香港浸會大學
HONG KONG BAPTIST UNIVERSITY

HKBU Scholars

DOCTORAL THESIS

Measurement, analysis and improvement of BitTorrent Darknets

Chen, Xiaowei

Date of Award:
2013

Link to publication

General rights
Copyright and intellectual property rights for the publications made accessible in HKBU Scholars are retained by the authors and/or other copyright owners. In addition to the restrictions prescribed by the Copyright Ordinance of Hong Kong, all users and readers must also observe the following terms of use:

- Users may download and print one copy of any publication from HKBU Scholars for the purpose of private study or research
- Users cannot further distribute the material or use it for any profit-making activity or commercial gain
- To share publications in HKBU Scholars with others, users are welcome to freely distribute the permanent URL assigned to the publication

Download date: 20 Apr, 2024

Measurement, Analysis and Improvement of BitTorrent Darknets

CHEN Xiaowei

A thesis submitted in partial fulfillment of the requirements

for the degree of

Doctor of Philosophy

Principal Supervisor: Dr. CHU Xiao Wen

Hong Kong Baptist University

April 2013

Abstract

BitTorrent changes the content distribution method from traditional client/server to Peer-to-Peer (P2P). Tracker plays an important role as the core components in BitTorrent protocol. BitTorrent tracker sites can be divided into two categories, public tracker sites and private tracker sites. The latter sites are known as BitTorrent Darknets or PTs. It is well known that public trackers suffer from free-riding problem, which cannot be tackled indeed by Tit-for-Tat (TFT) mechanism. Because users have neither motivation to continue uploading after he finishes downloading the contents; nor is he motivated to set a high uploading bandwidth limit. However, users in BitTorrent Darknets can easily achieve high downloading performance by deploying of Sharing Ratio Enforcement (SRE) incentive mechanism and possible Credit/Point system. For this reason, many users eager to join these communities which are operated underground and seldom open for registration. Therefore, there are limited studies in this field. This thesis revolves around three core aspects (i) measurement, (ii) analysis and (iii) improvement of BitTorrent Darknets.

In the area of measurement, we conducted a number of measurement studies to reveal fundamental characteristics of the popular private BitTorrent communities. We have traced 17 Darknets, 2 public trackers, 1 BitTorrent search engine from September 28, 2009 to Feb 28, 2011, and have obtained 35 datasets that cover over 5 million torrents. The measurement results cover community-level and torrent-level, including traffic, sites, torrents, users, contents, etc., which depict the whole ecosystem of BitTorrent Darknets from macro-scope to micro-scope.

In the area of analysis and modeling, on the one hand, we study the traffic of Darknets, the SRE mechanism and unravel the success of Darknet by the theoretical model. On the other hand, we find the negative effects caused by SRE mechanism, which are “Poor Downloading Motivation” problem caused by imbalanced resources supply and demand. This problem will do harm to new members and those who want to increase their sharing ratios to survive in Darknets. Afterwards, members will lose the motivation to download gradually.

In the area of improvement, we propose several models to analyze and improve the SRE incentive mechanism. We adopt the Predator-Prey model to analyze the high Seeder-to-Leecher Ratio (SLR) phenomenon and study the optimal stable SLR range ([1.67..1.73]) to guarantee Darknets sustainable development. We develop queuing model to simulate the seeding/leeching process, and use it to achieve maximized swarming performance with minimum seeding peers. Moreover, we propose a two-track payment system that is fairly consistent for paying users. It is a unified system which combines the advantages of SRE mechanism and Credit/Point system, which can improve the system balance. At last, we propose a SepRep reputation model which enables peers to calculate reputation values of other peers, and then we improve the SepRep model by utilizing the tracker of BitTorrent to increase the user cooperation, Experimental results shows it is feasible and effective in Darknets.

Our studies provide a comprehensive inside picture about Darknets, explain the impact of SRE incentive mechanisms with auxiliary systems in Darknets, and improve Darknets to tackle problems rooted from existing mechanisms. These contributions have some reference for establishing fairer and more effective incentive mechanisms for other P2P systems.

Table of Contents