest first
  - ■ Local rarest first
  - ■ Random
  - ■ Local rarest first + HELP messages
  - ■ Hierarchical BT + HELP messages

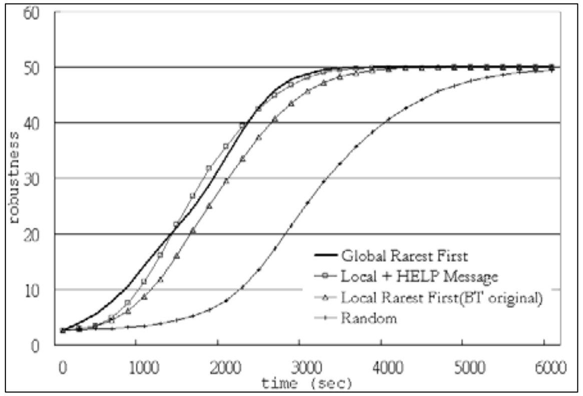
Performance Simulation

- □ Simulation environment

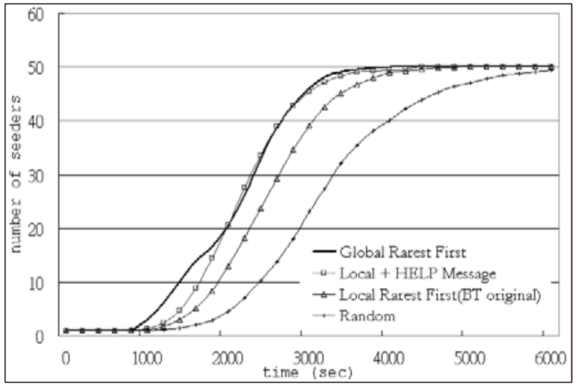
Number of Peers (with 1 seeder)	50
Number of Downloader	4
File Size	50MB
Piece Size	512KB
Upload Speeds of Peers	4、8、32、64 (KB/sec)
Speed Variation	95% ~ 105%

- □ 3 parts
  - ■ Static environment
  - ■ Dynamic environment
  - ■ Overhead and Hierarchical BT structure

Static environment：robustness



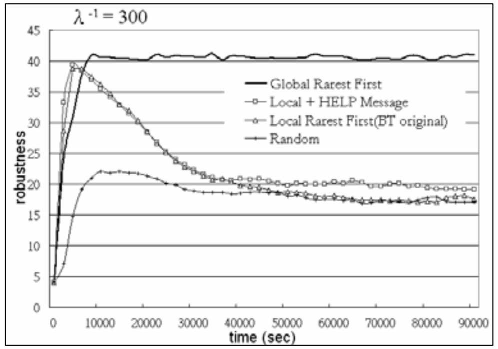
Static environment：Number of seeders

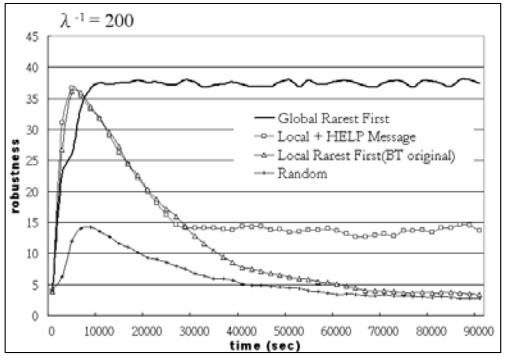


Dynamic environment

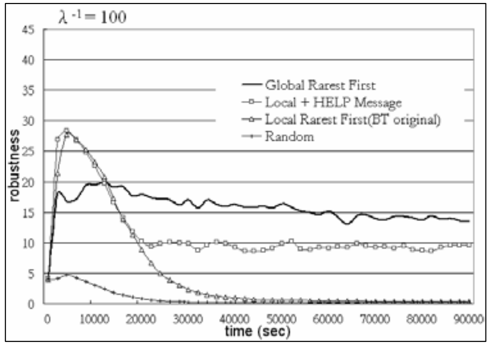
□The event of dynamic

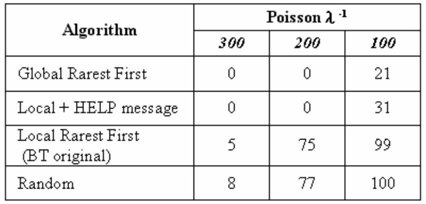
- The event that a peer leaves and a new peer joins is set to follow the poisson arrival process.





Dynamic environment

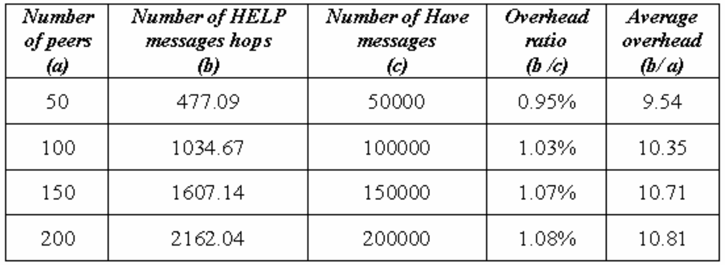




Algorithm	Poisson λ^{-1}		
	300	200	100
Global Rarest First	0	0	21
Local + HELP message	0	0	31
Local Rarest First (BT original)	5	75	99
Random	8	77	100

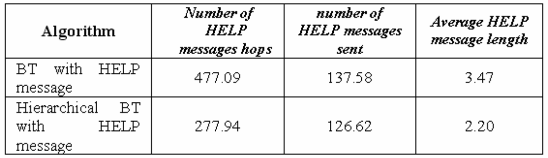
Overhead table

- We increase the number of peers to simulate the overhead at different environment.
- HAVE message
  - A peer will broadcast a HAVE message to its local group when it gets a new piece.
  - The number of HAVE messages will be
    peers number * pieces number * local group size
    ex. 50 peers，50MB file → 50 * 100 * 10 = 50000

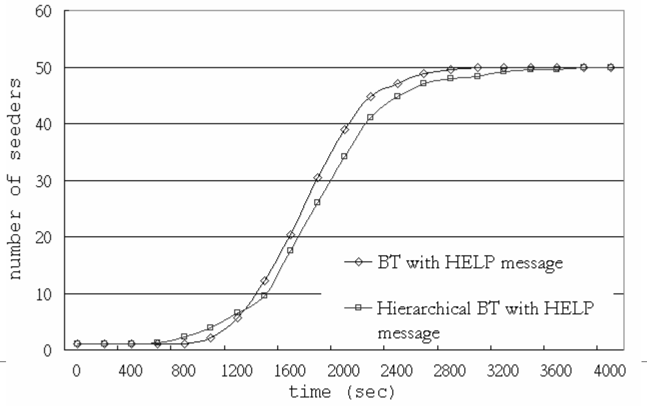


Number of peers (a)	*Number of HELP messages hops (b)*	*Number of Have messages (c)*	*Overhead ratio (b /c)*	*Average overhead (b/ a)*
50	477.09	50000	0.95%	9.54
100	1034.67	100000	1.03%	10.35
150	1607.14	150000	1.07%	10.71
200	2162.04	200000	1.08%	10.81

Hierarchical BT



Algorithm	*Number of HELP messages hops*	*number of HELP messages sent*	*Average HELP message length*
BT with HELP message	477.09	137.58	3.47
Hierarchical BT with HELP message	277.94	126.62	2.20



Conclusion

- A new HELP message mechanism is proposed in this paper.
- It enhances the efficiency of BitTorrent at static environment and reduces the occurrences of the last block problem at dynamic environment.
- Hierarchical BitTorrent structure not only successfully mitigates the overhead, but also speeds up the growth of a peer into a seeder.

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