

# Perceptions & Use of BitTorrent P2P File Sharing by Dartmouth College Students\*

Alex Gerstein  
Dartmouth College  
Computer Science, Film Studies  
`alex.gerstein@dartmouth.edu`

Scott Gladstone  
Dartmouth College  
Computer Science, Economics  
`scott.gladstone@dartmouth.edu`

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## Abstract

In our final project, we hope to investigate peer-to-peer (P2P) file sharing network protocols, specifically those related to torrenting (BitTorrent). After a general overview of the system and security flaws present, we plan to examine P2P in the context of Dartmouth College. By surveying students and speaking to Dartmouth College Computing Services, we hope to understand the disparity between the perception and actual use by students of torrent networks. If available, we also hope to obtain and analyze data from the College on student bandwidth habits, download frequencies, or other metrics that the College records. The outline below summarizes the questions we hope to answer and the individuals we hope to speak with.

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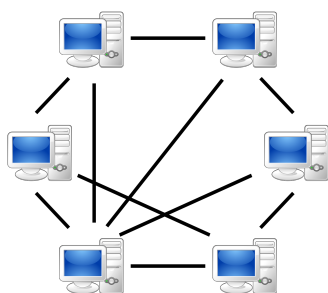
\*This paper constitutes the final project for the Fall 2013 iteration of CS 55: Security and Privacy, taught by Charles C. Palmer, Adjunct Professor of Computer Science, Dartmouth College; CTO Security and Privacy, IBM Research.

# 1 Introduction

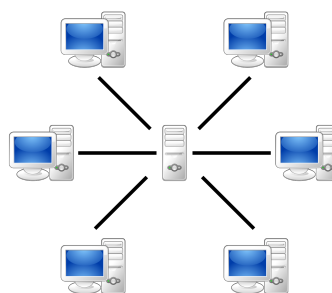
BitTorrent is a protocol supporting peer-to-peer (P2P) file sharing that facilitates the distribution of large data files over the Internet.<sup>1</sup> BitTorrent is one of the most common protocols for transferring large files and is often used for distribution of very popular files and files available for free, such as literary texts, audio files, movies, and applications. “Torrenting” is the process by which a user engages with a BitTorrent client in order to send and receive those desired files. To understand the uniqueness – and security implications – of the BitTorrent protocol, one must first develop a working understanding of P2P file sharing. From there, the legal implications of P2P file sharing and BitTorrent can be made clear. With this foundation, the authors then describe a study in which data about student perceptions of torrenting at Dartmouth College are compared with data collected by Dartmouth College network administrators describing student incidences of torrenting. Conclusion and policy recommendations are then made with the goal of aligning student perceptions and administrative desires.

## 1.1 Peer-to-Peer (P2P) File Sharing

According to one Internet dictionary, P2P is a “type of Internet network that allows users with the same program to connect with each other and access files on one another’s hard drives without the intervention of a server computer.”<sup>2</sup> This decentralized network architecture consists of individual nodes called *peers* that act as both suppliers and consumers of resources. In P2P networks, tasks are shared among multiple, interconnected peers who each make a portion of their resources – processing power, disk storage, or network bandwidth – available to all network participants, without the centralized coordination of a server-client model.<sup>3</sup> A comparison of a decentralized-P2P network and a centralized server-based network are presented in Figure 1 and Figure 2 below.



**Figure 1:** A peer-to-peer (P2P) network with interconnected nodes (“peers”) sharing resources. Source: Wikipedia.



**Figure 2:** A client-server model network, where individual clients request services from centralized servers. Source: Wikipedia.

P2P networks are often found in residential home networks, allowing users to configure their computers in peer workgroups to allow sharing of files, printers, and other resources among all devices; with a number of computers running similar network protocols, P2P is a convenient way to access shared resources.<sup>4</sup> However, the term “P2P” used today generally does not refer to the network architecture from which its name is derived, but to P2P file sharing systems. Using P2P software applications such as Napster or Kazaa, users are able to search for, transfer, and download data files over the Internet with any user on the same P2P file sharing network. The implications of such a system were huge: if *any* user on the system had a file that another user demanded, the second user could – via the network – obtain the file. The second user would then also be a source of the file in the P2P network, making it faster and easier for more users to download the files.

The first P2P file sharing networks, such as the purely-mp3 sharing network Napster, relied on a central index server to assist with the transfer of files. When someone searched for a file, the central index server – which contained an index of all of the users and their shared content – searched for all available copies of the file and presented them to the user; the file would then be transferred directly between the two private computers.<sup>5</sup> Because the file sharing occurred over a central network, Napster was held liable for copyright infringement over the sharing of mp3 files and was shut down in 2001.<sup>6</sup> New protocols such as BitTorrent represent a technological evolution of P2P file sharing networks.

## 1.2 BitTorrent Protocol

BitTorrent is a P2P file sharing protocol that makes use of unique design to reduce the bandwidth and download time for more frequently requested data. The protocol allows a single user to download files quickly by allowing users to join a “swarm” of hosts to download and upload from each other simultaneously. Thus, instead of attempting to transfer a large file from one user to another like other P2P network protocols – a slow, bandwidth-intensive process –, BitTorrent allows a user to download small segments of the file from a variety of users, significantly reducing computational energy and download time.<sup>1</sup> Because of this design, BitTorrent is often used for distribution of very large files, very popular files, and files available for free, as it is more efficient to distribute these files using BitTorrent than a regular download.

When a user “torrents” a file, meaning that the user is attempting to download a file over a P2P network using a BitTorrent client implementing the BitTorrent protocol, they begin by loading a .torrent file into a BitTorrent client. A .torrent file is a computer file that contains metadata about files to be distributed, including file names, sizes, checksums of all individual pieces, and a list of the network locations of “trackers” – a server that facilitates communication between peers on a P2P network – to help participants in the system seeking to download the same data find one another.<sup>7</sup> The tracker shares the peers’ IP addresses with other BitTorrent clients in the “swarm,” the group of all peers sharing a torrent.

Once connected, a BitTorrent client downloads bits of the files specified in the torrent in small pieces, downloading different segments from data from different computers in the

swarm. Once the BitTorrent client has some data, it can then begin to upload that data to other BitTorrent clients in the swarm; by using both downloading and uploading bandwidth and dividing the files into pieces, the time required to download the file is significantly reduces.<sup>1</sup> Thus, it is worth noting the following concept: “Everyone downloading a torrent is also uploading the same torrent. If 10,000 people are downloading the same file, it doesn’t put a lot of stress on a central server. Instead, each downloader contributes upload bandwidth to other downloaders, ensuring the torrent stays fast,”.<sup>7</sup> From this protocol, clients never actually download files from the tracker itself; the tracker keeps track of the clients connected in the swarm, but does not actually participate in the process of downloading or uploading data.<sup>7</sup>

The process of sharing data via BitTorrent starts with a *seed*, or the initial machine possession 100% of the data. Then *leechers*, also known as *downloaders*, which refers to peers that do not have the entire file or are in the process of downloading the file. As the number of downloaders increases, the reliance of new leechers on old leechers decreases, as each successful downloader becomes a source of the file for future downloaders.<sup>8</sup> From that point, the process repeats and continues, allowing peers on the network to share any and all files to which any other peer has access.

### 1.3 BitTorrent Security Concerns

What are security issues related to using BitTorrent? torrent poisoning (wiki)

## 2 Legal Issues

Torrenting is not inherently illegal.

### 2.1 Copyright Law Violations

What are the legal implications for an individual user for torrenting copyrighted information?

### 2.2 Dartmouth College Copyright Policy

What are the legal implications for a university like Dartmouth with students that do illegal torrenting? What are some past cases and punishments relating to torrenting?

## References

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- <sup>7</sup> <http://www.howtogeek.com/141257/htg-explains-how-does-bittorrent-work/>
- <sup>8</sup> [http://en.wikipedia.org/wiki/Glossary\\_of\\_BitTorrent\\_terms#Leech](http://en.wikipedia.org/wiki/Glossary_of_BitTorrent_terms#Leech)

\*\* statistics on P2P we may want to use: <http://www.ipoque.com/sites/default/files/mediafiles/documentstudy-2008-2009.pdf>