7200 Revolutions per Minute:
An Economic Analysis of the Struggle between the
Recording Industry and Peer-to-Peer File Sharing Networks

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May 2005

Abstract
Peer-to-peer networking is poised to revolutionize content distribution, at the expense of incumbent industries. This paper focuses on the nature of the struggle between the Recording Industry of America (RIAA) and several file sharing networks. Although filing lawsuits against individual users was a well-publicized strategy, the intentional destabilization of these networks has been the RIAA's most successful type of intervention. Several factors suggest that the industry will ultimately fail to contain this new technology and adapt to a new paradigm.

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1. Introduction

The Internet, introduced to the world in a wave of enthusiasm bordering on mania, once promised to change everything. Years later, it seems as if little has changed. People still read newspapers, frequent shopping malls, and go bowling.[1] True, some industries have adapted better than others, and a few may be on the decline. But there are few examples of the profound, revolutionary upheaval that had once been so eagerly anticipated.

Soon this will no longer be true. The entertainment industry, having long relied on an insular oligopoly of content distributors, is facing certain upheaval in the digital age. We are witnessing what economist Joseph Schumpeter once called "the process of creative destruction". In the shift from physical to virtual distribution, there lies a dramatic realignment of economic power, and the seeds of a renaissance for consumers of culture.

The Internet, at its core a hyper-efficient delivery mechanism, is already beginning to replace a complex and entrenched distribution network that was once a lucrative source of revenue. To listen to the popular press, it would seem as if college students are leading the charge, and that angry press releases and numerous lawsuits are the weapons of choice for an industry struggling to fight back. But this is not simply a case of "Hackers versus Hollywood". If we are witnessing an economic earthquake, let us understand the forces moving underneath.

In this paper, I explore the design and evolution of *peer-to-peer networks* (abbreviated "P2P"), the underlying mechanism for almost all file-sharing systems in use today. While P2P is a remarkably robust distribution architecture, it shares similar weaknesses to other arrangements in which there is no central authority or market mechanism to regulate the behavior of participants. Newer generations of P2P software address these problems with creative and elegant solutions.

I then turn my attention to the accusations of harm made by the recording industry. Music, with its high elasticity of demand and nearly seamless integration with computing technology, has been the content of choice on file sharing networks until very recently. Although many believe that this exposure must be responsible for declining music sales, it is not necessarily true. After a survey of the academic and research literature surrounding the debate, I conclude that whatever the cause, the focus on lost sales is shortsighted and misplaced. I then identify other mechanisms in which file sharing creates a hostile atmosphere for traditional content distribution.

In response to these threats, the recording industry has filed lawsuits against P2P software developers and users, and has attempted to destabilize these networks through technological means. These efforts have had varying success, and I evaluate each based on data I have compiled from a range of sources. I then discuss the industry's current litigation effort, *Metro-Goldwyn-Mayer Studios v. Grokster*, and its implications for the future of digital distribution.

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[1] Apologies to Robert Putnam.

The Internet was not designed to respect national boundaries, and this has a profound effect on the use of file sharing networks. I explain the ways in which national authority is limited, and illustrate some dramatic examples of how this limitation been exploited. The international nature of file sharing is essential to the current debate and yet too often ignored.

Finally, I present a theoretical framework to interpret the impact of file sharing on copyright law. Copyright is not an absolute set of rights, but an attempt to balance the needs of authors and society. As the nature of created works, their distribution, and their consumption change, so too must the balance of copyright.

It should be noted that while performing this analysis I have tried to avoid making moral judgments on the actors involved. The unauthorized distribution of copyrighted work may be sharing or stealing in the eyes of the reader; I hope the following is enlightening given either interpretation.

2.   Peer-to-Peer Networking Explained

Just a few years ago, when the Internet was an unfamiliar concept to most, it was often referred to as the "World Wide Web" or the "Information Superhighway". These are two strikingly different metaphors. The former evokes an image of multitudes of computers, joined together by a network of connections, while the latter seems to describe a fast conduit designed to shuttle information from one point to another. Which is correct? In fact, both are accurate representations, for there are two dominant network architectures employed on the Internet today.

The "World Wide Web" is an apt description of the peer-to-peer model. This type of arrangement was once considered fundamental to any computer network, although it later lost favor to the *client-server* model – well described as an "Information Superhighway". In contrasting the two, it becomes evident why the client-server model has been dominant, and why we now see a return to peer-to-peer.

Network Architecture

Computers on a peer-to-peer network (called *peers* or *nodes*) are connected to each other in a web-like fashion. [Figure 1] Each peer requests data (acting as a *client*) and provides data (acting as a *server*). The most distinctive aspect of this design is that it is completely decentralized, with no hierarchy among the computers on the network. In addition, there are several layers of communication connecting each machine. This architecture allows for the failure (or removal) of any peer with minimal disruption to the network.

Figure 1: A Peer-to-Peer Network
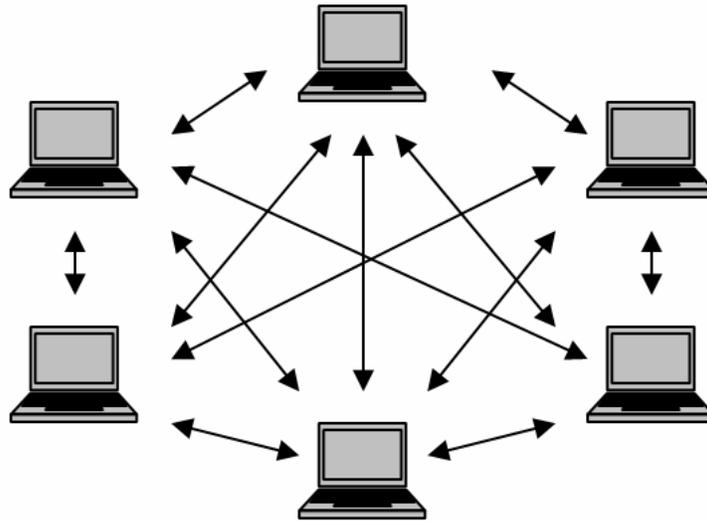
The Internet, as designed, is essentially a public peer-to-peer network.[2] As its use shifted from military and research applications to consumer use, this was to change. Personal computers did not have the storage or processing power to act as servers. In extending the network infrastructure through phone lines, bandwidth became limited and relatively expensive. The only feasible arrangement was to reorganize the network around fast, dedicated central servers, and configure less powerful machines to act as clients. [Figure 2]

Figure 2: A Client-Server Network
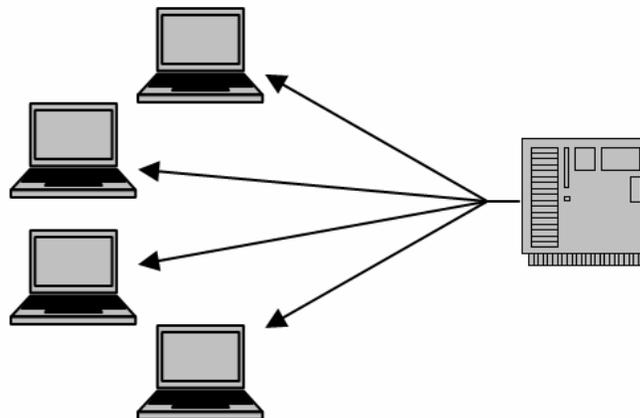
Thanks to rapid advances in computer technology, particularly in recent years, personal computers are more powerful and inexpensive than ever imagined. Bandwidth, too, is

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[2] Indeed, the Internet was "born" in April 1969, when a proposal was made to standardize P2P communication.

increasingly abundant and affordable. Furthermore, as the nature of computing is oriented towards short, intensive tasks (e.g. starting a program, or downloading a file), these resources often sit idle. Almost every computer in use today has surplus resources that can be used to share data with peers on a network. In this environment, the client-server model begins to lose its appeal, especially when contrasted with the advantages of a peer-to-peer network.

Strengths of the P2P Model

Efficiency

A peer-to-peer network is an example of *distributed computing*, in which several machines collaborate on a single task. The old adage "many hands make light work" is particularly relevant here. P2P efficiently taps the resources of the entire computing ecology, including bandwidth, processing power, and storage space.

Economy

A dedicated server, designed to communicate with many clients simultaneously, must be equipped with a network connection that is capable of handling a massive amount of data. Bandwidth costs are typically based on the amount of data sent in a given time period, and are the responsibility of the distributor. This arrangement is problematic in that costs are incurred each time a file is distributed, even if to the same client. For larger files, the financial burden can become prohibitive.

The peer-to-peer model shares the burden of transmission among those that request the file. A broadband connection typically has separate capacities for downloading and uploading. Newer P2P systems are designed so that as users download a file, they simultaneously make the downloaded portion available to others. By utilizing peer bandwidth that would otherwise remain idle, less demand is placed on the original distributor. This enables communication that might not otherwise exist. For example, one public interest site was able to distribute 150 GB of content while only serving 1.26 GB, for just 0.8% of the cost of client-server distribution.[3]

Scalability

In a client-server network, each client can be thought of as a liability for the server. Should the ratio of clients to servers become disproportionate (caused by, for example, sudden interest in a particular file), the ensuing bottleneck can slow all data transfer to a halt.[4]

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[3] Supreme Court Brief for Creative Commons as *Amicus Curiae* in Support of Respondents, Metro-Goldwyn-Mayer Studios Inc., et al., v. Grokster, Ltd., et al.

[4] There is a limit to the amount of time a client will wait for a server to acknowledge its request. If a server is overloaded past the point where it can respond within this amount of time, a situation can result in which *no* clients are receiving data.

A peer-to-peer network, in contrast, actually speeds up as demand grows. Each additional peer increases the capacity of the network, and the higher the demand for a file, the more sources are likely to be available.

Reliability

That the government designed the Internet to be impervious to nuclear attack is an urban legend (Lackman, 2003), but had this been the goal in mind, a peer-to-peer system would be an ideal choice. The decentralized nature of a P2P network enables it to recover gracefully from the failure of any given peer.

Although nuclear war is (arguably) less of a threat than it once was, dedicated servers still present a security risk. For example, it is almost impossible to prevent a "denial of service" attack, in which a server is overloaded with fake requests. Should it fail, the entire network collapses. For whatever reason, this type of hacker activity occurs almost daily on the Internet. It is telling that even under the client-server model, most content providers employ multiple servers that are interconnected as peers. This not only helps balance demand, but provides for backup if an individual server is disabled.

Weaknesses of the P2P model

Designers of an open, decentralized system value flexibility over control. This may be an entirely reasonable judgment when a network is small, with accepted behavioral norms and a sense of community among members. In a large P2P system, which lacks regulating authoritative and social mechanisms, this flexibility can leave the network vulnerable to abuse.

When outlining the weaknesses of the peer-to-peer model, it becomes clear that developers learn quickly. Many of these problems have been addressed in novel and creative ways, allowing file sharing to thrive even when millions of peers have joined a network.

Free Riding (or "Leeching")

Members of a peer-to-peer network create a public good when sharing files with others. Digital content is both non-rivalrous, and in the P2P model, non-excludable. Participation incurs some nominal costs, however. The most obvious of these is that members in some countries face the threat of litigation if they share copyrighted works. And in many networks, there is little benefit in sharing. Fundamental to the P2P architecture is that any peer can request a file, regardless of the contribution it makes to the network. This creates a social dilemma, in that the rational choice for many users is not to share files and free ride at the expense of others.

This set of incentives creates a self-reinforcing cycle. As fewer members share files, their costs increase, because they are more likely to face the threat of litigation. Each user that rationally decides to free ride thus creates a greater incentive for others to do so as well.

If left unchecked, free riding can lead to the collapse of a network. This is sometimes called the "tragedy of the digital commons".[5]

Early P2P networks suffered greatly from the free riding problem. A study of the Gnutella network concluded that upwards of 70% of its peers do not share any files. Among those that do share, the level of contribution is remarkably skewed. Just 1% of Gnutella users address 37% of the network's requests, and 20% are responsible for 98% of outgoing data traffic. (Adar, Huberman, 2000)

Developers have attempted to redress the free riding problem through a variety of rules and incentives. Early versions of Napster and Kazaa would search a user's computer for content and automatically make it available to the network. Files acquired through the network would also be shared by default. Kazaa introduced a simple rating system, which was based on the ratio of a peer's uploads to downloads. A high rating would give the user priority access to files on the network. Because the network was decentralized, this rating had to be stored on the user's machine, inviting manipulation. Unofficial versions of Kazaa, almost as widely used as the original[6], give users the top rating regardless of actual activity, rendering the system worthless.

The current generation of P2P software has largely abandoned the incentive model and instead relies on a more complicated set of rules. A user running BitTorrent or eDonkey2000 is forced to share the downloaded portion of a file while it is being transferred, but not afterwards. As such, costs are largely borne by the original distributor, who is an obvious target for legal action and can be held liable for each unauthorized copy. On the Kazaa network, which attempts to spread the cost of sharing among its users, copyright owners have been hapless in their efforts to stop the distribution of specific content. In contrast, targeted legal action against a BitTorrent user can immediately put a stop to trading. This dynamic is explored further below.

Given the difficulty in observing user activity on P2P networks, it is not surprising that few studies have explored the nature of free riding. Adar and Huberman (2000) conclude that neither bandwidth nor geographic location can predict a user's propensity to free ride, although their study predates lawsuits against file sharers. One would expect that users living in countries where there is no threat of litigation would be more likely to share copyrighted works. This is also explored further below.

Anonymity versus Authenticity

Users of peer-to-peer networks share files in an atmosphere of quasi-anonymity. Each peer is known to others solely by its network address, although a copyright owner can usually trace this to an individual if armed with a court order. While the recording industry has aggressively pushed for laws requiring a greater degree of transparency, it is file sharers who suffer the most under this arrangement.

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[5] In reference to Garrett Hardin's "The Tragedy of the Commons", published in 1968.
[6] "Kazaa," *Wikipedia.com.*

Establishing reputation is exceptionally difficult in a decentralized network. The sheer number of participants makes repeated interactions unlikely. Behavior is not monitored by a third party. Network addresses are easy to change, and for some types of broadband connections, are reassigned each time a computer accesses a network. It is difficult to prevent hostile peers from joining a network, and equally difficult to identify them once they do.

This weakness allows copyright owners to infiltrate P2P networks and destabilize them. Several techniques have been adopted, with varying degrees of success. Little is known about some of the convert actions the recording industry has taken, although it did go so far as to request an exception from an anti-terrorism bill that would prohibit it from creating computer viruses.[7] However, the most popular and effective strategy is also one of the least sophisticated. Because P2P does not have the capacity to designate "trusted" sources, peers are unable to determine the authenticity of any given file. If a network is seeded with fakes, these can be inadvertently downloaded and frustrate the user. Worse yet, if parts of a file are downloaded from multiple sources, any amount of bad data provided by a hostile peer will corrupt the entire file.

This problem has largely been addressed through the use of *hashing*, which is a type of "digital fingerprint" identifying each portion of a file. In the event a peer is presented with data that does not match the hash, the information is discarded, the provider is ignored, and an attempt is made to download the data from another source. Hashing can require a great deal of processing power, depending on the level of detail. The more sophisticated the technique, the less likely it is that corruption will go unnoticed.

Ironically, while the level of anonymity on a P2P network gives hostile nodes free reign, it is not enough to shield users from being personally identified. An obvious solution would be to enable completely anonymous file sharing, but this is a difficult, if not impossible goal. Some P2P programs claim to provide anonymity, but suffer from a variety of security flaws that render this promise meaningless.[8] In any event, methods that can be employed to hide user activity require a great deal of bandwidth, render multi-source downloads impractical, and increase the likelihood that a user will encounter a fake file. As a result, networks that highly value anonymity, such as Freenet, have not been popular. BitTorrent, on the other hand, while notable for its relative lack of anonymity, is also the most popular network in terms of data traffic.[9]

Malware (Adware and Spyware)

A common misconception among novice users is that participating in a peer-to-peer network will invariably expose them to computer viruses. It is very difficult to embed a

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[7] John Borland, "Online Music Wars Inspire New Weaponry," *News.com*, 15 October 2001.
[8] Supreme Court Brief for Computer Science Professors Harold Abelson, et al. as *Amici Curiae* suggesting affirmance of the judgment, Metro-Goldwyn-Mayer Studios Inc., et al., v. Grokster, Ltd., et al.
[9] Thomas Mennecke, "P2P Usage – Which Network Consumes the Most Bandwidth?" *Slyck.com*, 29 September 2004.

virus into a music or movie file, so this fear is generally unfounded. The real danger to P2P, which is often overlooked, lies in the software itself.

It is understandably difficult to monetize the development of P2P software. The nature of file sharing is that it is free. Napster, true to its dot-com roots, was never able to determine how it would make money. Sharman Networks, owner of Kazaa, once aspired to develop a payments system for copyrighted work.[10] When this plan failed, it was the first to introduce bundled advertising applications, such as GAIN.

GAIN had to be installed on any computer running Kazaa. It is an example of "adware", in that it embeds intrusive advertising into an operating system. [Figure 3] It is also considered "spyware". GAIN records a user's web browsing habits, which are sent to its marketing partners, along with the user's e-mail address and demographic information. Aside from the inconvenience and privacy implications, this type of software considerably slows down the systems on which it is installed. Worse yet, it is almost impossible to remove.

Figure 3: An Adware Window

The bundling of adware and spyware reinforced the stereotype that file sharing is inherently malicious and created a sense of distrust in the P2P community. Many companies exacerbated the problem by misleading users with creative definitions of the word "spyware". For example, a banner on the iMesh website proudly claimed that "iMesh is spyware clean", although it also explained that "iMesh is installed with the CyDoor banner and popup engine".[11] CyDoor, like GAIN, surreptitiously transmits a user's e-mail address and demographic information to other companies.

Grokster, embroiled in a lawsuit with Metro-Goldwyn-Mayer Studios, has become an unlikely poster child for peer-to-peer advocates. Considered the worst offender when it came to malware, the software was ridiculed in a recent review on a file-sharing website.

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[10] *Kazaa.com* website, accessed 1 April 2001 by the Internet Archive.

[11] "iMesh Gaffe," *Zeropaid.com*, 16 December 2002.

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Perhaps defining the very nature of spyware, Grokster has long
been loathed by many in the P2P community. While some P2P
applications may have the occasionally (sic) Bonzi Buddy or
CyDoor, Grokster contained an arboretum of third party
software... If someone was unlucky enough to install Grokster,
his or her personal computer was virtually incapacitated. The
homepage was changed, numerous pop-ups made net surfing nearly
impossible, various third party software sucked down system
resources, hijackware altered the browser and many more invasions
made using Grokster an awful experience... In all, 15 adware and
spyware programs were installed from the latest version of
Grokster. 12
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Of course, the peer-to-peer design is such that any computer can join a network, provided it uses a compatible protocol. It did not take long for unauthorized versions of Kazaa to appear, stripped of its debilitating malware. Kazaa Lite, released in April 2002, was a popular alternative. In an ironic turn of events, Sharman accused its developers of copyright infringement, and invoking a provision in the Digital Millennium Copyright Act, forbid search engines such as Google to link to the software. This led to the development of K-Lite and Diet K, programs which did not alter the original Kazaa software but allowed users to execute it in a secure environment.

Heightened awareness, pressure from distributors, and the popularity of ad-free open-source software[13] has helped reverse the trend towards malware. In the last few months, popular P2P programs such as Morpheus, iMesh, and WinMX have been officially been released without bundled software. Even Grokster now generously offers a "5 day trial with NO adware".[14]

Peer-to-Peer Software

More than a hundred different file sharing applications have been developed in the last few years. Consider the case of the Gnutella network, first envisioned by AOL engineers Justin Frankel and Tom Pepper. The original Gnutella software was adopted by the open-source movement, which now distributes a free version called Gnucleus. For-profit corporations developed others, including the popular BearShare and LimeWire. Users wishing to join the Gnutella network now have a variety of options, written for the Windows, Linux, and Macintosh operating systems, and designed for speakers of almost any language, including Tagalog, Slovenian, and Afrikaans.

Even so, there have been only four generations of the peer-to-peer architecture thus far, and with the exception of Gnutella, each has been dominated by a particular file sharing application. These provide an excellent approach for understanding the evolution of P2P, and are detailed below.

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[12] Thomas Mennecke, "Grokster Goes From Bad to Worse," *Slyck.com*, 16 November 2004.

[13] Open-source software has freely available source code; anybody may view the code or redistribute it.

[14] *Grokster.com*, accessed May 4, 2005.

Napster

Napster's release, in the fall of 1999, was a watershed event in the history of file sharing. It was the first massively popular P2P system, in no small part due to its ease of use and the exploding demand for MP3 music files. Within months, Napster made file sharing accessible to millions, and in doing so, enlisted consumers in the battle for content distribution.

Napster's system was technically a peer-to-peer design, in that files were transferred directly between computers on its network. However, it did employ a central indexing server, akin to a search engine. Each Napster user would log into this central server, which kept track of what files were available on the network.

The centralized nature of Napster quickly became a source of concern. The capacity of the indexing server did not grow as quickly as the number of peers on the network, causing bottlenecks.[15] Worse, users were uncomfortable relying on a system in which one company served as an intermediary for every transaction. An open-source alternative to Napster, called OpenNap, partially addressed these issues. The software continued to employ central indexing servers, but these were easy to set up, and users could choose which they wished to be connected to.

After a series of debilitating filtering requirements imposed by the courts, Napster was eventually shut down in July 2001. This is explored further in the next section.

Gnutella

Of all the peer-to-peer networks, Gnutella has the most convoluted history. The program was surreptitiously developed by an AOL subsidiary and placed on a testing server in March 2000. It would remain there for just one day, after which embarrassed AOL executives removed the link. To their chagrin, the program had already been downloaded over 10,000 times, and was embraced by the open-source community as an alternative to Napster.

Gnutella was remarkable in that it featured a completely decentralized architecture.[16] Before joining the network, a user needed the Internet address of at least one Gnutella peer. After a connection was established, the software would download, and continually update, a list of addresses for participating machines. Each peer would then maintain four or five connections to others.

When a search was initiated, the originator would send a request to each connected peer, and these in turn would forward the request to the peers it was linked to. At each step, the number of peers considering the request would multiply exponentially, "flooding" the network. If a match was found, the message trail was reversed, and the location of a peer

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[15] Supreme Court Brief for Respondents, Metro-Goldwyn-Mayer Studios Inc., et al., v. Grokster, Ltd., et al.
[16] Almost every Internet application, including Gnutella, relies on one or more central domain name servers which track the location of computers on the network.

with the desired file would be sent back to the originator through the same path. Only at this point would a direct connection be established.[17]

In its infancy, Gnutella was considered invulnerable. However, when Napster was shut down by the courts, millions of users overwhelmed the network and exposed a fatal flaw. Gnutella could not scale. As peers joined, the burden of their search requests increased exponentially, but the resources they provided to the network increased linearly. At its worst, a query on Gnutella could take more than four hours to be relayed throughout the network.[18] This sluggish response time frustrated everyone. "Gnutella has been ultimately disappointing," remarked one industry commentator.[19]

After a long decline, Gnutella has recently become more popular. Newer versions of the software arrange the network around "supernodes", a technology first introduced by FastTrack and described below.

Kazaa (FastTrack)

Several P2P companies have licensed the FastTrack network, which was developed in March 2001 by a Dutch company called Consumer Empowerment. The first application to see widespread use was Morpheus, published by StreamCast. In February 2002, while StreamCast and Consumer Empowerment were embroiled in a bitter contract dispute, Morpheus users discovered that their software had mysteriously been disabled. En masse, they switched to Kazaa, a rival FastTrack application that had coincidentally just been purchased from Consumer Empowerment by Sharman Networks.

This corporate coup d'etat set the tone for the new breed of for-profit P2P organizations. Sharman, now the undisputed leader, was aggressive and ruthlessly profit-oriented. It was the first to bundle adware and the first to take legal action against other P2P developers. Many in the file-sharing community were offended by its actions and baffled by its success.

Sharman's plan was to leverage copyright infringement on its network as it tried to coerce the recording industry into a licensing deal. In essence, the Kazaa software was an ultimatum: either the industry works with us, or it will suffer from rampant piracy. As a concession, file sharing was initially limited to low-quality music files. The company's website explained:

> We are currently discussing with European collecting-rights
> organisations (sic) with the objective to make an agreement in
> which KaZaA members will be able to pay a flat monthly fee for a
> "Music subscription" and be able to share and download music from

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[17] This was an anonymizing feature that was later abandoned. It made search requests burdensome to the network and assumed that each peer delivering the request would be available to deliver the response.

[18] Lee Rainie, Susannah Fox, Amanda Lenhart , "13 million Americans "freeload" music on the internet; 1 billion free music files now sit on Napster users' computers," Pew Internet & American Life Project, 8 June 2000.

[19] Ray Hoffman, "Gnutella – The Big Hype," *Slyway.com*, 23 May 2001.

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        commercial artists legitimately and at full CD quality. Until
        that is in place you can only find MP3 files that are of maximum
        128 kbps, which is slightly under CD quality. ²⁰
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Technically, FastTrack was similar to both Gnutella and Napster, combining the best of both arrangements. A peer with comparatively more processing power and bandwidth was automatically designated a "supernode", best thought of as a regional indexing server. Slower, less capable machines would connect to a supernode, and upload a list of files they were sharing with the network. Search requests were also coordinated by the supernode, which would look for a match in its list of known files, and forward the request to other supernodes. This hierarchical arrangement was in constant flux, as peers left and joined the network.

The FastTrack network also enabled multi-source downloads, addressing the huge imbalance between upload and download speed on almost any broadband connection. A cable modem, for example, may send data to a user twenty times faster than the user can provide data to others. If a file transfer involves just two peers, the slower upload speed becomes a limiting factor. But all available bandwidth is utilized when a file is simultaneously downloaded from multiple sources.

BitTorrent

BitTorrent was introduced to the world at a developer's convention in February 2002. Originally designed to facilitate the distribution of Linux, it has since been adopted as a file sharing tool and currently enjoys widespread popularity.

BitTorrent is remarkable for its lack of decentralization. There is no search feature to help a user locate files on the network. Instead, they must employ the use of "trackers", server applications that maintain a list of peers sharing a particular file. As such, the design of BitTorrent is said to be naturally resistant to copyright infringement. Because a centralized tracker coordinates all transfers of a particular file, if the tracker is disabled, the file is no longer available. Some trackers also save the network addresses of peers that have accessed a file. In at least one case, the Motion Picture Association obtained these addresses after suing the owners of a tracker site.[21]

BitTorrent is popular because of its speed. Each file is broken into small fragments, which are distributed and reassembled among peers in a seemingly random fashion that maximizes the capacity of the network. Each peer takes advantage of its fastest connections to download these fragments, while simultaneously uploading any that it has already obtained to others. With Kazaa, by contrast, files were not shared until they had been completely downloaded, and then to only one peer at a time. While it may take hours to download a video with Kazaa, it can take only a couple of minutes using BitTorrent.[22]

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[20] *Kazaa.com* website, accessed 1 April 2001 by the Internet Archive.
[21] "BitTorrent," *Wikipedia.com*.
[22] Clive Thompson, "The BitTorrent Effect," *Wired*, January 2005.

3.   P2P and the Recording Industry: Accusations of Harm

Any type of digital content can be shared on a peer-to-peer network, but music is by far the most popular. Digital music is compact, easily distributed, and provides the same experience as its analog counterpart. Consumers also seem to have an insatiable appetite for music. The most basic 20GB iPod can play music for four weeks before having to repeat a single song.[23] Demand for such an incredible variety of music was unthinkable just a few years ago.

The recording industry has long been dependent on its ability to control distribution for the bulk of its revenue.[24] These companies have never been focused on the creative process itself, but instead their role as assignees and licensees of copyright. Peer-to-peer technology threatens this well-established and highly lucrative business model. However, as we shall see, the nature of the threat is not as clear-cut as the industry would have us believe.

Decline of Sales

The Recording Industry of America (RIAA), a trade group whose members can boast of a 90% share of music sales in the United States alone, largely coordinates the industry's response to file sharing.[25] It first blamed computer piracy for declining sales in March 1999, several months before Napster was released. It was a surprising claim, as few computers were enabled to play music at the time. Mark Hardie, a senior analyst at Forrester Research, dismissed the accusation as "naïve and unsupported".[26] Just a few months later, RIAA seemed to reverse itself, claiming at a press conference that piracy was no longer an issue.[27]

Sales continued to slump as digital music came of age. [Figure 4] Fueled by the optimism and resources of the dot-com boom, an entire ecology of tools and services was introduced, promising to revolutionize music distribution. The RIAA responded with an aggressive and sustained campaign against file sharing, proclaiming that Napster and its ilk were solely responsible for the industry's change in fortune.

[23] *Amazon.com*, accessed 5 May 2005.
[24] Sarah Simon, Richard Bilotti, Scott Babka, "Online Music: Hitting the Right Note?" Morgan Stanley, 16 January 2004.
[25] *RIAA.com*, accessed 11 May 2005.
[26] Beth Lipton Krigel, "Music Industry Blames MP3 for Sagging Sales," *News.com*, 25 March 1999.
[27] Jim Hu, "Recording industry sings new Net tune," *News.com*, 21 July 1999.

Figure 4: Music Sales (Excluding Digital)
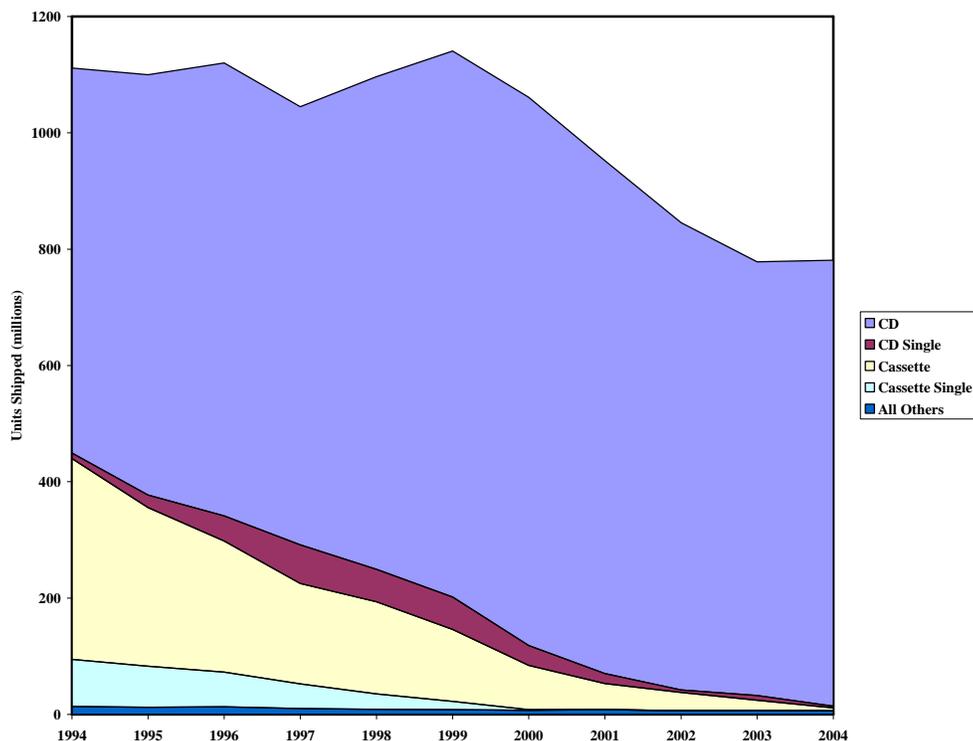
Source: RIAA

Mechanisms

File sharing lowers the cost of obtaining music. Central to the question of harm is the extent to which downloading affects *legal* sales. If downloads serve as a substitute for purchases, a causal path exists, and industry accusations of harm are justified. There are other factors to consider, however. For example, file sharing may only draw in users who would not otherwise purchase music.

Piracy could also boost demand for music sales through demand-side externalities. Some industries, particularly makers of software, are known to tolerate piracy because it serves as a promotional mechanism and helps establish a critical mass of users.[28] Similarly, exposure to content on P2P networks may increase a consumer's appetite for music overall. The value of this content has likely increased, now that it can be shared with others.

Evaluating the economic impact of piracy is highly dependent on the pricing and price elasticity for legitimate sales. If the value of music is enhanced by sharing, content owners can raise prices to extract this surplus. Treating all pirated copies as lost sales will then overestimate harm. On the other hand, if content owners deliberately set low prices to in an effort to discourage piracy, a valuation of lost sales may underestimate harm.

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[28] Dan Bricklin, "The Software Police vs. the CD Lawyers," *bricklin.com*, 2003

Either way, piracy has an effect on the price elasticity for legitimate music, which must be also taken into account.

Academic Research

Much attention has been paid to the claim that file sharing is responsible for the drop in music sales. Academic investigations have come to different conclusions, doing little to temper the debate.

Every study, including my own, faces a challenge in that obtaining data on the nature of file sharing is exceptionally difficult. Activity on a decentralized peer-to-peer network is almost impossible to observe. Most users are reluctant to admit that they share files, and are likely to avoid doing so if they are being monitored. File sharing is also just one aspect of a digital revolution which has affected our society in countless ways. Attempting to control for these factors on a macro level often seems like a fool's errand.

Worse, the political nature of the file sharing debate encourages bias in design or the willful misinterpretation of a study's findings. An infamous example is the May 2000 SoundScan report on music sales, which the RIAA seized upon to justify legal action against Napster. The study showed that CD sales had dropped significantly at record stores located near universities. The RIAA encouraged the assumption that file sharing was to blame, asserting that students were far more likely to have access to broadband, and as such were more likely to tap into P2P networks. While this may be true, they were also far more likely to purchase from online retailers, and these sales were not evaluated in the report. Record stores were also losing market share to discount retail stores, such as Wal-Mart.

Four academic studies on the relationship between file sharing and lost sales are widely cited and generally held in high regard. A brief review gives the reader an impression of the variety of approaches that have been employed, and the equally wide variability of conclusions.

- Liebowitz (2003) considers it self-evident that file sharing acts as a substitute for retail sales, and focuses on explanations that suggest otherwise. He evaluates claims that changes in income, demographics, recording formats, prices, or distribution are to blame, and concludes that none are particularly likely.

- Zentner (2003) uses country-level data to forecast aggregate music sales based on Internet usage. His analysis shows a positive, but not significant, relationship between file sharing and music purchases. After introducing an instrumental variable to control for heterogeneity in demand, his regressions predict that downloads reduce sales by roughly 30 percent.

- Rob and Waldfogel (2004) suggest that consumers segment themselves into downloaders and buyers, and that any negative correlation between downloads and sales reflects the insularity of the two groups. Relying on survey data of

consumer purchasing habits, they conclude that downloads reduce sales by 10 to 20 percent.

- Oberholzer and Strumpf (2004) have authored the most sophisticated study to date. The two researchers analyzed a dataset of actual file sharing activity recorded in late 2002 by an OpenNap server. Their regression, heavily instrumented to control for changes in popularity, shows that downloads have an indistinguishable effect on sales, with a narrow standard error. The authors also note that although sales of all musical genres have suffered equally, some are not heavily represented on P2P networks.

Other Explanations

Joe Fleischer, head of sales and marketing for BigChampagne, a company that monitors file sharing activity for the music industry, admitted that "the single-bullet theory employed by the RIAA has always been considered by anyone with even a modicum of economic knowledge to be pretty ambitious as spin."[29] Even the most pessimistic studies conclude that only a fraction of the drop in music sales can be attributed to file sharing. There must be other explanations for this trend.

First, it is important to note that music sales have shown variability in the past, and that the current slump is by no means unprecedented. In the 1970s, the industry endured a much more severe decline.[30] Furthermore, the 1990s were a period of unusually high sales, perhaps because consumers were replacing older formats with CDs.

Distribution channels for physical media have also changed. Discount retailers take an increasing share of sales from traditional music stores. (Zentner, 2003) These retailers offer less selection and keep fewer albums in stock. Oberholzer and Strumpf estimate that half of the decline in CD shipments can be attributed to this reduction in inventory.[31] The market for used CDs is also vastly more efficient, thanks to the coordination of internet retailers such as eBay and Amazon.com.

Music competes in an increasingly crowded entertainment market. Sales of DVDs and videotapes increased by $5 billion from 1999 to 2003, more than offsetting the concurrent $2.6 billion reduction in album sales.[32] Consumers also spent $10.3 billion on video games in 2002, up from $9.4 billion in 2001.[33] Cell phones now compete for the attention of the teenage market, long responsible for a majority of music sales. Girls 13 to 16 spend 50% of their disposable income on mobile phones, a spending category that simply did not exist just a few years ago.[34]

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[29] John Schwartz, "A Heretical View of File Sharing," *New York Times*, 5 April 2004.
[30] Supreme Court Brief for Felix Oberholzer-Gee and Koleman Strumpf as *Amici Curiae* in Support of Respondents, Metro-Goldwyn-Mayer Studios Inc., et al., v. Grokster, Ltd., et al.
[31] *Ibid*.
[32] *Ibid.*
[33] NPD press release, 27 January 2003
[34] Sarah Simon, Richard Bilotti, Scott Babka, "Online Music: Hitting the Right Note?" Morgan Stanley, 16 January 2004.

The music industry may also have suffered as the result of its own consolidation, particularly in radio. Fewer albums are released each year, and many feel that the industry neglects older consumers, who are responsible for 45% of music sales.[35] A 2003 NPD study found that half of these consumers are purchasing less music simply because they have little interest in what is currently available.[36]

Societal Benefit

The impact of file sharing extends well beyond the recording industry. In focusing on the question of harm, almost all commentators neglect to consider the value provided to consumers by this new technology. It is entirely possible that file sharing negatively affects music sales and yet still provides a net benefit to society.

Price discrimination for music sales has never been feasible. Even when it comes to physical media, transfer among consumers is not difficult. As such, the recording industry has been forced to act as a single-price monopolist, leaving many socially beneficial transactions unconsummated. Considering that the marginal price of physical media is quite low, and that of digital media is essentially zero, this implies a huge deadweight loss.

Unpaid downloading allows consumers to engage in crude third-degree price discrimination. (Rob, Waldfogel, 2004) Imagine people segment themselves into one of two groups, "buyers" and "downloaders", based on factors such as access to broadband and risk aversion. File sharing leaves downloaders obviously better off. Given that millions of users participate in peer-to-peer networks, the benefit is likely to be sizeable. The recording industry is harmed to the extent that this technology entices would-be buyers to become downloaders. If we believe the most pessimistic studies, this is fewer than 30%. As such, it would seem that file sharing is a net benefit to society.

Granted, this is a static analysis. Over time, society may suffer if producers are unable to recover the costs of output. When it comes to music, this is unlikely. First, it is questionable whether artists benefit from the current system of distribution. In a recent poll, two-thirds said they did not consider file-sharing to be a threat to their livelihood.[37] Second, while distribution of physical media is remarkably inefficient, digital music sales will be anything but so.

Finally, consider the cost of putting an end to file sharing, if that is even possible. This would certainly impose an enormous burden of liability on the computer, electronics, and telecom industry. It would require a costly reengineering of most consumer devices, including personal computers, severely restricting both legal and illegal uses. And even then, it would necessitate a degree of societal control found only in a totalitarian state.

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[35] Sarah Simon, Richard Bilotti, Scott Babka, "Online Music: Hitting the Right Note?" Morgan Stanley, 16 January 2004.

[36] *Ibid*.

[37] Press release, Pew Internet & American Life Study, 5 December 2004.

Control of Distribution

Underlying the music industry's campaign against file sharing is the fear of losing control over distribution. There can be no doubt as to their current dominance. The top five labels account for 80 percent of all music sales. (Rob, Waldfogel, 2004) In May 2000, the Federal Trade Commission found that these companies had overcharged consumers by roughly half a million dollars in the previous four years.[38] Recent litigation alleges that the practice has continued.

In July 2000, Jupiter Communications released a study showing that Napster use was likely to increase music purchases. Hilary Rosen, Chief Executive of the RIAA, responded

> I don't think it matters at all whether we've been economically
> hurt. I think that if I own my shirt and you borrow it, it
> doesn't matter whether or not I have another shirt. You're just
> not entitled to borrow it without my permission. And if you have a
> copyright asset, that is the principle of copyright -- that you
> get to control and own your own work, and other people don't get
> to profit from it without your permission. [39]

The industry's campaign against file sharing is, in some ways, a distraction from the issue of distribution. Certainly, music companies would prefer not to remind consumers of their role in the creative process, nor deepen the suspicion that CDs are overpriced. However, at several crucial points in the battle over file sharing, the industry's true concerns became apparent.

When Napster was ultimately shut down by court decree, it agreed to pay $26 million in damages to copyright owners, but it also paid an advance of $10 million for future licensing. The company hoped to develop a business model based on legitimate music sales. Napster developed a sophisticated trading system which would identify copyrighted works using audio fingerprinting. However, as it geared up for the launch of this new product, Napster discovered it was unable to get any licenses from the major labels.[40]

Sharman Networks alleged similar behavior in a January 2003 lawsuit. Sharman claims it bought Kazaa intending to profit from the distribution of authorized, copy-protected entertainment. Even its website promised "a revolutionary payment system that makes it easy for everyone to buy and sell digital content on KaZaA".[41] After several meetings with industry executives, Sharman was also denied a licensing agreement.

Simply put, the industry does not want to move towards an online distribution model. Music companies have long relied on bundling songs into albums to increase sales, but

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[38] Matthew Fagin, Frank Pasquale, Kim Weatherall, "Beyond Napster: Using Antitrust Law to advance and enhance online music distribution," *Boston University Journal of Science and Technology Law*. Summer 2002

[39] John Borland, "RIAA Chief Determined to Keep Copyright Controls." *News.com*, 20 July 2000.

[40] "Napster," *Wikipedia.com*.

[41] Thomas Mennecke, "Thumbs Down for KaZaA," *Slyway.com*, 26 March 2001.

this does not translate well in the digital world. Despite heavy discounting, Apple reports that only 45% of songs purchased in its iTunes store are sold as part of an album.[42] Online revenue is also less than that of "brick and mortar" sales. Assuming that consumers continued to buy albums, volume would need to increase by 45% for the industry not to be affected by the transition. If people will only buy, on average, four tracks of a given album, volumes would have to increase fourfold.[43]

User behavior

The strength of copyright is socially defined, and any movement away from it, legal or otherwise, is perhaps the most terrifying aspect of file sharing for content owners. The recording industry had long campaigned on the legislative front, but was completely unprepared to argue its case at the consumer level. Yet within months of Napster's release, it was clear the RIAA had embarked on a cultural crusade.

Computer piracy had long been constrained by the need for sophisticated technical knowledge. Many assumed that the demand for illicit works was similarly limited. But an April 2001 study by the Pew Internet & American Life project found that

> One of the major attractions of the Internet to newcomers is the fact they can download music so conveniently and, in most instances, at no extra cost. While they are hesitant to do some of the more sophisticated activities online such as buying products or getting job information from online sources, Internet newcomers are almost as eager to download music as those who have been online for longer periods of time. [44]

Most consumers embraced file sharing without second thought. At the time, 78% of downloaders, and 53% of all internet users, did not believe that unauthorized file sharing was theft.[45] In fact, only 37% were aware that it was illegal.[46] The industry responded with a massive education campaign, and when that didn't seem to work, lawsuits against individual file sharers.

These efforts have cost the industry millions of dollars and a great deal of negative publicity. Even so, it appears as if little has changed. A follow-up study by the Pew project reported that

> Americans' attitude towards copyrighted material online has remained dismissive, even amidst a torrent of media coverage and legal cases aimed at educating the public about the threat file-sharing poses to the intellectual property industries. Consumers argue, in some news reports, that downloading simply supplements their regular music purchasing habits or serves as a form of

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[42] Sarah Simon, Richard Bilotti, Scott Babka, "Online Music: Hitting the Right Note?" Morgan Stanley, 16 January 2004.

[43] *Ibid*.

[44] Mike Graziano, Lee Rainie, "The music downloading deluge: 37 million American adults and youths have retrieved music files on the Internet," Pew Internet & American Life Project, 24 April 2001.

[45] Amanda Lenhart, Susannah Fox, "Downloading Free Music: Internet Music Lovers Don't Think It's Stealing," The Pew Internet & American Life Project, 28 September 2000.

[46] IFPI Digital Music Report, 2005

sampling new music. Some consumers have also been quoted as saying
that the prices of CDs and DVDs are too high with too little
profit going to the artists, while others say the music they want
simply isn't available offline because it is out-of-print or
otherwise hard to find. Still others say that they are entitled to
make "fair use" of the music they purchase by sharing it with
friends over these networks. [47]

In a sense, the industry's efforts to influence the legislative process had backfired.
Although it urged consumers to respect and abide by the law, this had little effect on
those who had already made the choice to download files. Industry analyst Scott Jensen
commented

While laws ideally stem from generally accepted morals, laws can
also be immoral and the public knows this. The public knows that
the law can be perverted to suit the interests of others. The
public knows that industry in the past and present have done this
on numerous occasions. [48]

The recording industry's harsh stance against peer-to-peer technologies has hurt it in two
specific ways. As a group, America's youth are the most active file sharers and the least
concerned about copyright law.[49] A majority of Americans under the age of 18 have
downloaded music. (Oberholzer, Strumpf, 2004) Having been threatened by punishment
and largely escaping it, this generation of consumers is being conditioned to flout
copyright law. As one law professor eloquently wrote

The teenagers who playfully flouted [Napster's] injunction in the
first weeks after its ruling and ultimately moved on to other
file-swapping sites when the injunction was tightened undoubtedly
drew a number of conclusions from the experience. On the basis of
the injunction-circumvention experience, many of these teenagers
have been socialized to believe that the copyright laws and the
courts are largely ineffectual, and that noncompliance with the
spirit of the law is socially acceptable. Through their exposure
to a system in which the law says one thing, but everybody does
the opposite, they may well have developed enduring attitudes
toward intellectual property laws. (Strahilevitz, 2003)

Furthermore, the aggressive actions by copyright owners have been answered by an
increasingly hostile campaign against them. While music lovers and free-speech
advocates would have been expected to rally against the industry, they are now joined by
an antagonized group of "technology providers" (Lemley, 2003) who fear that the RIAA
intends to limit their freedom and has the technical wherewithal to resist any efforts to do
so. One website warned

Our ultimate goal is to undermine every effort of the RIAA and
every court ruling that violates our fundamental right to share
information. As we speak, your government is allowing the RIAA to

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[47] Mary Madden and Amanda Lenhart, "Music Downloading, File-sharing, and Copyright," Pew Internet &
American Life Project, June 2003

[48] Scott Jensen, "The P2P Revolution: Peer-to-Peer Networking and the Entertainment Industry" (white
paper published 9 September 2003), *nonesuch.org*.

[49] Mary Madden and Amanda Lenhart, "Music Downloading, File-sharing, and Copyright," Pew Internet &
American Life Project, June 2003.

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determine this future. Since we have been labeled software
pirates, then we must do what pirates do best. We have a clear
message for all parities (sic) against freedom of information: We
are what you say we are, if we are pirates, then nothing you have
is safe. Your precious MP3s, your movies, your applications,
everything you hold so dear is no longer safe. We are out there
and we will steal. [50]
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4.   P2P and the Recording Industry: Industry Reaction

For more than five years, the music industry has struggled to contain the growth of file sharing. Many are familiar with its well-publicized legal assault, but efforts to destabilize peer-to-peer networks have been just as important. Neither strategy has proved to be the long-term solution the industry had hoped for. The fight for control over music distribution has culminated in a Supreme Court case, the outcome of which will define the limits of consumer freedom in the digital age.

Lawsuit against Napster

Legal Action

Napster seemed to be an ideal case for the recording industry. Through its central indexing server, the company was not only aware of infringing activity, but had the ability to prevent a file from being transferred. Years later, embroiled in its own court battle, even Sharman Networks agreed that the case against Napster was "just" because the company had a requisite degree of control over its network.[51]

The RIAA brought suit against Napster in December 1999, when the service was just five months old, claiming both contributory and vicarious copyright infringement.[52] Napster, in turn, argued that it did not provide infringing content, nor did music pass through its servers. The company also made it clear to its users that trading music under copyright was illegal. To many, Napster's professed respect for the law sounded hollow, as early versions of its software searched a user's hard drive for music and shared every song by default.

The case dragged on for months, and with every legal twist and turn, Napster's woes were headline news. The fledgling network could not have asked for better publicity. In the midst of its legal battle, Napster became one of the Internet's most popular destinations, and introduced the concept of file sharing to millions.

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[50] Ray Hoffman, "What To Do Now," *Slyway.com*, 7 March 2001.

[51] Supreme Court Brief for Sharman Networks as *Amicus Curiae* in Support of Respondents, Metro-Goldwyn-Mayer Studios Inc., et al., v. Grokster, Ltd., et al.

[52] Contributory liability implies that a party knows, or reasonably should know, of infringing activities and materially contributes to this infringement. Vicarious liability is applied when a party has the right and ability to control infringing activities.

Napster lost the court battle, and reached an agreement with the RIAA in March 2001. The company would filter out names of copyrighted songs from its central index, preventing their transmission. Its effort proved relatively successful. According to WebNoise, the average number of songs shared per user dropped 60%, from 172 to 71.[53] More importantly, the previous month was to be Napster's most popular, in which its 13.6 million users traded 2.7 billion files.[54,55]

Even so, both the RIAA and the court insisted that any level of infringing activity was unacceptable. This goal proved impossible to achieve. Napster was unable to keep its filters up to date, thwarted by users who used intentional misspellings of popular songs. Napster was finally shut down in July 2001.

Analysis

Without question, this was a pyrrhic victory for the RIAA. Just three months after the fall of Napster, 3 billion files were traded on the FastTrack and Gnutella networks, setting a new record.[56] Other Napster users migrated to the OpenNap network, which at the time seemed immune from legal action.

The extent to which the RIAA suffered from this action is plainly evident, even when just focusing on the Napster/OpenNap protocol. Using the resources available at the Internet Archive, I have collected historical data mapping the size of these networks. The size of the central index, in terms of available songs, was reported to each peer and referenced on a popular file sharing website. This is obviously an imperfect measure. User libraries overlap, so fewer songs are added each time a peer joins the network. Even so, a vivid illustration of the ineffectiveness of the Napster lawsuit is clear. [Figure 5]
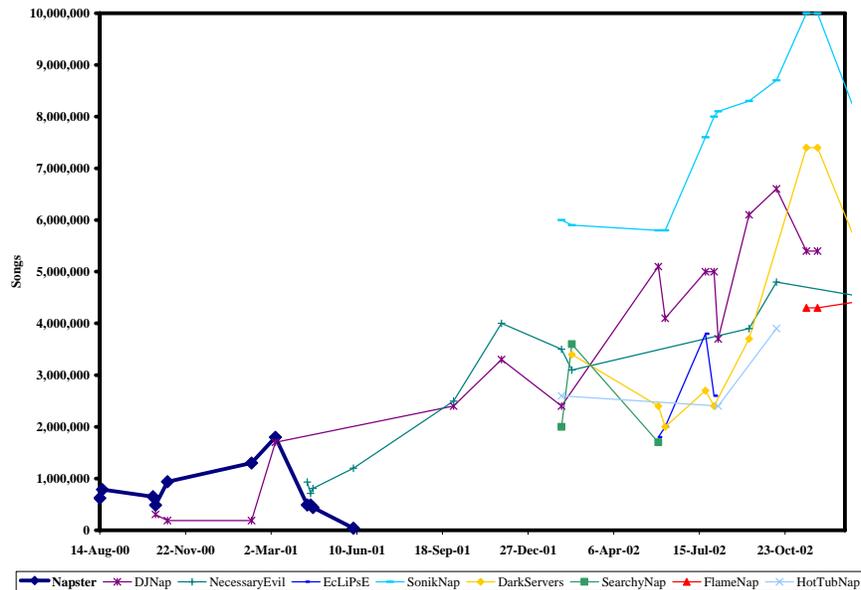
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[53] John Borland, "Napster Filters More Than Half of Downloads," *News.com*, 15 March 2001.
[54] "Napster," *Wikipedia.com*.
[55] John Borland, "Judge lets Napster live despite injunction," *News.com*, 6 March 2001.
[56] John Borland, " Suit hits popular post-Napster network," News.com, 3 October 2001

Figure 5: Napster and the OpenNap Networks

Having failed to stem the tide, the RIAA was to take more drastic action, although several months passed before it did so.

Lawsuits against Users

Legal Action

Peer-to-peer users were first threatened by lawsuits in August 2000 by angry musicians, including, quite infamously, Metallica. At the time, it was widely believed that the industry itself would never the drastic step of suing its own customers, if only because of the negative publicity. Indeed, as late as March 2001, the RIAA's official position was that it would not target individuals for legal action.

In April 2003, the tone changed. The industry had just lost the first round of its case against Grokster and StreamCast, which is described below. It had also lost, on appeal, the right to demand that internet service providers identify an individual based on their network address. Peer-to-peer activity was at an all time high, sales continued to slump, and a widely hyped education campaign appeared to have no effect. To the executives of the recording industry, it must have seemed as if the situation was spiraling out of control.

In July 2003, the *Wall Street Journal* reported that the RIAA was preparing to sue thousands of file sharers. An official announcement came in June, and the first lawsuits were filed in September. Over the next two years, in eleven separate actions, at least 5,436 users were sued, with many more settling out of court. [Figure 6]

Figure 6: RIAA Lawsuits
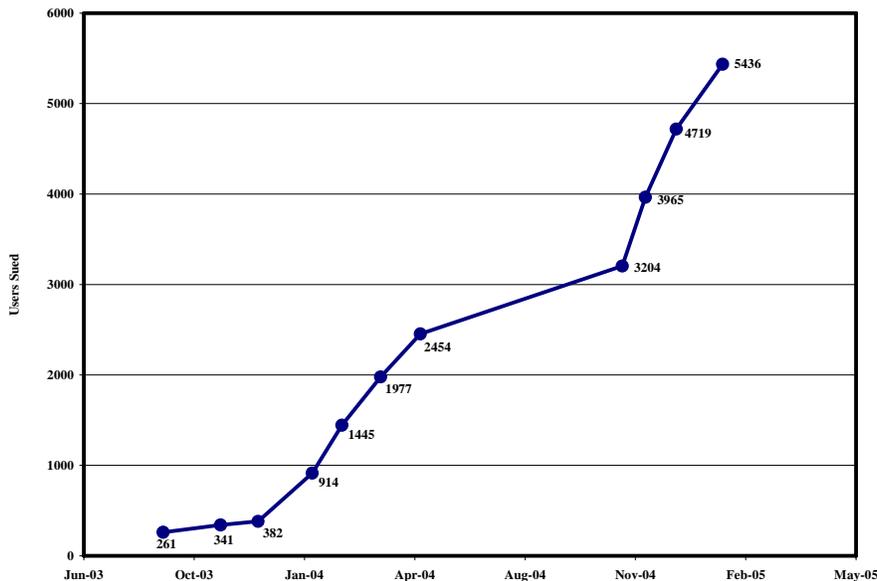
Source: News.com

Analysis

As many predicted, the lawsuits proved to be a public relations disaster. Barely 24 hours after its first court filing, the RIAA announced that a 12-year old honors student who lived in a public housing project had settled for $2000. A few days later, the trade group was forced to drop a lawsuit against a 60 year old woman accused of sharing a hardcore rap album, as she did not own a networked computer.

Despite these missteps, the industry claimed victory almost immediately. A study by Neilsen/NetRatings, issued shortly after the lawsuits were filed, reported that the use of P2P programs fell by 15%.[57] Greg Bloom, a senior analyst at the company, insisted that "a drop this significant probably has some kind of external cause". However, in the same time period, NPD noted that the use of AOL Instant Messenger dropped 9%.[58] In reality, it was difficult to make any conclusions about the effectiveness of this new legal strategy.

As with the Napster case, many users simply fled to safer havens. A study from the Pew Internet & American Life project noted that

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While it's clear that the industry's legal campaign has made a
lasting impression in the minds of American Internet users, we are
also seeing evidence that a segment of users are simply moving
away from the most popular and highly monitored file-sharing
networks and are instead using alternative sources to acquire
files. 59
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[57] John Borland, "RIAA Threat May Be Slowing File Swapping," *News.com*, 14 July 2003.

[58] *Ibid*.

[59] Pew Press Release, 25 April 2004.

With the passage of time, the impact of these lawsuits is now more easily quantified. Through the Internet Archive, I have collected time-series data on the number of users participating in the leading peer-to-peer networks. With the exception of BitTorrent, this statistic was reported to each peer, and referenced on a file sharing website.

One aspect of the legal attack is crucial to understanding its effect. Virtually all RIAA lawsuits target Kazaa users.[60] [Figure 7] Worse, the RIAA and other researchers rely on the FastTrack network to measure file sharing activity, and then extrapolate their findings to other peer-to-peer networks.[61]

Figure 7: Users Sued, by Network
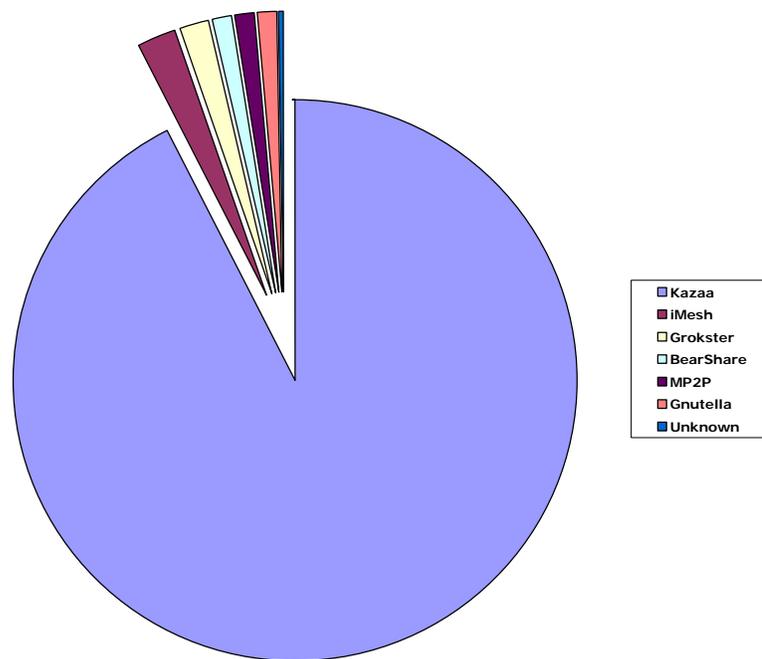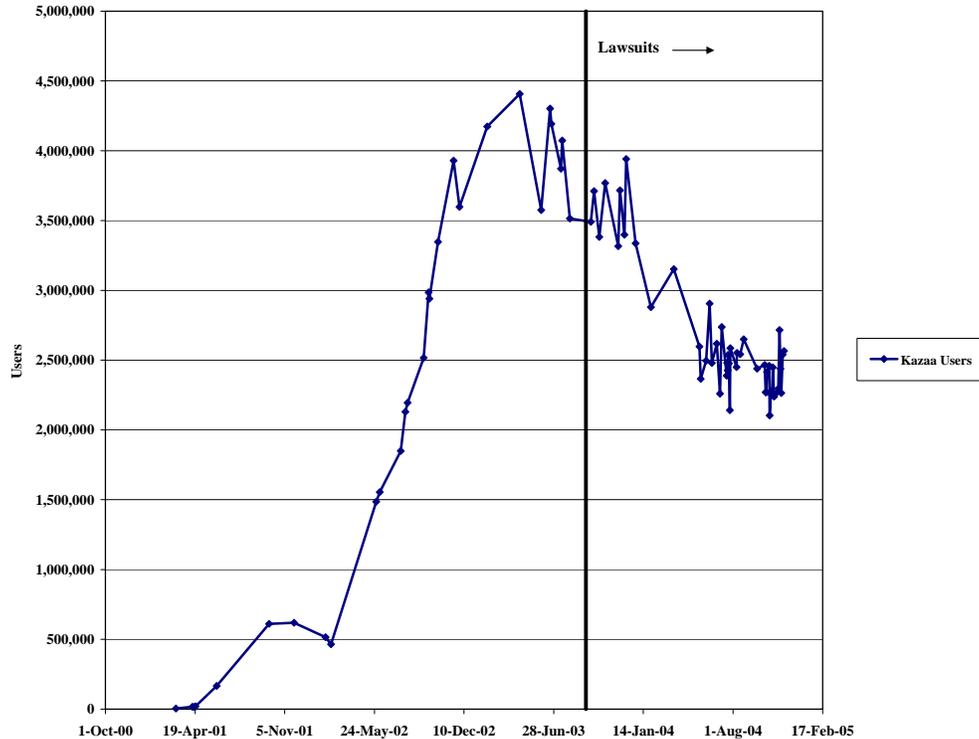

Source: Slyck.com, via the Internet Archive

The reasons for this are technical in nature. Older versions of Kazaa allowed a user to browse through the shared files offered by any other peer. Although this feature was disabled, another aspect of the FastTrack network made it vulnerable to surveillance. Its peers are arranged around supernodes, each of which is responsible for maintaining a list of files available on connected machines. It is relatively easy for an interested party to join the FastTrack network as a supernode, and intercept this information.

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[60] Thomas Mennecke, "IFPI fudging piracy numbers", *Slyck.com*, 9 June 9, 2004
[61] *Ibid*.

As such, it is no surprise that RIAA considered its legal effort a victory. Use of Kazaa plummeted after its users were targeted. [Figure 8] However, there are several clues as to why this might be a spurious correlation.

Figure 8: Kazaa Users

Source: Slyck.com, via the Internet Archive

For one thing, Kazaa was not the only file sharing system that suffered from a rapid decline. It seems as if all FastTrack licensees were somehow affected. This is especially puzzling when considering iMesh. Very few of its users had been sued. Moreover, the company itself settled with the RIAA in July 2004 and has since been operating on a quasi-legitimate basis, although unauthorized activity on its network remains unchecked. iMesh users should have felt no more threatened than users of any other network, with the exception of Kazaa. Yet the data suggests otherwise. [Figure 9]

Figure 9: Users of Selected P2P Networks
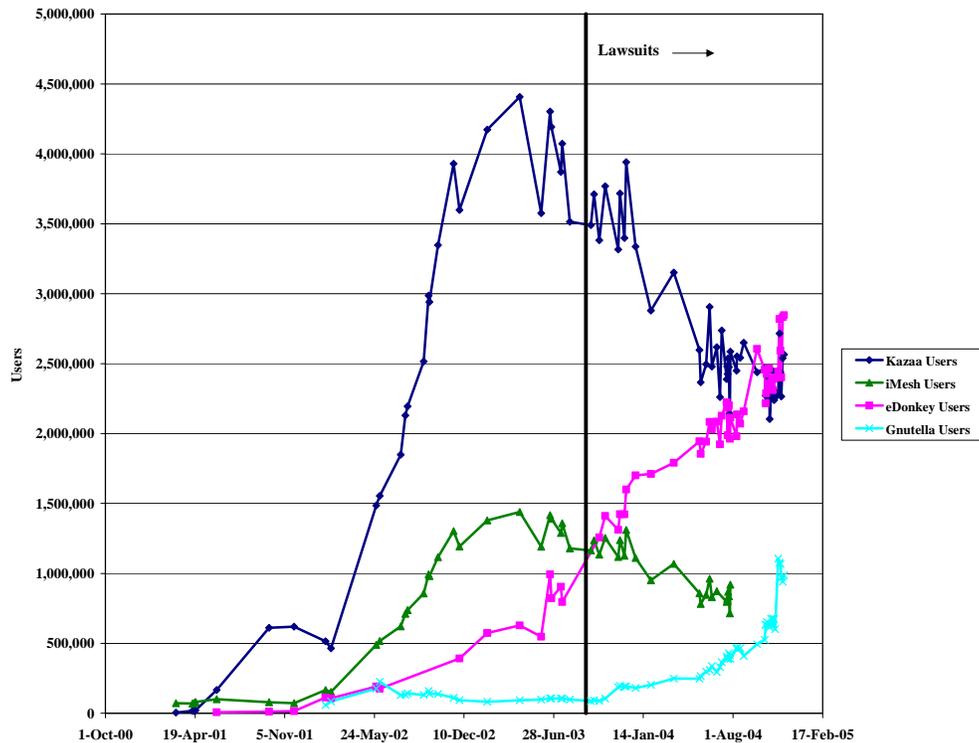
Source: Slyck.com, via the Internet Archive

Further evidence against the efficacy of targeting users is found in the rapid growth of the BitTorrent. Its developer, Bram Cohen, considered unauthorized file sharing on the network "patently stupid" because of the ease in which a copyright owner can obtain the Internet address of a BitTorrent peer.[62] While the RIAA has yet to turn its attention to the network, the motion picture industry has already sued thousands of BitTorrent users. This suggests that file sharers are not particularly concerned with the risk of litigation.

Estimating activity on the BitTorrent network is undeniably challenging. Eric Garland, CEO of research company BigChampagne, considered its use "unquantifiable".[63] Even so, several studies suggest that the network is increasingly popular. For example, in September 2004, CacheLogic determined that BitTorrent is by far the largest P2P network in terms of data transfer. [Figure 10] Another study suggested that BitTorrent is now responsible for upwards of 30% of all Internet traffic.[64]

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[62] Seth Schiesel, "File Sharing's New Face," *The New York Times*, 12 February 2004.

[63] Scott Banerjee, "P2P users get more elusive; faster networks touch to detect," *Billboard*, 31 July 2004.

[64] Personal conversation with Jim Graham, Public Relations Director for BayTSP, 19 April 2005.

Figure 10: Share of Data Transferred, by Network

|	
■	BitTorrent
■	eDonkey
■	FastTrack
■	Gnutella
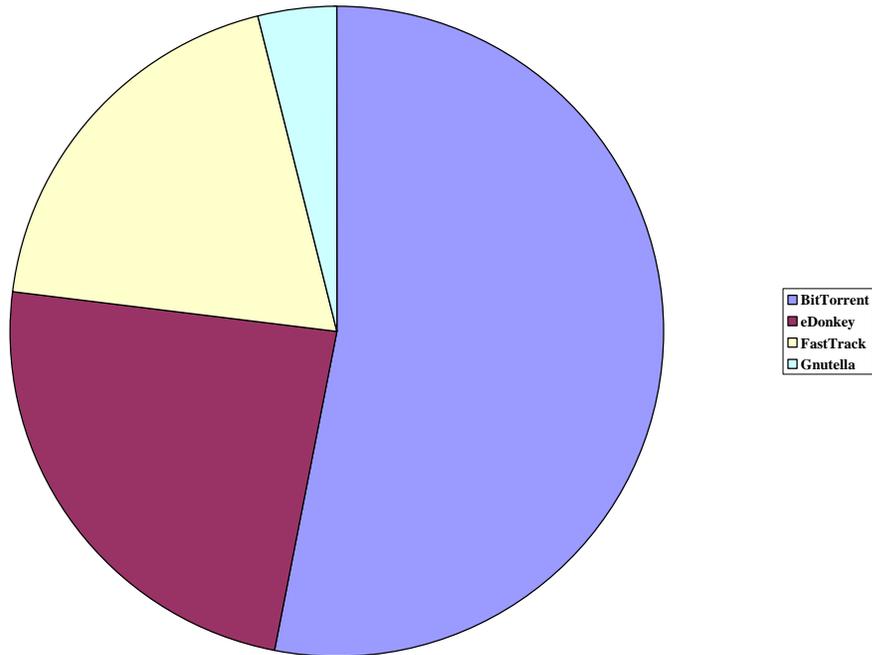
Source: CacheLogic

The number of BitTorrent users is a far more useful metric, but the nature of the network is as such that it is impossible to estimate with any degree of precision. Even so, a remarkable trend is evident in a dataset I have collected from Suprnova.org, a popular BitTorrent tracking server that was shut down in December 2004. The site reported the number of users that were referenced in its trackers, estimated to be roughly 80% of all BitTorrent peers.[65] It is clear that BitTorrent was in a period of remarkable growth. [Figure 11]

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[65] Thomas Mennecke, "BitTorrent Statistics," *Slyck*.com, 21 January 2004.
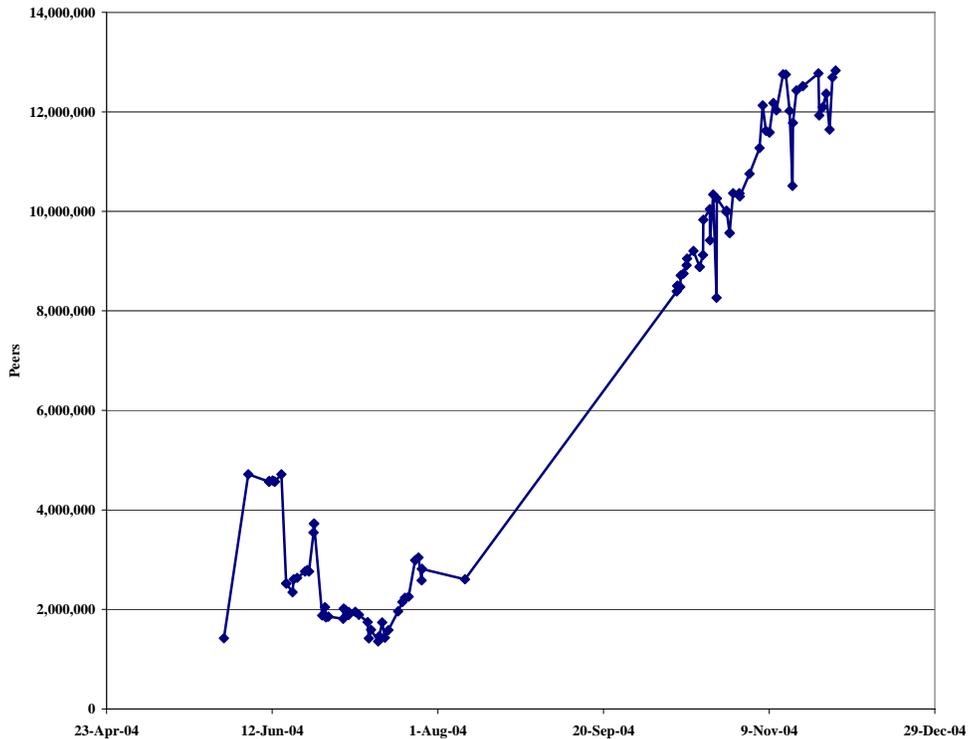
It is not clear how the threat of legal action could be an effective deterrent, given the unexplained decline in the use of iMesh and the rapid rise of BitTorrent. But the RIAA was concurrently employing other means to stop the spread of file sharing. And while the impact of lawsuits was greatly enhanced by the ensuing publicity, some actions demanded a level of secrecy which belie their effectiveness.

Destabilization

Spoofing (or "Poisoning")

The RIAA has hired several firms to coordinate network-based attacks on peer-to-peer systems. Several methods have been employed, but by far the most popular is simply to litter a network with fake versions of copyrighted files. This is referred to as "spoofing" or "poisoning". These bogus files can be downloaded in their entirety by an unsuspecting user. Far more likely, they will be used for a portion of a multi-source download, resulting in a corrupted and unusable file.

File sharing programs attempt to identify fake files by comparing the "hash", which is analogous to a digital fingerprint. Unfortunately, this technique requires a deal of processing power. Developers must determine how thoroughly a file will be checked, striking a balance between speed and effectiveness. The FastTrack network, perhaps showing its age, employs a simple hashing technique which allows massive amounts of

corruption to go unnoticed. Other networks use a much more sophisticated process, which may slow data transfer but is far more resistant to spoofing.

Analysis

Interdiction companies began seeding the FastTrack network with fake files in early 2003.[66] By June 2004, at least 25 billion bogus files had been placed there.[67] No other system has been subject to spoofing on such a large scale.[68] This is a significant liability for FastTrack. Chris Hedgecock, President of file sharing website Zeropaid, believes that Kazaa is withering from the competition.

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At heart, most of these peer-to-peer users are lazy. Kazaa was
simply the easiest way to get things they were looking for. Now
they're being frustrated. It's taking longer to get files, so
they're looking elsewhere. [69]
```

It seems intuitive that spoofing would be responsible for the Kazaa's declining fortunes. After all, users began abandoning the network well before the RIAA lawsuits were announced. It would also explain the demise of iMesh, which is also based on the FastTrack network.

To test this hypothesis, I have analyzed time-series data reflecting the use of 12 peer-to-peer systems that access 9 different networks. The number of peers on each network was compiled and reported by Thomas Mennecke at Slyck.com, a popular file sharing website. Historical data was obtained through the Internet Archive, which maintains snapshots of this website from August 2000 to November 2004.

[This section is being revised]

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[66] John Borland, "Start-ups Try to Dupe File-Swappers," *News.com*, 15 July 2002.

[67] John Borland, "Does Kazaa Matter?" *News.com* 30 June 2004.

[68] Scott Banerjee, "P2P Users Get More Elusive; Faster Networks Tough To Detect," Billboard, 31 July 2004.

[69] John Borland, "Does Kazaa Matter?" *News.com* 30 June 2004.

Lawsuit against FastTrack Licensees

Legal Action

In October 2001, the RIAA decided to join the Motion Picture Association of America (MPAA) in targeting the increasingly popular FastTrack network. Alleging copyright infringement, the trade groups brought suit against the companies which owned Morpheus, Kazaa, and Grokster. Unlike the Napster case, the issue of liability was very much in question. It was not clear if licensees of the decentralized network could be expected to have any control over user activity, much less the ability to prevent unauthorized distribution of copyrighted works.

The answer came in April 2003, after Kazaa had been stripped from the case because of jurisdictional issues. A federal judge ruled that

> ```
> Grokster and StreamCast are not significantly different from
> companies that sell home video recorders or copy machines, both
> of which can be and are used to infringe copyrights... When users
> search for and initiate transfers of files using the Grokster
> client, they do so without any information being transmitted to
> or through any computers owned or controlled by Grokster. If
> either defendant closed their doors and deactivated all computers
> within their control, users of their products could continue
> sharing files with little or no interruption. [70]
> ```

The case was quickly appealed, and the RIAA and MPAA shifted their legal arguments to reflect the judge's findings. If the FastTrack licensees were unable to monitor user activity, they reasoned, this was by design, and therefore the design must be changed. In August 2004, the court once again sided with the defendants, explaining that

> ```
> The introduction of new technology is always disruptive to old
> markets and particularly to those copyright owners whose works
> are sold through well-established distribution mechanisms. Yet
> history has shown that time and market forces often provide
> equilibrium in balancing interests, whether the new technology be
> a player piano, a copier, a tape recorder, a video recorder, a
> personal computer, a karaoke machine or an MP3 player. Thus, it
> is prudent for courts to exercise caution before restructuring
> liability theories for the purpose of addressing specific market
> abuses, despite their apparent present magnitude. [71]
> ```

The dispute is now in the hands of the Supreme Court. The RIAA and MPAA have made it clear that they are asking for nothing less than a new standard to define copyright infringement. Peer-to-peer networks, they say, have forever disrupted the balance between technology and content ownership. As such, a company should be judged not by its products, but on whether its business is predominantly based on the distribution of infringing works.

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[70] John Borland, "Judge: File-Swapping Tools are Legal," *News.com*, 25 April 2003.
[71] John Borland, "Judges Rule File-Sharing Software Legal," *News.com*, 19 August 2004.

Analysis

For twenty years now, the standard for copyright infringement has relied on the 1984 *Sony v. Universal City* Supreme Court ruling. The *Sony* case was remarkably similar to *Grokster*. Again, content owners were fighting the development of a new technology that threatened their distribution model. This time, at issue was the introduction of the VCR, which MPAA President Jack Valenti famously likened to the Boston Strangler. The court ruled that

> ```
> The staple article of commerce doctrine must strike a balance
> between a copyright holder's legitimate demand for effective –
> not merely symbolic – protection of the statutory monopoly, and
> the rights of others freely to engage in substantially unrelated
> areas of commerce. Accordingly, the sale of copying equipment,
> like the sale of other articles of commerce, does not constitute
> contributory infringement, if the product is widely used for
> legitimate, unobjectionable purposes. Indeed, it need merely be
> capable of noninfringing uses. [72]
> ```

By any measure, peer-to-peer networking meets this criterion. The RIAA and MPAA allege that only 10% of the files available on the FastTrack network are shared legitimately. However, in the *Sony* case, the court found that just 9% of videotape recordings were authorized by content owners. More importantly, if an estimated 13 billion files were available on peer-to-peer networks by 2004, 1.3 billion of these are available for legitimate use.[73] In comparison, 128 million items are available to the public at the Library of Congress.[74]

The RIAA and MPAA, in proposing to abandon the *Sony* standard, are not simply defending their dominant position in the distribution of copyrighted works. Judging technology on "predominant" use would actually strengthen their hand. The recording and motion picture industries are a closely aligned group of incumbent businesses. In deciding whether to license content, they essentially dictate the proportion of lawful use. Looking back to *Sony*, we see that use of the VCR shifted once studios agreed to release films on videotape. This begs the question of how a court could adequately judge future non-infringing use, much less an investor of a nascent technology who must consider potential liability.

Moreover, as the National Venture Capital Association wrote

> ```
> At the heart of the Petitioner's argument is an arrogant and
> unreasonable claim – that the Internet must be designed for the
> ```

---

[72] Supreme Court Brief for Internet Law Faculty William W. Fisher III, et al. as *Amici Curiae* in support of respondents, Metro-Goldwyn-Mayer Studios Inc., et al., v. Grokster, Ltd., et al.
[73] Supreme Court Brief for American Civil Liberties Union, et al. as *Amici Curiae* in support of respondents, Metro-Goldwyn-Mayer Studios Inc., et al., v. Grokster, Ltd., et al.
[74] *Ibid*.

```
            convenience of their business model, and to the extent that its
            design reflects other concerns, the Internet should be illegal. 75
```

The RIAA and MPAA have essentially argued that should the ability to stop the distribution of infringing works be a technical possibility, that corresponding design must be chosen regardless of other factors. But FastTrack's decentralization should not be considered an inducement to copyright infringement. The peer-to-peer model, in not relying on any central server, allows for a network that is both robust and efficient. It is nothing less than fundamental to modern information architecture.

5.   International Exposure

My analysis thus far has been focused on the United States, but an essential aspect of file sharing is its international nature. Peer-to-peer systems do not recognize international boundaries, nor do they respect variations in law or jurisdiction. This has predictably been exploited by both P2P companies and users.

Physical distance is largely irrelevant to file sharing. (Oberholzer, Strumpf, 2004) A peer is not much more likely to request a file from a machine in close proximity than one thousands of miles away. (Gerber, Houle, Nguyen, Roughan, Sen, 2003) And by no means is file sharing an American phenomenon. By 2001, international use of Napster outweighed domestic use. (Goldberg, 2002) Furthermore, a majority of file requests from US peers were answered by machines located abroad. (Oberholzer, Strumpf, 2004)

The P2P industry is in itself a lesson in geography. Most P2P companies are registered to do business in countries where they are relatively immune from legal threat. We now know that Sharman Networks, for example, is incorporated in the Pacific island of Vanuatu, although it employs a management company in Australia and keeps its software in Estonia. But for several weeks after Kazaa became the world's most popular file-sharing application, no one was able to determine where the company was physically located.[76]

The ability to incorporate in almost any country has afforded P2P companies a level of indemnity that was simply unimaginable before the advent of the Internet. In most instances, copyright owners find that their hands are tied. EarthStation 5, which claimed to be located in a Palestinian refugee camp, was well known for taunting the US recording and movie industry. It issued this press release in August 2003.

```
            In response to the email received today from the Motion Picture
            Association of America to Earthstation 5 for copyright violations
            for streaming FIRST RUN movies over the internet for FREE, this
            is our official response! Earthstation 5 is at war with the
            Motion Picture Association of America and the Record Association
```

[75] Supreme Court Brief for National Venture Capital Association as *Amicus Curiae* in support of respondents, Metro-Goldwyn-Mayer Studios Inc., et al., v. Grokster, Ltd., et al.
[76] John Borland, "Morpheus Woes Lift Rival From Obscurity," *News.com*, 5 March 2002.

> of America, and to make our point very clear that their governing
> laws and policys (sic) have absolutely no meaning to us here in
> Palestine, we will continue to add even more movies for FREE. [77]

Of course, laws regulating the use of P2P networks also vary from country to country. In Canada, for example, both downloading and sharing copyrighted works is perfectly legal.[78] In other nations, copyright enforcement may be feeble or non-existent. (Hwang, 2004) Countries that do not have a strong content industry of their own have little incentive to implement restrictions on ownership. In some cases, governments actively encourage infringement, hoping to stem the flow of revenue into what they consider to be a culturally hostile influence.[79]

Even so, the vast majority of content owners simply run into jurisdictional issues when fighting piracy abroad. It is no coincidence that most OpenNap and BitTorrent servers are located outside the United States. Efforts by the recording industry to control their use have met with indifference and distain. The response to a violation notice by a Swedish BitTorrent site, while more colorful than most, is also quite typical.

> As you may or may not be aware, Sweden is not a state in the
> United States of America. Sweden is a country in Northern Europe
> [and] US law does not apply here… It is the opinion of us and our
> lawyers that you are fucking morons. [80]

6.   Proposed Framework

It is important to recognize that content ownership does not consist of an absolute set of rights. Copyright law is designed to balance the needs of both producers and consumers. Authors need protection from abuses that would deny then fair compensation or the ability to retain some degree of creative control. Consumers, in turn, must be entitled to adapt a work for their personal use.

The balance of copyright is determined by a dynamic process which reflects the costs and benefits of ensuring these rights. Lemley (2003) conceptualized this balance as a point on a continuum, in which content producers retain absolute rights on one end, and consumers retain absolute rights on the other. [Figure 12] Traditionally, US law has favored the rights of producers, allowing them to claim most of the value of a work with minimal cost. Consumers faced high costs if they tried to reclaim some of these rights.

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[77] "Earth Station 5 Declares War Against The Motion Picture Association of America," PR Newswire, 22 August 2003.

[78] In Canada, making a copy of any work constitutes fair use, regardless of whether the source itself is authorized or not. Furthermore, it is legal to make copyrighted works available to others, since in doing so, one enables this fair use.

[79] Scott Jensen, "The P2P Revolution: Peer-to-Peer Networking and the Entertainment Industry" (white paper published 9 September 2003), *nonesuch.org*

[80] Clive Thompson, "The BitTorrent Effect," *Wired*, January 2005.

Figure 12: The Balance of Copyright (I)

Consumers   Producers

Dominate   Dominate
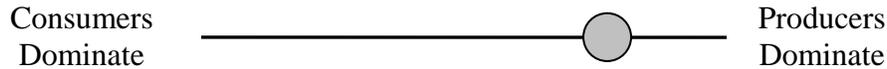
With the introduction of peer-to-peer file sharing, the balance of copyright shifted abruptly to the left. [Figure 13] Producers now faced high costs in protecting their rights. Consumers, however, found that they could afford a greater share of control.

Figure 13: The Balance of Copyright (II)

Consumers   Producers

Dominate   Dominate
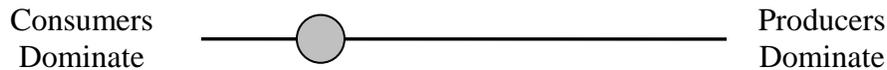
I propose a similar framework, but one that better illustrates how changes in the supply and demand for control determines the balance of copyright. Consider the diagram below. [Figure 14] It is reasonable to assume that as the amount spent on copyright enforcement increases, so to does the degree of control afforded to a content producer. But consumers value a work based on the benefits of consumption. As producer control increases, fair use decreases, which implies fewer benefits to the consumer. So, as copyright costs increase, the demand for control by consumers will decrease.

It is important to note that the balance of copyright depicted is an aggregate point for all producers and consumers and for all copyrighted works. Naturally, a producer's desire for control of a particular work will vary, as will the value a consumer places on fair use. As such, piracy is not only predictable, it is also efficient. But in general, should a producer spend to the right of the balance point, consumers will comply with copyright law. Not spending enough, to the left of the balance point, results in piracy.

Figure 14: The Balance of Copyright (III)
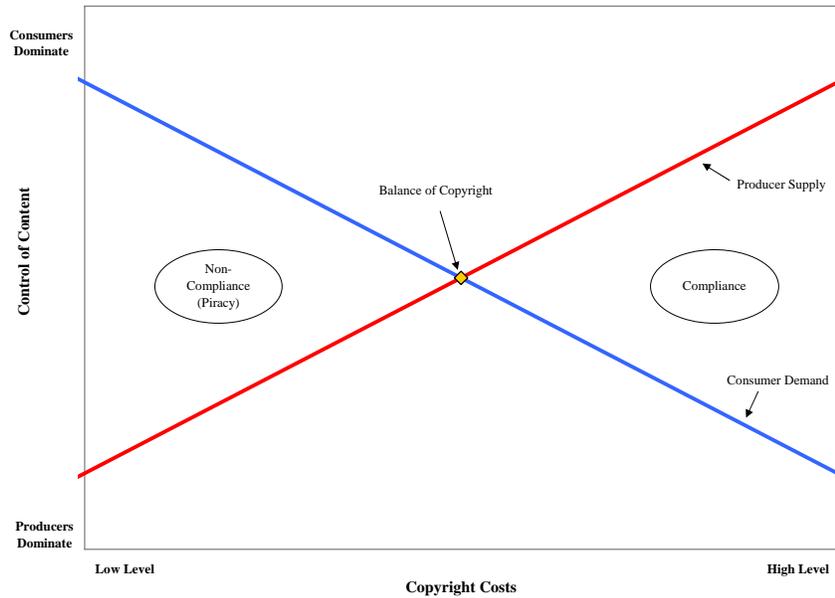
File sharing significantly increases the cost of enforcing copyright. Producer supply of control falls for any amount spent on enforcement. As shown in the model, copyright costs increase, while control decreases. [Figure 15]

Figure 15: The Balance of Copyright (IV)
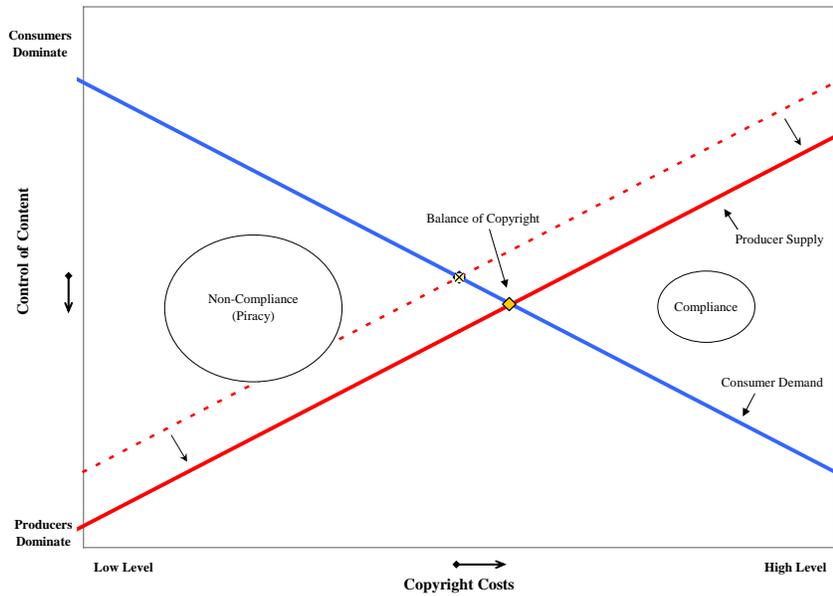
However, producers can also influence the cost of fair use. For example, by seeding a peer-to-peer network with fake files, copyright owners increase the demand for legitimate works. [Figure 16] Consumers actually demand less control over content. Copyright costs decrease, although the overall level of producer control also decreases.

Figure 16: The Balance of Copyright (V)
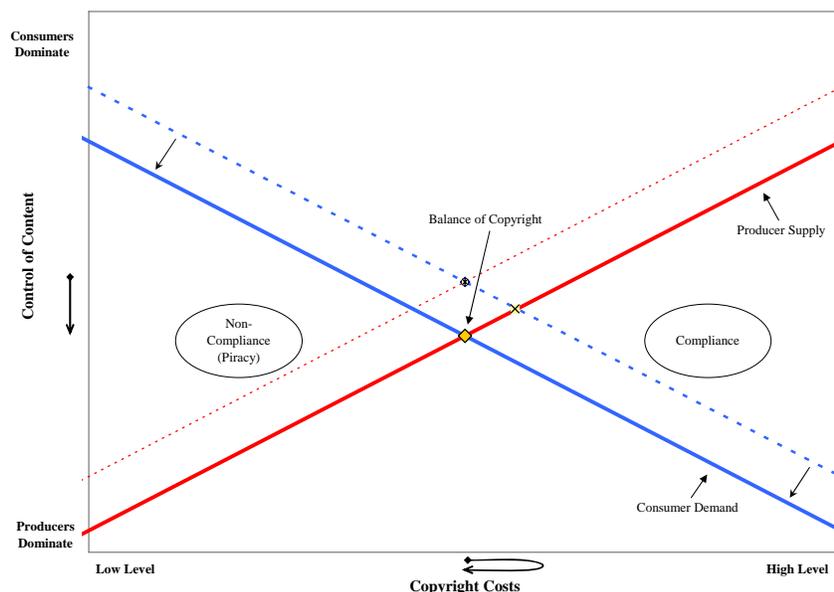
Clearly, file sharing networks are increasingly resistant to destabilization. However, there are other means by which content owners can shift consumer demand for control. The focus on damaging unauthorized content may need to shift to enhancing legitimate works. As Wayne Rosso, president of Grokster, once said

```
You have to liken P2P to tap water. It is always going to be
there. It's free, and people are going to use it. But bottled
water makes a lot of money too. ⁸¹
```

7.   Conclusion

Pundits on both sides of this debate are fond of invoking apocalyptic visions of what is to come, be it a future without copyright or a future without file sharing. Each is terrifying and completely implausible. No technological change will ever uproot the basic need for copyright, nor will a capitalist society deny itself a powerful tool because it threatens incumbent businesses.

To be sure, peer-to-peer networking will force drastic and sometimes uncomfortable change. However, this is the nature of change, not the nature of peer-to-peer. We need to be comfortable with the idea that evolution, by design, is difficult and often painful. Joseph Schumpeter eloquently wrote

```
A system -- any system, economic or other -- that at every given
point of time fully utilizes its possibilities to the best
advantage may yet in the long run be inferior to a system that
does so at no given point of time, because the latter's failure
```

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[81] John Borland, "Free vs. Fee: Underground Still Thrives," *News.com*, 30 May 2003.

> to do so may be a condition for the level or speed of long-run
> performance. (Schumpeter, 1950)

We are only just beginning to understand the nature of the digital revolution. At this point, only one thing is certain: nothing will ever be the same.

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