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## Master Thesis: “Adaptive BitThief”

This document describes the subject and the general time schedule of Christian Decker’s master thesis in the autumn 2011. Adaptations or changes can be agreed upon by the advisers.

### Subject

As pure peer-to-peer (p2p) systems are completely decentralized, and resources are shared directly between participating peers, all p2p systems potentially suffer from free riders, i.e. peers that eagerly consume resources without reciprocating in any way. Not only do free riders diminish the quality of service for other peers, but they also threaten the existence of the entire system. For that reason, it is crucial for any system without centralized control to incorporate a rigorous incentive mechanism that renders freeloading evidently unattractive to selfish peers. Unfortunately, many solutions so far either could easily be fooled or were unrealistically complex. Bram Cohen’s BitTorrent protocol heralded a paradigm shift as it demonstrated that cooperation can be fostered among peers interested in the same file, and that concentrating on one file is often enough in practice. The fair sharing mechanism of BitTorrent is widely believed to strongly discourage freeloading behavior. However, several projects have shown that not only can selfish clients achieve a disproportionately high download rate (e.g. BitTyrant), but the BitTorrent protocol permits completely free riding clients (e.g. BitThief), which download without uploading any data in return. The BitThief client, developed at our research group, was implemented as proof of concept to show that freeloading is possible in BitTorrent. However, from a selfish user’s point of view, BitThief may not be the best strategy within the BitTorrent system as uploading some data might boost the download rate. Depending on the user’s preference, there are several reasonable optimization objectives for a selfish client to implement. For instance, a user might want to maximize the download rate regardless of the upload rate, or she might want to maximize the ratio between download and upload rate, or she might want to set a threshold on the upload rate and maximize the download rate without exceeding the threshold.

The task of this thesis is to explore further possibilities of increasing BitThiefs efficiency, and to eventually offer its users the possibility to download torrents at their preferred download vs. upload profile. By conducting measurements in live torrent swarms and/or by doing simulations in closed lab conditions, Christian should study the behavior of existing clients, and develop both, exploits that are specific to a certain client as well as utmost selfish mechanisms that perform as well as possible against any imaginable client. This might include techniques like adapting to the features found in a particular swarm, forging file blocks, disguising as other clients etc. In essence, the resulting client should most efficiently implement the desired optimizations. In particular, it should provably outperform any other BitTorrent client if the optimization mode is to maximize the download rate.

## Outline of Work Plan

- Study the BitTorrent protocol, and the architecture of the BitThief client by implementing UDP support for the tracker protocol.
- Investigate policies employed by other selfish clients like BitTyrant, and search existing research work for other exploits.
- With pen and paper, define reasonable optimization goals, and come up with mechanisms that might be suitable.
- Set up measurement and/or simulation environments to study the behavior of existing clients.
- Implement general and client-specific exploits, evaluate and refine them. Potentially, propose and evaluate additional mechanisms.
- Integrate the most successful mechanisms into BitThief.
- Discuss implications of the introduction of such adaptive selfish clients to the BitTorrent system.
- Write the report, and prepare the final presentation.

## Duties of the Student

- Regular meetings with the advisers. Ideally, there will be a meeting every week, but the frequency of meetings can be adapted.
- There will be one mid-term presentation given by the student in front of the research group after roughly two months, and one final presentation at the end of the thesis.
- The student will have to write a short summary of his progress at the end of each month (“Monthly Report”).
- Finally, the student has to write a report (English or German), presenting his work and results. This report should also include a critical review of the work.

## General

- Independent working is expected.
- A possibility to work in our building (ETZ) is provided. It is also possible to work at home.

## Contacts/Advisers

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