



Broadband technologies transforming business models and challenging regulatory frameworks – lessons from the music industry

MusicLessons - Deliverable 1

Report on technology versus usage and effects

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Key observations from the report

In order to defend established business models for the distribution of music, the major record companies have done their utmost to hinder the development of P2P networks, by means of

- Having activities of firms offering P2P services or technology declared illegal, on the grounds that their major purpose is to encourage people to ignore copyright laws. Napster was closed. At the time of writing, April 2005, the jury is still out as regards the case of Kazaa /Altnet (Australia) and Grokster (USA).
- Investing heavily in lobbying politicians and legislators in support of their claim that file-sharing is stealing, and that there is a direct causal link to falling CD sales and lay-offs.
- Commissioning companies to pollute the Internet with "spoof" files, but at the same time, becoming more and more dependent on eavesdropping in P2P networks ("sniffing") for planning marketing strategies based on P2P users' preferences.
- Mounting legal attacks on individual file-sharers and demanding considerable sums of money in out of court settlements.

Smaller record companies and creators, on the other hand, see these new forms of customer interaction as a marketing opportunity for the unknown creator, developing business models that use the unregulated Internet to create a fan base amongst potential future consumers.

Available data does not support a direct link between file sharing and diminishing music sales. Econometric studies have not been able to find any significant effects. User studies, however, identify a relatively small group who say that they buy less music but the majority, 80 - 85 % of the down-loaders, maintain that their purchases remain the same or more.

Music file sharing can then not explain the drop in CD sales from 2000 and thereafter. What was witnessed was an effect of the change of music format from CD to MP3; the music industry was too late and not sensitive enough to make a response to this change. Today, in April 2005, there are many opportunities to download and pay for music (MP3) online and the sales are up again in many territories. A significant observation is that concert/touring business has been growing dramatically since file sharing became popular.

The strategies of the major content owners have driven software P2P development in the direction of networks which offer participants ever greater degrees of anonymity. The tarnished reputation of P2P technology stemming from content owners' attacks could hinder the wider potential of this technology in many other areas than those involving the mere swapping of audio- and audiovisual files. Some of the music industry rhetoric and strategies could actually do more to harm than to support the cause of copyright, as regards acceptance in society as a whole.

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1. Music industry responses to the digital revolution

1.1 Historic preamble – from the pianola to the Peer-to-Peer network

History often repeats itself. When the gramophone record emerged, manufacturers of pianolas tried to stop it – the new technology would ruin the music industry. When radio emerged, music publishers in the USA did their best to ban music from being distributed through this new medium. A long trip through the courts, the formation of a composers' collecting society (ASCAP) and a supreme court ruling eventually led to a negotiated solution, the broadcast licence.

A similar tale can be told for each new disruptive technology. The film industry predicted that TV would lead to the death of film and tried to hinder TV stations from transmitting films. The same argument emerged when the sound and video recordable cassettes came on the market. The then head of the Recording Industry Association of the USA (RIAA) is quoted as saying: “for every album sold, one is taped. In our henhouse, poachers almost outnumber the chickens” (*Kusak-Leonard 2005*). Home taping was killing the music industry. Dual track recording encouraged stealing and should be banned according to the recording industry – a key legal ruling in the UK (the Amstrad case) found however that such equipment could be used for legitimate purposes and therefore was permissible. The Sony-Betamax case in the USA went to the Supreme Court and the judgement was virtually the same.

So from an historical perspective, the convulsions caused in the music industry by the development of digital networks, file sharing and storage systems, is hardly surprising. And one would expect it to be a temporary phase while positions of different parties are established, and financial/legal rules of play agreed.

But there would seem to be a number of differences, not only ones related to the magnitude of the responses.

- The prospective of a new technology allowing consumers to make unlimited numbers of perfect copies and swap them anywhere around the world has been interpreted by the industry as a far greater perceived threat than the audio cassette.
- In past conflicts regarding new technology, the route to resolution has been through the courts. New technology has never been banned on legal grounds, but new payment models have emerged, based on uses involving the very same new technology. The much-hated VHS cassette became a major source of income for the film industry when it started renting films to consumer with VHS players. In the current case, the music industry has focused not only on trying to block technologies and actors seen as unacceptable (file sharing, Napster etc) but has also focused on individual consumer behaviour. The entertainment industry has never before chosen the tricky route of suing individual consumers, who presumably are future potential customers, for behaviour deemed to be unacceptable (stealing). The potential PR nightmare of suing

future customers has functioned more as a scare tactic than triggering an awakening of the body politics moral conscience regarding illegal activities. The Pew Internet and American Life Project's February study of Internet users in the USA found that 28% no longer downloaded music because 'they were afraid to get into trouble'. 15% said they had stopped because of viruses, pop-ups etc, but only 10% claimed that their discontinuation of file-sharing was a result of a decision 'that it was wrong' (*Pew/ALP quoted in Music & Copyright April 13th 2005*).

- Most of the rhetoric has come from the recording industry, where financial results have been sliding. Other sectors of the music industry, for instance the live /concert sector, appear to be in much better health. Evidence suggests that activities within digital networks have a marketing and promotion effect which has supported the concert industry. The global value of the sound carrier market reached a peak in 1999 (38 billion dollars), falling to 31 billion in 2002, but rising to 33 in 2004. This can be compared to the global value of music and event merchandising, concerts and touring, which Kusek & Leonard estimate at 25 billion dollars/annum, and music publishing (12 billion U.S. dollars). Certainly the live sector has seen spectacular rises over the past 3 years. According to the monitoring agency Pollstar, ticket sales in the U.S. rose from 1.7 billion dollars in 2000, to 2.8 billion in 2004. Music & Copyright (April 2005) estimate that global box office receipts, excluding classical music, opera and musicals) exceeded 10 billion dollars for the first time in 2004. Kusek and Leonard (2005) conclude that "the record business is suffering, but the music industry as a whole is alive and well".

1.2 Traditional business solutions for deriving revenue from disruptive technologies

A limited number of business and legal solutions have been used over the decades to solve the music industry's "problems" arising from new technology. A number of negotiated licenses have been concluded. Copyright societies have granted radio stations blanket licences allowing them to play all music repertoire, as long as the stations report back on which music has actually been performed. At times the state has intervened and applied statutory or compulsory licenses, specifying for example, in the USA, how much composers and publishers should receive for the inclusion of a musical work on a physical carrier. Where content owners are reluctant to make the works they control available to the public, the state (if it considers such availability to be in the public interest) can enforce a compulsory licence, guaranteeing that rights holders receive remuneration but are required to provide access to the market.

Levies on blank tapes were introduced in a number of EU countries in the 1980s. The system recognised that home taping could lead to a loss of revenue for rights holders, and the levy provided a certain measure of compensation. This area is still the subject of much debate in connection with the implementation of the EU Copyright Directive (2001). More on this later.

Since the introduction and growth of file sharing services (P2P), the recording industry has shown no desire to legalise this widespread activity via one or more of the traditional solutions listed above. The industry's strong message has been that file sharing is piracy (stealing), that every download amounts to a lost sale of a unit of physical product (a CD for

instance), and that file sharing allows consumers to get music for free. Provision of alternative legal downloading services has been slow to say the least, a fact that is readily admitted by the industry.

1.3 The “official” recording industry position since 1999

A number of interesting points can be made regarding the “official” record industry position.

a) Downloading of music is not entirely free. Consumers have to pay for Internet access, and require certain hardware. A Swedish study from 2003 estimated that share of the fees the 8 million Swedes pay annually to their operators/ISPs purely for downloading and exchanging music amounts to approximately 150 million Euros per annum. This can be compared to an annual value of sound carrier sales in Sweden of around 200 million Euros. (*Landegren, J., Liu, P., “Usability Factors in the Distribution of Digital Music Services”, Masters thesis, Royal Institute of Technology, Stockholm 2003*)

b) Most downloading is not commercial piracy as for example in the case of an illegal CD factory, where individuals provide and charge for illegal copies. P2P activities mainly involve individuals who exchange music as a hobby.

c) That each download, had it not happened, would have led to an equivalent sale in the physical market has been challenged by a number of researchers. Studies from the Harvard Business School estimate that up to 5000 downloads must occur before there is a likely risk of a lost sale of one unit. Other research suggests that sharing music in the virtual environment stimulates a need for equivalent physical goods or experiences. Some groups of file sharers actually purchase more physical goods as a result of P2P. The rise in concert attendances is also probably linked to this phenomenon. P2P activities, although a subject of official horror for the recording industry, have become more and more important for marketing decision-making in that very same industry. As we shall note later, “sniffing”, that is noting consumer preferences via electronic eavesdropping in P2P networks, has become a major focus of investment for the leading record companies, thereby providing what is seen as the best indicators of market desires and on which marketing strategy can be based.

If Internet usage costs as much as it does, then why has a business solution not emerged involving a sharing of revenues between operators and rights holders? The answer lies primarily in the international and national conventions and laws, which have been designed to protect property in the virtual world.

1.4 Legal frameworks and their relevance

The first global attempt to develop a legal regime for protecting immaterial rights in the digital environment was the WIPO copyright directive of 1996. This then served as a baseline for national and regional legislation, including the Digital Millennium Act in the USA (2000) and the EU Copyright Directive of 2001.

Heavy lobbying from two quarters coloured these legal instruments. They reflected the concerns of both the international content industries (primarily audio and audio-visual) and the

telecommunications sector. This resulted in the content industry being given a legislative base that would allow for more stringent control over IPRs in the digital than in the analogue environment. And the telecommunications sector was spared the problems associated with conduit responsibility. The latter covered both moral issues (an operator can hardly be held responsible for the nature of a communication between individuals over the network) as well as economic aspects. Telecommunication firms (operators and ISPs) have not been willing to discuss revenue sharing with rights holders when individuals trade copyrighted materials over their networks.

The implementation of the EU Copyright Directive over Europe has been slow. This is partly because it includes some opportunities for ambiguity. Circumnavigating an encryption or copy-control device designed to hinder copying is illegal. This means that a protected digital work cannot, per definition be copied. Provisions for levies on carrier such as recordable CDs, assume that these provide a compensation for copying carried out legally for personal use. The more works that are copy protected, the less such personal copying can take place (legally) and the argument for a compensation levy thereby becomes inconsequential.

File sharing had hardly been conceived when the WIPO Copyright Treaty was drawn up. File sharing as a technology has numerous potential uses outside the realm of downloading/uploading of music and films. But its influence over the development of legal regimes is still strong. In such cases there is always a risk that the development of new business models arising from the introduction of new technology, can be delayed by incumbents endeavouring to retain older forms of doing business.

This point was made most emphatically in a speech by European Commissioner for competition policy, Mario Monti, in July 2004 at a workshop on “quality audio-visual contents”. His title was “access to content and the development of competition in the New Media market – the Commission’s approach”. The focus was on new communications services such as high-speed mobile telephone networks, and the need to offer consumers a wide range of content choice, as a prerequisite for growth and a healthy economic environment for infrastructure investment.

The Commissioner raised a number of concerns about competition in the area:

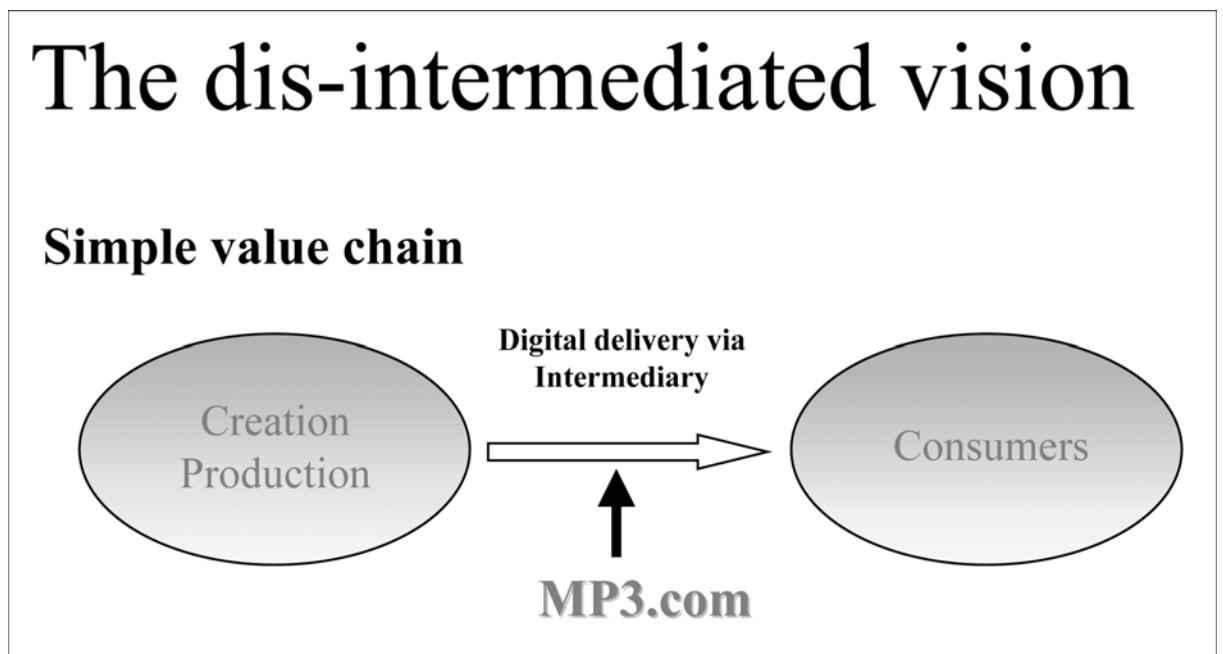
“The importance of access to attractive content for the success of all media is generally recognised by most operators ... since the Commission’s general objective is to keep media markets open and to stimulate growth as much as possible, the Commission needs to ensure that access to key inputs in the markets for delivery of content is not unjustifiably restricted... We certainly do not have the illusion of having removed once and for all the obstacles that, as far as content is concerned, might hamper the development and opening to competition of new media markets. . In many cases, innovation builds up as a challenge to existing technologies and/or processes. As such, it pits new players against established firms. Such configurations obviously create incentives for the incumbents to try to block or curtail the new dynamics in the market place, to try to maintain their position at the expense of the innovations” (*Monti 2004*)

1.5 The legal battles from 1999 through to 2005

With the established major record companies uncertain about security in the Internet, and unwilling to make their material available “legally”, other entrepreneurs stepped.

My MP3.com, launched in the late 1990s, was an initiative to make music available via a specific web site. It had two functions; one legal and the other for most part illegal.

MP3.com offered creators the opportunity to post their own music on the site, which was equipped with banner advertising. The firm shared advertising income 50/50 with the creators according to their percentage of actual downloads. It was a very efficient case of disintermediation, but also ran the risk of becoming very “noisy” as contributions increased. There were a number of cases of totally unknown groups who succeeded in navigating through the noise and generating revenue (see figure below).



To generate even more advertising income and attain a critical mass of users, the firm also made copyrighted materials available for downloading without the permission of the record companies concerned. The major players sued MP3.com for copyright transgression and won considerable damages. In 2002, one of the majors, Universal, waved some of the damages in return for taking over MP3.com, and closing down the illegal activities. Various regional subsets of MP3.com for unsigned music acts continued until 2003 when the last variant, in Europe, was closed. The experiment with the shortened value chain had been and gone.

Napster provided the first large-scale file sharing system, where transactions were logged on a central computer. Napster too was sued by the recording industry for encouraging the trading of copyrighted materials without permission from the owners (record companies and music publishers).

The initial focus on Napster when the RIAA announced plans to sue the operation, led to a huge increase in visits to the Napster site by curious individuals. This probably did more to establish P2P activities as a popular movement than anything else. One of the major record companies' parent organisations (Bertelsmann) saw a business potential in Napster, if it could be made legal. It bought Napster at the same time as the 5 major record companies were suing Napster in the U.S. courts.

Napster was found to be in breach of copyright and huge damages were passed down. Bertelsmann was either unwilling or unable to pursue the legalisation of Napster. The Napster company was sent into bankruptcy, a number of heads rolled at Bertelsmann, and the Napster brand name was sold to Roxio, a company that was then designing software for CD burners. Napster later re-emerged as Napster 2 embodying entirely different software and functioning as a subscription service for downloading, but not for file sharing.

In retrospect one can postulate that the closing of Napster might well have been a major strategic error by the international recording industry. Napster stored information regarding queries and transactions on a central server. It was easy to find out which works had been swapped. Had it been possible to legalise the service via some form of participation fee, then fair distribution of revenues generated to copyright holders would have been relatively simple.

Instead the anti-Napster strategy encouraged the software development of more decentralised P2P systems, offering users greater anonymity as regards both files swapped and user identity. As demonstrated in the technological section of this report, this trend has continued at an ever-increasing rate since 2002.

1.6 Heading for darknets – from Kazaa and onwards

Kazaa was the brainchild of Swedish entrepreneur Niklas Zennström. Programmers in Estonia wrote most of the code. It was originally intended to be a service which copyright holders could accept. Negotiations were carried out in 2002 with copyright societies first in Sweden and later in Holland. It appears that the recording industry was unwilling to collaborate. Kazaa was not marketed at all, but a few copies attracted the attention of a global virtual "word of mouth" chain and interest exploded. The recording industry's response was to chase Niklas Zennström and his company, which in 2003 was based in Holland. Legal challenges to Kazaa, based on the Napster case, were mounted in Holland. A final judgement ruled that Kazaa was not merely a technology, which encouraged individuals to steal copyrighted materials, but that it could also be used for legal purposes. Shortly before this ruling, Zennström had sold Kazaa to Sharman Networks based formally on the island of Vanatua, but with operations driven from Australia.

Once again a legal case was mounted against Sharman in a suit filed by the Australian recording industry association. The case started in late 2004 and a judgement is expected in mid 2005. The recording industry case noted that Sharman had introduced filters to minimise pornography traffic in the P2P network, but had not done the same with music. Sharman's defence was twofold:

Pornography filtering is based on identifying certain words and thereafter blocking files. Music titles consist of numerous words, and the same words turn up in both legal files (introduced by copyright holders who wish them to be available) as well as illegal files.

Another interesting aspect of the Sharman case referred to the recording industry's strategy of polluting P2P networks with false files. They maintained that many popular files involving copyrighted materials could not be downloaded because of the high presence of false files and decoys. We return to this aspect of recording industry strategy later.

Sharman are also involved in a legal P2P system where files introduced by copyright holders can be traded, and the resulting revenues shared between the service (known as Altnet) and copyright holders. Buyers can earn reward points when they purchase licensed materials. The Kazaa network gives access to both legal and illegal files, which can be both swapped for free or traded for a fee. In this context it resembles the former My MP3.com service, with file sharing added on.

Despite the on-going court hearing in Australia, a significant event occurred in March 2005. One of the larger independent record companies V2 (in the Virgin conglomerate) announced a deal to make all its copyrighted materials available via Altnet. Certain materials, such as promotion videos will be available for download free of charge.

Quoted in the UK trade paper Music Week (2005-03-26), V2 head of new media, Beth Appleton said: The only controversial element of this is that our legal files are going to be sitting alongside files that are illegal. ... It is an opportunity to expose (our materials) to all of the 2.5 million who use Kazaa at any one time, and to show that V2 is embracing P2P as a marketing and distribution model".

The technology involved in the trend towards more user anonymity and darknets will be described in the technological part of this paper.

1.7 The ultimate legislation-technology battle – Grokster to the Supreme Court and encrypted anonymity

Another post-Napster variant, Grokster was sued in 2003 in the USA by the recording and films industries. The purpose of the technology, they argued was solely to encourage criminal behaviour. Grokster responded naturally with the defence that a) they could not be responsible for how individuals used the P2P service, and that b) legal uses also existed. A U.S. Court of Appeals panel of judges found Grokster not guilty of copyright infringement. The industry appealed to the Supreme Court.

The Supreme Court treatment of this case could have long-reaching consequences. It involves essentially a second look at the Sony-Betamax ruling from the 1980s, but with a slight difference. The Court will probably look at what, if anything, Grokster could have done in the digital environment to ensure that copyrighted materials that were illegally in circulation were filtered out (similar to the discussions in the Kazaa case in Australia). Venture capitalists and a number of industrial observers have claimed that a negative outcome could thwart investment in new IT firms, i.e. if technology is deemed illegal in its infancy, before satisfactory business models have emerged for it to benefit all parties.

While the global content, technology and venture capital industries await the U.S. Supreme Court judgement, the shift towards various forms of greater anonymity continues in the P2P world, heading for an areas of collaborative computing which have been termed “darknets”.

The actions of the recording industry to stem file sharing have led to counter actions on a gigantic scale. P2P traffic has not been terminally thwarted, either by legislation or actions against individuals in the form of mass court cases.

The magazine Wired recently summarised a number of analysts’ observation regarding the growth of P2P traffic and its significance for infrastructure capacity and operators’ investment decisions.

According to research company TeleGeography, Internet users consumed more bandwidth than ever during 2004, a trend driven by peer-to-peer networks and growing demand for video files. This is even leading to operators increasing their network capacity.

Data from Cachelogic, a firm that monitors P2P traffic, suggest that efforts by the film and music industry to hinder P2P via enforcement have only increased the public’s curiosity in these new communication networks. P2P traffic now accounts for between 60 and 80% of Internet traffic. While capacity is not a current problem, the trend could require extra investments in the near future for some carriers.¹

1.8 Enforcement strategies of the music industry

Most of the enforcement strategies aimed at individual P2P users or groups of users (e.g. university students) appear to be driven by trade bodies representing primarily the 4 major record companies, SONY-BMG, EMI, Warner and Universal and the US-based film and computer games industries. Smaller independent companies, and indeed concert promoters and managers have been less anti file sharing in both public statements and actions. Indeed, as we have seen above, some are even signing deals with legal or semi-legal P2P networks. At the time of writing no major record company has allowed its recordings to be swapped, even in a legal P2P system where revenue is collected on the basis of usage, but where consumers can decide which materials they wish to share with others.

The recording industry’s legal onslaught on individuals has occurred mainly in the USA where thousands have been taken to court. Most cases, however, have been settled out of court. It seems the industry prefers to publicly set an example (or several examples) but without going through a court hearing. One possible reason is that courts might consider the exact economic damage, the commercial aspect of what the infringer did or did not do, which could lead to some legal uncertainties, not as to whether the acts were legal or illegal, but as to the reasonable extent of damages awarded.

Legal actions against individuals have spread from the USA to Europe. Denmark was one of the EU’s first member states to implement the Copyright Directive. The Danish recording

¹ <http://www.wired.com/news/business/0,1367,67202,00.html> 20050415

industry has been active in hunting down individuals who download music, sending out several demand notes requiring damages as an alternative to a court hearing. It is interesting to note that Denmark has observed one of the highest decreases in sales of legitimate CDs, down over 50% during a 2 year period from 2002 through to 2003. Finland, in contrast, which has not yet implemented the Directive, actually noted an increase in phonogram sales during the first quarter of 2005. Generalisations can hardly be made from such a minute sample, but the observation gives food for thought.

In Sweden the actions of the established music, film and computer games industries seems to have produced a strong counter movement. Illegal sharing of films and games is monitored by an organisation called the Anti Pirate Bureau (APB), financed mainly by the U.S. film and games industry. This is a private organisation which uses various methods to monitor P2P usage and the individuals concerned. Some doubts exist about the legality of the methods they use to collect information, which include electronic eavesdropping and the physical use of paid infiltrators and informants.

A counter organisation, called not surprisingly, the Pirate Bureau, has a very active web presence, and is clearly collaborating with similar organisations in other countries. They claim that the industry body's methods are illegal and that this justifies further downloading of products controlled by major companies, who in their opinion are over greedy. The process of reaction – counter reaction has escalated in Sweden, almost to the extent of what can only be termed a full scale cyber and publicity war in which the main victim could be the very thing copyright owners say they wish to defend, namely the copyright regime.

The actions of the Anti Pirate Bureau in Sweden have also led to a minor degree of dissention between different rights holders' organisations. The music performance collecting society, STIM, has a policy not to engage in spectacular actions aimed at individual offenders. STIM prefers to seek a major growth of legal services that can satisfy consumers' needs. The musicians union, on the other hand, appears to have moved much closer to the position of the producers that a download is a clear case of theft and must be prohibited. The latter message of course is not exactly true, since those rights holders who decide to make their materials available via a P2P network for free can do so, and related downloading is totally legal. Indeed this is the basis for a number of new business models which are emerging and are mainly used by small to medium sized players.

1.9 Extended suing of file-sharers

The recording industry's strategy of suing individual file-sharers is to be extended to cover more countries and continents, according to an interview with IFPI chairman, John Kennedy in the UK trade paper Music week (20050405). 963 actions have been brought in 11 European countries including first time applicants in the Netherlands, Iceland, Ireland. The campaign is being extended to Japan, and hopefully to South America (Brazil, Mexico). A UK industry spokesman stated in the same article that "suing was just as important as spreading the message ... song swapping on services such as KaZaa, Gokster and Gnutella is wrong".

This last very general statement is of course not totally correct. Where material is public domain, or where creators have allowed their own works which they control to be available over a P2P network, then the legality is total and unambiguous. This suggests that the major

record companies' strategy is not only to protect their own copyrighted materials, but also to hinder the emergence of new business models which use P2P networks for marketing purposes.

1.10 Content owners and the relation with ISPs/operators

Content owners have not been satisfied with the ISPs' interpretation of their lack of conduit responsibility. Many court cases have involved forcing ISPs to divulge the identity of customers who down or upload large quantities of data in the form of music or film files.

On March 9th, 2005, the Swedish Anti Pirate Bureau won a court order approving an action by the official bailiffs to raid the premises of one of Sweden's oldest ISPs, Bahnhof. To get the order, the APB was required to give exact details of their "property" which could be found on servers belonging to Bahnhof. Four films and 8 CDs were named, and the court minutes notes that evidence had been acquired via a named person who had had the possibility to link up to the servers in question.

The raid occurred the next day in the early morning. The bailiffs staff, however, could find no such material on the servers owned and operated by Bahnhof in their ISP/Web hotel operations. They did find two servers which were owned or used by an employee. These, according to statements from the APB contained thousands of music tracks and numerous films and games. The two servers were then confiscated, not by the bailiffs, but by the police who were called in.

It transpired that the APB had worked with an informer for over two years (a friend of the employee in question). Documents from Bahnhof indicate fairly convincingly that the informant had himself uploaded films and games onto the server in question.

An immediate assumption was that Bahnhof might demand heavy damages from the APB for unreasonable tarnishing of its reputation as an ISP. But after a week or two, a confidential agreement was signed in which both sides agreed to lay down arms and not engage in furthering legal consequences of the raid.

This event raises a number of issues. It is also unique being probably the first case anywhere of such a raid on an ISP. The fact that it occurred the same week as the Swedish government presented its planned bill for the implementation of the copyright directive also is curious. The public response was extremely negative, and three political parties shortly afterwards announced they were reconsidering their support for a bill which would ban up or downloading in cases where all rights holders had not given their prior permission.

A speculation is that the APB desired to do something spectacular as part of a scare campaign directed not only at individuals but also at ISPs (whom they see as hiding behind the absence of conduit responsibility concept). The confidential agreement with Bahnhof could involve a guarantee from the ISP to react favourably in future to any further complaints by the APB. This would thus avoid the need for the APB to go to court and possibly be forced to divulge the methods used by a private organisation to collect information.

The raid has also led to other legal responses. The Swedish data inspection agency is investigating the APB's methods of collecting and storing data about individuals, to see if they

are in conflict with Swedish legislation concerning collection and storage of electronic data about individuals, data that in principle cannot be stored without informing the individual in question.

Public response has taken different forms. The Bahnhof incident must have created a certain amount of government embarrassment since Sweden is already overdue with the implementation of the EU Copyright Directive.

The ensuing “cat and mouse” game demonstrated many variants. A group of young IT literate activists calling themselves the Angry Young Hackers, managed to break into the servers of the APB and publicised emails between the APB and persons who appeared to be taskmasters in a English-speaking country. The emails boasted of having had an infiltrator working in Bahnhof for over two years. The conclusion in the form of a confidential agreement between the Swedish IFPI, the APB and Bahnhof has made it very hard to find out exactly what employees and infiltrators were engaged in at Bahnhof.

We have devoted much detail to this event since it can be regarded as a critical incident in the war over the industry’s and indeed the public’s loyalty to and support for the copyright regime.

1.11 Legal distribution sites – the majors slow to adopt, but smaller players find new value from the Internet

Almost a year passed after the enforced closing of Napster before the then 5 major record companies offered consumers a “legal” way to buy music over the Internet. Two ventures were launched in 2002, PressPlay (Universal, Warner, Sony) and Musicnet (EMI and BMG). Their purpose was to offer subscription services to consumers willing to pay a monthly fee to be able to download a fairly limited number of recordings. The business proposal generated minimal consumer interest. The selection was limited compared to what was becoming available via file-sharing networks, and what was downloaded became erased if the consumer terminated the subscription.

By 2003, both Musicnet and PressPlay had folded. PressPlay’s technology was later sold to Roxio and turned up again in the guise of Napster 2 (which has nothing to do with Napster the original).

A number of entrepreneurs were starting other downloading services – OD2 in Europe offered a platform for music distribution. Rhapsody in the USA was another newcomer.

One of the first legal P2P types of systems was Whippit (UK) – trading occurred within a walled garden, but the content was solely from smaller independent companies keen to explore new means of distribution.

Paid downloading took off after Apple launched iTunes in 2003. Considerable material from the majors was offered at a price of 99 cents per download. Apple’s main aim was not to generate music from retail sales of music but to market the iPod, as well as Apple’s proprietary music file software. The price for purchasing content was high for Apple, around 60 – 70 cents of the 99 was demanded by the major record companies. This left little room for a profit margin for Apple, and established thereby an embryonic market where price competition was

unlikely. Despite early statements from Apple that all suppliers, large and small would be treated equally, conflicts arose when Independents found that they were being offered less per download, as well as having to wait longer to get into the system.

When the major record companies felt it was time to include download in sales charts, this created problems for the Independents who felt left out. In the UK, the independent record companies' organisation, AIM, filed a complaint with the OFT (Office of Fair Trading) against the trade association BPI's handling of a new sales chart that included download statistics. AIM argued in April 2005 that their members were discriminated against as regards access to services such as iTunes, and thus were not fairly represented in any sales charts the British Phonographic Industry or BPI (representing mainly the major record companies) condoned.

There are still no legal P2P systems where consumer can introduce any music they like and pay a charge for downloading. Some initiatives are emerging where the major record companies allow certain recordings to be traded within a walled garden, but they are conditional on different control mechanisms which limit via Digital Rights Management systems (DRM) when, how often and how long the works can be available.

Despite taking the Grokster issue to the Supreme Court, industry sources claim that the majors have been talking to Grokster's principles about a plan to offer a type of P2P system to Grokster users. This would allow users to have access to certain recordings whilst denying access to tracks that had not been authorised. A similar venture is Snowcap, pioneered by Napster's founder Shawn Fenning. This would allow for a filtering system that bans files not authorised by the major record companies.

A general conclusion is that the major record companies are eagerly trying to find virtual equivalents to the physical world's opportunity to limit what is available to the customer, and link availability to marketing campaigns. Pure P2P, even with a revenue system compensating rights holders, places the emphasis on consumer-led rather than producer-led marketing. The former is something the major record companies are clearly not ready to accept.

While the majors are keeping up the pressure on P2P applications and users, many smaller actors and creators are developing business models that use the power of the Internet and P2P. The P2P networks become places where one's music can be exposed. Revenues come further along the value chain if and when the public develops an affection.

Many examples of this are emerging. Consider this statement from a rock group The Radio Department, based in the southern Swedish city of Malmö:

"Wherever we play people seem to know about us, incredibly well. The audience stands there singing our songs at places where we hadn't the faintest idea they would know about us. It seems they had found our songs on the Internet and then spread them via local radio stations and fanzines.

It's a sign of the Internet revolution. Downloading maybe hurts artists like Madonna and Metallica - at least that's what they claim.

When we played in London last year, a guy from Italy had flown over just for our concert. and now he has organized two concerts in Bologna and Rome! And we get mail from China and Chile."

On the other side of the Atlantic, in Brazil, a similar tale is being told. A rock musician from San Paulo got an invitation from a concert promoter to play in Barcelona, Spain. Since

none of his records had been released in Spain, he assumed that the interest had come from Brazilian ex-patriots in Spain. On his arrival at the concert venue he found an audience of 5,000 Spaniards who had found his music on the Internet – recordings he had himself uploaded to see if there was any interest.

The music his future fans had downloaded in Spain was available legally, and an unknown audience had found it.

There is a serious risk that such models could be hindered by the official music industry position, promoted forcefully, that downloading is theft and is therefore illegal.

Reflecting once again on our initial historical background, one can surmise that some form of legal P2P activities, where those who enjoy music can make their favorites available to a network of virtual friends, is an inevitable future reality. With the current cat and mouse game/war, there might be a number of unfortunate casualties amongst creators experimenting with new business models along the bumpy road to this future reality.

There is another surprising paradox in current market/marketing developments. The majors, in an effort to produce better financial results, are concentrating their resources on fewer artists and larger marketing budgets. But the reality of the market is that local artists are selling more and more (as a percentage of total legal physical sales) in many different countries. Local artists' sales accounted for almost 40% in Sweden during 2004, an all time high. A similar trend can be noted in the live music and touring business. The Internet seems to offer local artists an opportunity to create a market both at home and in other territories where the Internet offers curious music lovers a chance to find new experiences. Long-term this can only be positive for the music industry as a whole. The majors' strategy seems to be very out of synch with this observation.

1.12 Paradoxes continued – spoofing

As observed previously, a major record company strategy has been to pollute the Internet and P2P networks with false materials (spoofs and decoy files). Anecdotal evidence suggests that this has encouraged P2P users to migrate from Kazaa to other more “spoof-free” environments such as Direct Connect, Bit Torrent, etc.

The content industry has also been keen to promote the dangers of P2P networks, in particular their vulnerability for malicious software such as viruses. There is no evidence that they have been responsible for introducing software viruses into P2P networks. On the other hand, the admitted policy of using infiltrators and provocateurs to disturb, identify and expose P2P network users suggests the likelihood of such activities been over zero. No major record companies have admitted financing spoofing activities, but their trade organizations have preferred to “neither deny or admit”. News reports from one of the major suppliers of spoof files, OverPeer, in the USA, as well as financial results from their owners, Loud Eye, indicate an increasing trade value for this type of service.

That pollutions tactics have been successful is supported by empirical data from a few emerging studies. In December 2003, Patil downloaded a series of popular songs and identified the quantity and sources of spoof files and found that up to 70% of attempted downloads from Kazaa produced spoof files. Spoof or phony files were defined as:

Files “not sounding like the expected songs. They could fade out after 30 seconds, contain irritating defects, or be a totally different song altogether” (Patil, A., 2003 “*Identifying Sources of Spoof Files and limiting their impact on the FastTrack Network*” 6.805 *Ethics and Law on the Electronic Frontier*.²

Patil concluded that the sources of this form of pollution were a limited number of IP addresses, but that simple methods can be used to avoid downloading spoofs via identifying these sources and blocking them. Another conclusion is that spoofing “effectively blocks efforts to download music by smaller artists on major labels”, presumably because so many more real alternatives are available for the major artists.

A similar experiment was carried out in Sweden in late 2004/early 2005. Attempts were made to download a selection of newer and older works from the Kazaa network (purely for research purposes). In some cases, 100% of all the attempted downloads turned out to be polluted files introduced into the Kazaa P2P network. The results also indicate that an avid downloader of popular songs would consume an extraordinary amount of bandwidth in a number of unsuccessful attempts. The practice of spoofing is not obviously illegal, but it certainly can contribute to clogging of public networks, certainly in limited local area networks, where, for example, a housing association shares mutual bandwidth.

Two major US-based suppliers of spoof files have been identified: Covenant and Over Peer (mentioned above). Over Peer’s owner, Loud Eye has now purchased the UK-based music digital music distribution company, OD2. One can expect that Over Peer will extend its activities to local offerings in Europe.

1.13 Paradoxes continued. Sniffing – more and more important for marketing strategy

Public information about the range of music files that are actually swapped in P2P networks is limited. Data collected in our own research efforts suggests a 75/25 to and 80/20 mix between highly popular songs and a diverse range of more obscure works.

The major record companies have discovered that data regarding P2P activities can provide valuable data about consumers’ preferences. The phenomenon of “sniffing” (listening to traffic) has become a growing ingredient of importance in the major record companies marketing strategies. A number of firms such data, with the most well known one being US-based Big Champagne. Anecdotal evidence suggests that release plans for some major artists, e.g. for a schedule of singles from a CD album, have been revised on the basis of files being swapped or not swapped.

Here we have yet another paradox. The very industry that is trying so hard to outlaw P2P activities over the Internet is becoming more and more dependent on those very same activities as the best source of information regarding consumer preferences.

² <http://web.mit.edu/patil/Public/805project/>

1.14 Summary of the music industry response to digital music distribution

Throughout the history of the record industry, there have been tensions between smaller players, often amateurs and enthusiasts who willingly take risks in the market, and the major player who seek to minimize risk via seeking control over their products and high marketing investments (*Wallis, R., Malm, K. 1984*). These tensions have never been so apparent as now.

The major record companies have done their utmost to hinder the development of anarchic, un-managed P2P networks where their control over usage is minimal. Smaller players see these new forms of customer interaction as a marketing opportunity for the unknown creator.

Thus, the major companies have tried to have the firms offering P2P services or technology declared illegal, on the grounds that their major purpose is to encourage people to ignore copyright laws. Napster was closed. At the time of writing, April 2005, the jury is still out as regards the case of Kazaa / Altnet (Australia) and Grokster (USA).

The majors have also:

- Put much effort into lobbying politicians in support of their claim that file-sharing is stealing, that is the reason for falling CD sales and the lay-off of numerous music industry employees. The implementation of the 2001 Copyright Directive has played a key role in this strategy, allowing the industry to publicize the message that downloading is illegal.
- Put much effort into commissioning companies to pollute the Internet with “spoofer” files.
- Mounted legal attacks on individual file-sharers demanding considerable sums of money for out of court settlements. This initiative started in the USA and is now spreading around Europe.

At the same time, independents and start-ups (e.g. unknown music groups) have been developing business models that use the unregulated Internet to create a fan base amongst potential future consumers. This trend could be hampered by a widespread campaign to convince the public that all downloading is illegal. Such is not the case, even within the scope of the EU Copyright Directive. But how can consumers be expected to know whether a file made available by a group of musicians is fully legally available for downloading, without any functioning digital tagging system that can guarantee status of a file? If such a system could be speedily introduced, how would it deal with the myriad of spoof files introduced to frustrate file-sharers?

We have also noted that the major record companies are also becoming more and more dependent for their market intelligence on data gleaned from listening in to the activities of file sharers, i.e. the very activities the industry is dedicated to eradicating?

In Sweden, one can see signs of a public revolt against the anti file-sharing activities of the major audio, and audio-visual content owners, a revolt which could cause irreparable damage to the very concept these same players are dedicated to defend, namely the copyright principle.

2. Technology overview

2.1 Introduction

Peer-to-peer (P2P) systems and GRIDS have become very popular in the past few years. P2P systems, primarily because they offer a way for people to get content in a simple and cost efficient way. GRID computing has emerged as an important new field, distinguished from conventional distributed computing by its focus on large-scale resource sharing and innovative applications.

In this chapter we focus our technology overview on P2P systems. We do not have the ambition to present a complete coverage in this deliverable – there are lots of “complete” technology studies and overviews of such systems. This chapter will serve more as a basis for understanding the recent rapid developments of P2P systems and how this relates to the media market activities and actions. GRID systems are closely related to P2P systems and thus we will give a short overview of such systems also. Particularly since these systems are heavily supported within EU for resource sharing purposes within science and technology.

We will also describe some other important technologies that are important in the context of the present “game” between the media industry and the user. In that respect we will discuss new firewall techniques, especially designed for P2P software users, to block certain connections. Since 1999 there has been a successive technical development giving the user more opportunities to be anonymous when downloading media content. However, new technology such as device fingerprinting techniques under development can be used to counteract users terminals to be anonymous. Anonymous P2P systems will be discussed but also small world networks and darknets – an important occurrence.

2.2 P2P systems

P2P systems, beginning with Napster and Gnutella has become immensely popular in the past few years, primarily because they offered a way for people to download music in principle without paying³ for it. These systems represent a paradigm shift from the usual web client/server model. There are no “servers” - every system acts as a peer. The table below compares P2P systems with client-server and web based systems.

³ However, the user have paid for other things such as PC, Internet access, levies on CDs and other mass storage equipment etc.

Table 1 P2P and client-server based systems – A comparison

	Client–server		Peer-to-peer
	Session based	Web based	
Coupling between “peers”	Tight	Loose	Very loose
Communication characteristics	Asymmetric	Asymmetric	Symmetric
Number of clients	Moderate (1000)	High (1 000 000)	High (1 000 000)
Number of servers	Few (10)	Many (100 000)	None (0)

With a very large number of peers, content can be widely replicated, providing the opportunity for high availability and scalability, despite the lack of centralized infrastructure. P2P systems have been subject to extensive analysis and careful design to guarantee scalability and efficiency. Also, rather than being designed specifically for one purpose for example sharing of music, these systems provide a powerful platform for the construction of a variety of decentralized services. Examples of such services are network storage, content distribution, web caching, searching and indexing, and application-level multicast.

P2P systems are structured overlays that allow applications to locate any object (content) in a small number of network hops. Moreover, these systems can be designed to be scalable, fault-tolerant and provide effective load balancing. However these systems are not “secure” in the sense that they are not designed to withstand an adversary. If P2P systems are to be widely deployed on the Internet (at least, for applications beyond sharing music files), they must be robust against a conspiracy of some nodes, acting in concert, to attack the remainder of the nodes.

P2P networks are characterized by direct access between peer⁴ computers, rather than through a centralized server. P2P refers to applications that take advantage of resources (storage, cycles, content, human presence) available at the edges of the Internet.

Before going into details of P2P systems it can be worth mentioning the main advantages of P2P systems:

- No costs for central servers
- No costs for outbound communication from central servers
- No costs for management of central servers.
- No central servers that are vulnerable to attacks

⁴ Peer: ‘one that is of equal standing with another’

2.3 General characteristics of P2P systems

An application is P2P if it:

- Allows for variable connectivity and temporary network addresses
- Gives the nodes at the edges of the network significant autonomy

Another way to describe P2P networks, is to think about ownership: "Who owns the hardware that the services run on?". In this sense, P2P offers a way of decentralizing administration (as well as cost).

Another characteristic of most P2P networks is their self-organizing capacity: The topology of a P2P network must change as nodes (i.e. users PCs) will enter or leave, in order to maintain its connectivity and performance.

P2P file sharing networks can be classified by their "degree of centralization", i.e. to what extent they rely to one or more servers to facilitate the interaction between peers. Three categories are identified:

- Centralised
- Decentralised
- Partially (de)centralised

P2P networks constitute highly dynamic networks of peers with complex topology. This topology creates an overlay network, which may be totally unrelated to the physical network that connects the different nodes (computers). P2P networks can be differentiated by the degree to which these overlay networks contain some structure or are created ad-hoc. By structure we mean the way in which the content of the network is located with respect to the network topology (Is there a way of directly knowing on which nodes some specific content is located, or do we need to search the entire network or parts of it to find the content?):

One can distinguish between 3 three different topologies:

Unstructured: The placement of data is totally independent of topology. Since there is no information about which nodes are likely to have the relevant files, searching essentially amounts to random search, in which various nodes are probed and asked if they have any files matching the query. The disadvantage of unstructured systems is that it is hard to find the desired files without distributing queries widely. For this reason unstructured P2P systems are considered not to be scalable.

Structured: The overlay topology is tightly controlled and data (or pointers to data) are placed at specified locations. Structured systems offer a scalable solution for exact-match queries. The disadvantage of structured systems is that it is hard to maintain the structure in a system where nodes are joining and leaving at a high rate.

Loosely structured: Data is dependent of routing but not completely specified so not all searches succeed.

Table 2 Some well-known P2P networks – A short description

P2P network	Category	Topology	Characteristics
Napster	Centralised	Files anywhere Centralised index	Vulnerable to censorship, malicious attack and technical failure Quick response
Gnutella	Decentralised	Files anywhere Users connect directly via random search	Does not scale Does not always give an answer
Kazaa	Partially centralised	Files anywhere Super nodes service a part of the network	Reduced response time No single point of failure Vulnerable to censorship and malicious attacks
Direct Connect	Partially centralised	Files anywhere Super nodes service a part of the network	Reduced response time No single point of failure Not vulnerable to sensor- ship and malicious attacks due to special require-ments on users Direct Connect is an open, community oriented and user controlled network
BitTorrent	Decentralised	Fixed size pieces of files anywhere	Downloading of pieces possible only from connected peers i.e. not always possible to get a complete file
Freenet	Decentralised	Data are pushed for storage Data: files, identifiers, addresses Search by chained requests	Security and privacy issues Small world network

2.4 Technology development over time

Napster was the first system that started P2P file sharing. The technology behind Napster was a natural step away from ordinary web central server technology relying on distributed storage

but keeping a centralized database with a searchable index. The centralized database was possible to attack. When Napster was “attacked” another “natural” development step was taken to a fully decentralised system – Gnutella – and thereby introducing a step towards anonymisation of links between users and content. In addition to distributed storage Gnutella used a fully distributed database. A peer, only needs to know the IP address of one or a few participating peers, to reach any other peer hosting content. However the Gnutella technology had some scalability drawbacks and since it used random search for content it was not certain that a given piece of data could be found.

Kazaa, that was developed later, did not have the same properties as earlier P2P systems and became very popular. Kazaa uses “super nodes” that dynamically serve a small subset of the P2P system by indexing and caching content contained in the part of the system they serve. However, taking the users perspective, early versions of Kazaa had another drawback. It was easy (for the operator) to close down the system since it used one single port in the PC. The next version of Kazaa used port-hopping techniques making it in principle impossible (for the operator) to close down the system, since other services (FTP⁵) exists, that use the same port-hopping technique. However, as shown in other chapters in this report, there were other methods to close down Kazaa.

Technology has gone further towards more anonymisation. As an example, BitTorrent technology splits up content into smaller pieces when a file is made available. The main purpose of this technology is not anonymisation, but resource sharing. But it is tempting to believe that it can/will be used for anonymisation.

The systems Winny and Freenet use encryption to achieve anonymity. Freenet is designed so that information stored in the system is encrypted and replicated across a large number of continuously-changing anonymized computers. It is extremely difficult for an attacker to find out which participants are hosting a given file, since the contents of each file are encrypted, and can also be broken into sections that are distributed over many different computers. Even participating peers don't know what they are storing.

Freenet participants each run a node that provides the network some storage space. To add a new file, a user sends the network an insert message containing the file and its assigned location-independent globally unique identifier (key), which causes the file to be stored on some set of nodes. During a file's lifetime, it might migrate to or be replicated on other nodes. To retrieve a file, a user sends out a request message containing the key. When the request reaches one of the nodes where the file is stored, that node passes the data back to the request's originator. The routing algorithm is heuristic in nature. Therefore, the Freenet system does not guarantee that a given piece of data will be found.

Freenet can also be viewed as a small world network⁶ sometimes also called “walled garden” since data in the system is opaque to outsiders and even insiders.

TinyP2P is a proof of concept system. The system is included in this technology overview only because the P2P client is written in 15 lines of computer code only and thus it

⁵ File Transfer Protocol

⁶ The small world phenomenon is the hypothesis that everyone in the world can be reached through a short chain of social acquaintances. The concept appeared after an experiment by psychologist Stanley Milgram which found that two random US citizens were connected by an average of six acquaintances.

shows how difficult it will be to control or regulate development of P2P systems. TinyP2P is not suitable for large systems but can be used for small networks that can co-exist. Optimised technologies of this kind could very well be suitable for small world networks.

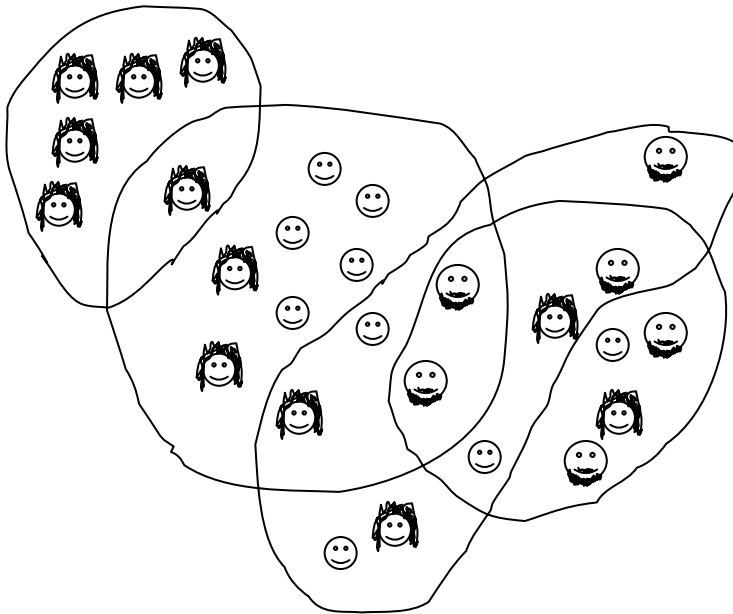
2.5 Small world networks and darknets

In the absence of global databases development of co-operating small world networks could very well be an outcome. Every small world network could be protected. Possibly a enhanced but downscaled version of the present popular Direct Connect system where the performance is controlled by its community oriented approach and user control.

Each small world network could be a darknet (*The Darknet and the Future of Content Distribution*: P. Biddle, P. England, M. Peinado, B. Willman; Microsoft Corporation). Behind the idea of a darknet there are three assumptions:

1. Any widely distributed digital item (music, software, game, book etc.) will be available to a fraction of users in a format that permits copying
2. Users will copy such items if it is possible and interesting
3. Users are or will soon be connected by high bit rate transmission

Figure 1 Illustration of interconnected small world darknets



For darknets to function it is important that there exist possibilities for new items to be injected into the net. This is possible only if content protection systems – DRM⁷ systems – are possible to break or that there is some other leakage in the management of content. However it is difficult to quantify the effectiveness of such DRM systems but up till now it is evident that they last between a month and one year or so.

DRM systems are used for two things – controlling and monitoring. Monitoring is used by the licensing institutions for statistics and later sharing of revenues between rights holders. Controlling is used to protect content from being copied. But DRM systems can be very intrusive, something users do not accept.

2.6 On user privacy

Another manifestation that users do not accept intrusion is a recently developed tiny firewall program called PeerGuardian. This firewall is especially designed for P2P software users, but also to anyone who is concerned about the investigations that corporations and authorities perform on the Internet and undesirables such as Ad servers and Spyware servers. PeerGuardian blocks connections for the configured IP ranges and logs the blocked connections. It uses blocklists for the blocking, but IP ranges can also be configured manually. PeerGuardian is pre-configured for blocking certain organisations such as RIAA, MPAA and many others.

User anonymity and privacy is very important. Internet technology is interesting in the sense that it is possible to hide very much of ones identity. E-mail addresses, computer MAC addresses etc can be spoofed. But recent research (*Remote physical device fingerprinting: T. Kobono, A. Broido, K. Claffi*) on physical device fingerprinting has shown that it is possible to remotely fingerprint and distinguish between different devices. The technique exploits small deviations in device hardware – clock skews. The authors have shown that the method is usable over long distances, multiple hops and different access technologies. Application examples are the tracking of a computer as it connects from different locations, and the counting the number of computers behind a NAT⁸ etc. It is not likely that this kind of technology will be used to track millions of users in the “game “ between users and the media industry, but it illustrates that a lot of measures and countermeasures exists that can be exploited in such a “game”.

2.7 Trust in P2P systems

P2P systems require a large amount of trust from their participants. A peer in the system must trust that all other peers implement the same protocols and will respect the goals of the P2P system. When content is requested based on keywords it is possible for an opponent to spoof the results. As described in another chapter of this report the recording industry has been deploying decoy music files, having the same name and approximate correct length but not the

⁷ DRM: Digital Rights Management.

⁸ NAT: network Address Translation

correct music. One solution to this is to introduce a concept of popularity as is done in Google's PageRank technology. Since one of the goals of this project is to develop new business models based on P2P technology it is interesting to see if it is possible to introduce such a popularity concept in P2P systems.

Another issue in P2P systems is that they require the user to install a program on their computer. This program will work together with other peers programs to implement the system. Users should not necessary trust arbitrary programs, written by a third party, to run on their computer. It seems necessary that some kind of security architecture is needed. GRID computing has emerged as an important new field having focus on large scale resource sharing and problem solving in dynamic virtual organisations. (*The Anatomy of the Grid. Enabling Scalable Virtual Organizations: I. Foster, C.Kesselman, S. Tuecke*)

2.8 GRID systems

A GRID system is a geographically distributed computation platform comprising a set of heterogeneous machines that users can access through a single interface.

GRID computing has emerged as an important new field with a focus on large-scale resource sharing and is a collection of computers, online instruments, data archives, and networks that are connected by a shared set of services that, when taken together, provide users with transparent access to the entire set of resources for industrial, science and engineering purposes. This calls for high control, with resource providers and users defining clearly and carefully what is shared, who is allowed to share, and under which conditions.

The implementation of such constraints requires mechanisms for expressing policies, for establishing the identity of a user or resource (authentication), and for determining whether an operation is consistent with the sharing relationships (authorization). Sharing relationships are often not simply client-server, but peer to peer.

P2P systems, as described above, have much in common with GRID computing, but they have to date not overlapped significantly. P2P developers have focused mainly on vertically integrated solutions (e.g. file sharing without access control), rather than seeking to define common protocols that would allow for shared infrastructure and interoperability.

GRID has been deployed in relatively sophisticated services and applications, connecting rather small numbers of sites into collaborations like scientific computation applications. P2P communities have developed rapidly around rather unsophisticated, but popular, services and applications. One can expect that P2P developers will try to expand into more sophisticated services. The Internet telephone system Skype is a sign of that.

Table 3 The distinction between GRID computing and P2P computing

Characteristics	GRID	P2P
Resource management	Distributed	Distributed
Resource ownership	Resource locked to singular or multiple nodes depending on architecture	Singular, multiple or distributed depending on circumstance and architecture
Resource allocation	Centralised	In principle no single permanent node for hosting centralised content
Interface	Single or multiple image	Circumstantial
Interoperability	Enforced within a framework	Multiple competing standards
Suggested equipment	High-end	Any type including wireless devices
Scaling	2-1000 units	Theoretically infinite. Depends on network backbone, transmission speed, transmission protocol
Discovery mechanism	Centralised index	In principle always decentralised

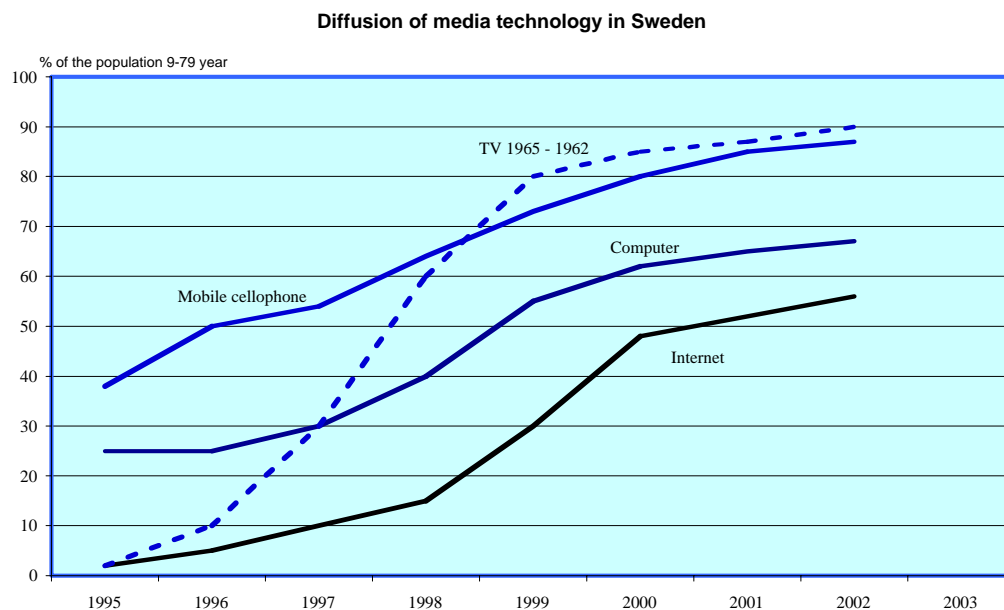
3. Technology and usage

3.1 The diffusion of new media

When Nicholas Negroponte 1996 published his book "Being Digital" he predicted that traditional mass media as newspapers and television will give way to consumer-led electronic media in which people will take only the information they need. Printed newspapers distributed as physical paper-objects will disappear in a few years' time as well as television channels broadcasted to a passive mass audience. Ten years later, however, television and the daily newspaper is still the main information source for most people. At the same time computers and the Internet has become a natural part of the everyday life of newspaper readers and among a majority of the television audience. The old media continues to exist together with the new media but at the same time there is an adaptation process when the role and function of the new media redefines the old.

Looking back in media history it took ten years for television to spread to 90% of the Swedish population. This is faster than in most other countries, partly due to the late introduction of television in Sweden. The withhold demand speeded up the diffusion process. But still 15 years after the introduction of television there were older people who stuck to the radio as their only broadcast media and it took 40 years until 99% of the population had access to television in their homes.

Diagram 1 Diffusion of media technology in Sweden



The introduction of a second television channel, TV2, was faster. There was only a need of a small adapter and new antenna to receive the new public service channel and instead of only one programme there were two programs to choose among. In just one year 90% of the population had got the new equipment.

The technological change between black and white and colour television was a little slower, but successively when old TV sets had to be replaced with new ones the proportion of colour TV sets increased. After 15 years 90% of the population had access to colour television. The spread of video recorders was slower. The demand was weak and the interest half-hearted. After 10 years 50% of the population had a video recorder in their home and today after 30 years 85% have an video recorder. However, the use of it is very sparse. Even slower is the spread of digital television. People are not interested, the demand is low and here the technical shift between analogue and digital television has to be forced by regulation. Without digital television there will be no television. (*Findabl, O. Television. Nordicom: Mediesverige, 2001/2002 and 2004*)

Far from all new media technology arouse a demand to get IT from the majority of the population. During many years computers were only of interest for 25 to 30% of the population. And perhaps it would still be like that if not Internet had been developed to a global communication and information network. In the middle of the 90s the diffusion of Internet started and in just 5 years half of the Swedish population had got access to Internet in their homes. The speed of the development is comparable to when colour television was introduced. But later, during the beginning of the new decennium the spread has declined and is today nearly zero. Contrary to colour television that in 10 years became a media technology for everyone, Internet has become in Sweden a technology for a majority, but 1 of 3 Swedes is still not part of the new information society and in most countries Internet is still a technology for a minority.

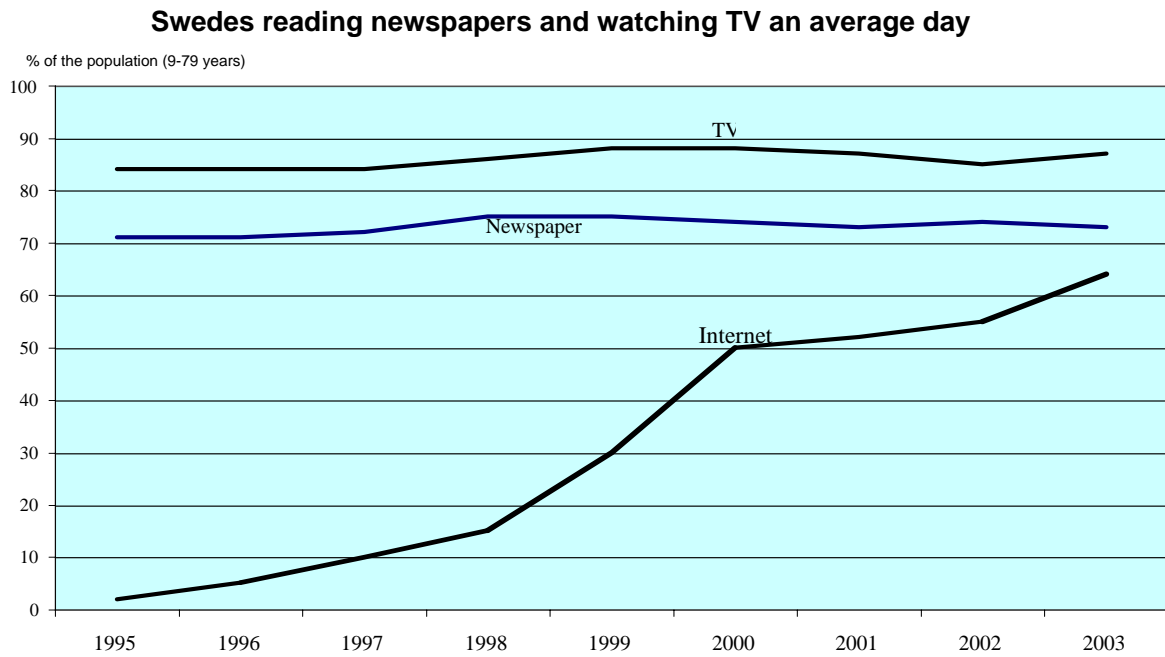
So the spread of new technology takes time and not all new technology and devices will be of interest for a majority. The development is not any longer driven by a demand but by economical and technological reasons. An exception is mobile cello phones which have slowly become a success and after 20 years 85% of the Swedes have got one. Contrary to Internet the diffusion of cello phones continued at the same speed even after 50% of the population had got access. However, 3G, the more sophisticated and more expensive cello phones are of interest only for a minor group of businessmen as well as the small computer like Palms. They will probably never be used by the great majority. (*Findabl, O. Internet and the Swedes. World Internet Institute, 2004*)

3.2 New media often complement and do not compete with old media

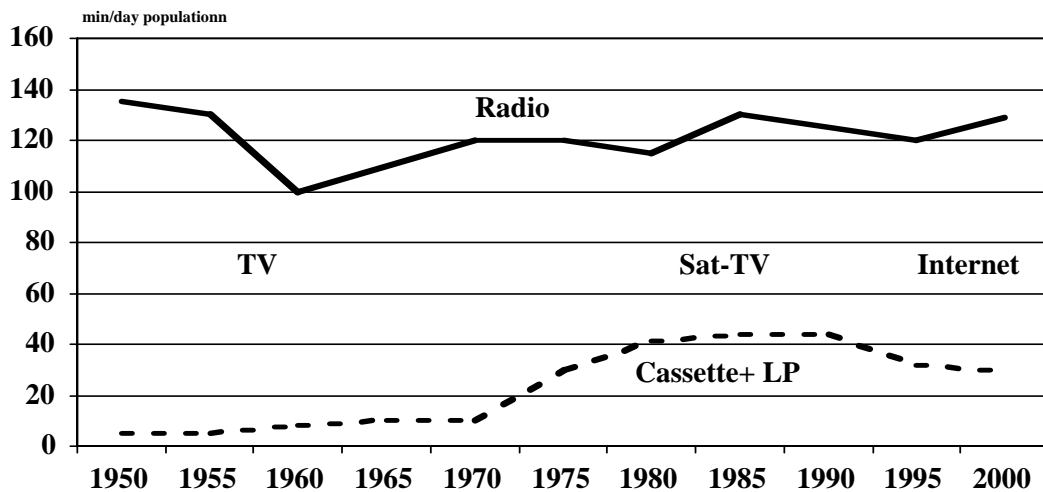
When the radio was introduced as a new media in the 1920th the newspaper owners were very afraid that their readers would change their media habits and start to listen to radio instead of reading newspapers. But what happened was that people began to listen to the radio and at the same time continued to read newspapers. When television started to broadcast in the fifties both radio and newspaper companies were afraid to loose their audience to the new medium with moving pictures. Radio listening declined for a short period but the schedules were

rearranged and instead of competing with television in the evenings radio became the medium of the morning and new music channels started. The radio adapted and survived even when people began to listen to music cassettes, and when people started to watch television newspapers were read as never before.

Diagram 2 Daily media consumption in Sweden



Changes in radio listening

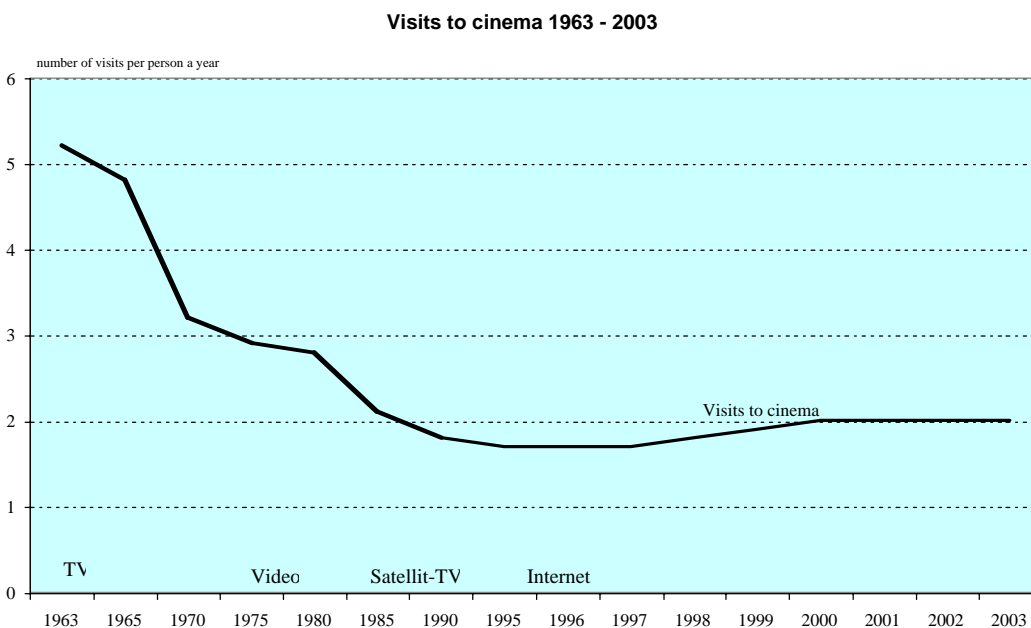


3.3 The exception when cinema lost its audience

The exception from the rule that new media is a complement, not a competitor, to the old media is the decline of the cinema audience. When television was introduced and started to show films several days a week television became the main film medium. It was not the brand new films but all kinds of older movies. Later came the video recorder that slowly spread among the population. People stayed at home watching television and the Swedes went more and more seldom to the cinema. Many cinemas all over Sweden had to close down, specially in villages and smaller towns.

So here we have an example when the new media, presenting the same content in a new context, take away the audience from the old medium. It is also of interest to notice that internet is not a rival for the cinema audience. On the contrary visits to the cinema have become a little more frequent during the last ten years.

Diagram 3 Visits to cinema in Sweden 1963 - 2003

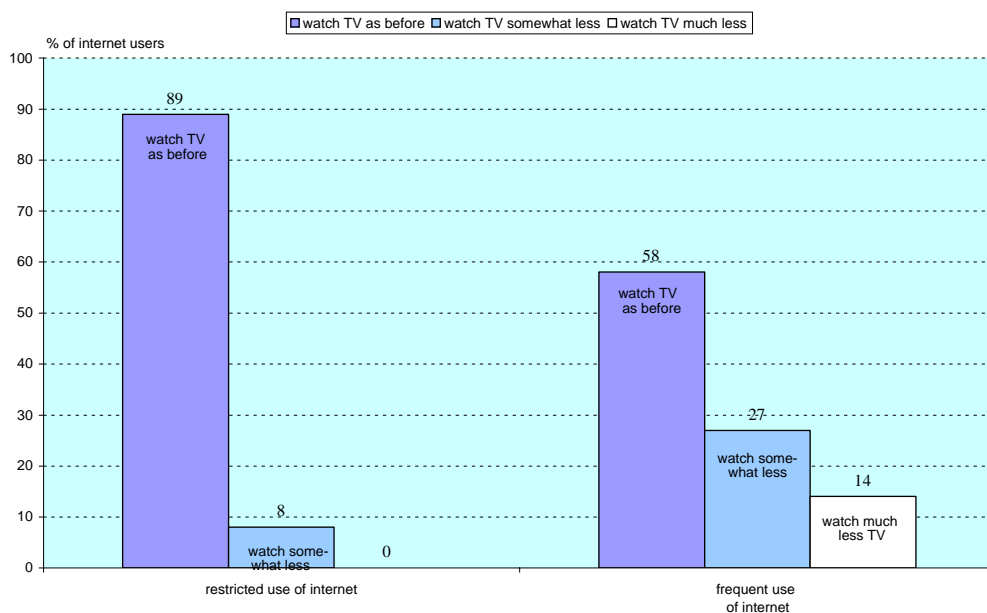


3.4 Different measures, different results

Surveys based on interviews with internet users can be difficult to assess. Often other kind of research – time use studies or observation – give different results. An example is how to estimate the effect of internet use on television. Do people watch as much as before, or do they have to reduce the time spent for watching to be able to use internet?

If we are comparing users and nonusers of internet, then there are only small differences in TV viewing time. They watch TV just as much both groups. The same result we can find in time use studies. The time spent watching, measured in minutes per day, have not declined since internet was introduced. Instead there is a small increase. But if we ask the internet users directly, if they use TV more or less or just like before, nearly half of the frequent users say, shown in the diagram below, that they watch less.

Diagram 4 *Effects of Internet use on watching TV among heavy, average and light users in Sweden*



3.5 The impact of file sharing on CD sales. Where have all the CDs gone?

MP3 is an audio compression standard that allows tracks from an audio CD to be compressed into a digital file at 1/10 of its original size. When it was introduced 1992 few understood its importance for the distribution and, storage of music. Once compressed, songs can be easily stored on a hard drive for playback on any Personal Computer, with virtually no loss in sound quality. Users can manage their music collection on their PC, home stereo connected to the PC, or Internet radio station. The small size of MP3s allows for hours of music to be stored rather than the one-hour limit of traditional CDs.

It was first 1999 in combination with an effective distribution network like Internet that the digital format MP3 became visible for a majority of young Internet users. And with the help of file sharing between peers (P2P) a network model was introduced where each

computer connected is simultaneously able to offer and request a service with parity and in a decentralized manner. The computers request and send files and supply services questioning the shared files.

The music industry, represented by RIAA, was afraid that young peoples' sharing of music files would result in a decrease of music sales and they wanted manufacturers to build a time-bomb trigger into their products that, when activated at a later date, would prevent users from downloading or playing non-SDMI-compliant music.

At the same time, 1999, the new way to distribute music started to pass the big music companies and musicians started to publish single and whole albums in MP3 format. A free download for the first week and then purchasable directly from the band's website.

November 1999 Napster offered a downloadable program, free of charge, and a public accessible FTP-site that made it possible to download music from personal MP3 sites.

Downloading music for free became a tremendous success and at the same time music sales started to level out. The music industry blamed Internet and they saw a direct causal negative link between file sharing and CD sales. They also sponsored research that supported their claim. On the other hand there were contrary evidence given from other research teams that showed that downloading music increased the music interest and people bought more CDs. As described in chapter 1 of this report, the disagreement ended in a trial where the RIAA, the music industry, accused Napster of illegal behaviour, giving away their music for free.

And if file sharing was the substitute for the purchase of a record there should have been a strong impact on the sales as 250 million CDs were downloaded per month at the peak of Napster compared to the national sales of 80 million CD per month.

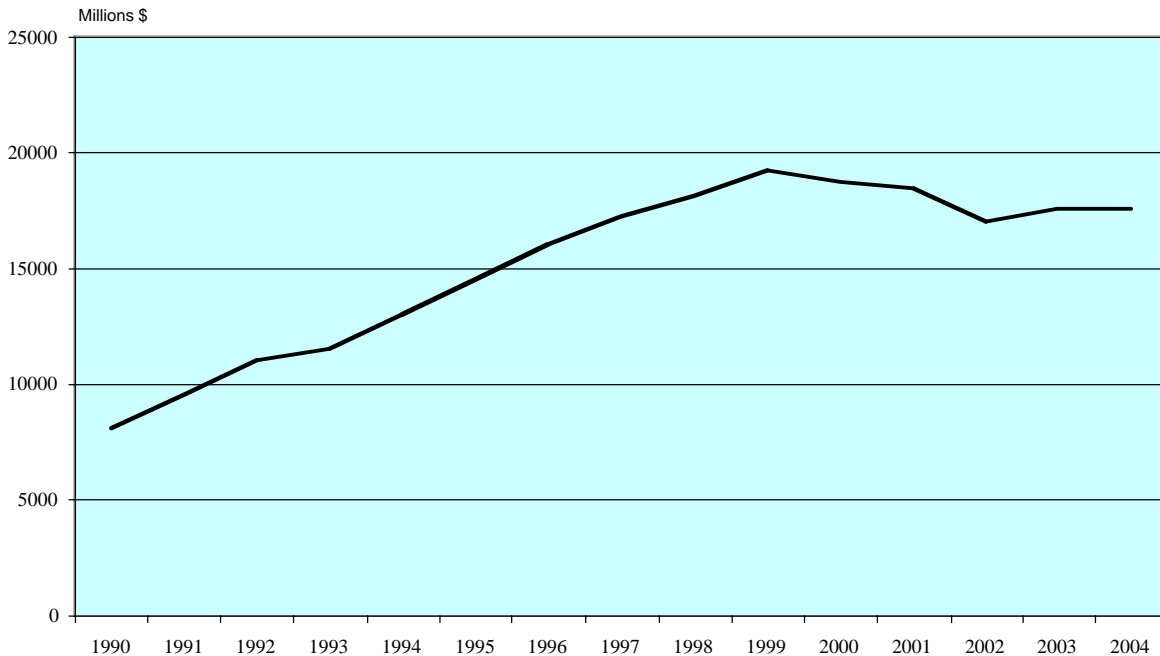
But the evidence at the time of the trial was not yet convincing (*Liebowitz, S. Will MP3 downloads annihilate the record industry? The Evidence so far. Dallas: University of Texas, June 2003*). If the decline in sales begun 1999 when file sharing started there could have been a correlation. But CD sales continued to rise during 1999-2000 when Napster existed and file sharing became popular.

The evidence against Napster presented in the "Fine Report" was a comparison between music stores near college campuses and more typical stores. Students were expected to be most likely to use MP3s. And it was found that sales fell in stores near college campuses, but that was true for the year prior to Napster's existence as well as for the year following its birth.

Napster was closed down in 2001 but file sharing continued to be popular. A majority of Americans under eighteen had downloaded and half of them were heavy users. CD sales started to fall after 2000 and 2001, but there was not a dramatic drop as could have been expected if all millions of tunes downloaded was a substitute for a legal purchase from a music shop.

Diagram 5 U.S. consumer spending on Tapes, LPs and CDs

source:Stevens & Sessions, 2005

Consumer Spending on Tapes, LPs and CDs

There are many conditions, besides file sharing, that can explain the CD decline. In US there was a recession in the economy during these years and as have happened during earlier recessions entertainment spending declined. Other proposed explanations to the sales drop have been high prices and fewer titles released (*Ziemann*). And a combination of high price and fewer CD titles released during a recession could have contributed to the decline of CD sales. (*Where have all the CDs gone? Sound & Vision, June 2003*).

Still another explanation could be changes in the personal entertainment budget. Expensive games and DVDs could have constricted the money available for CD buys. And as we can notice in the table below spending on DVDs has increased.

Table 4 U.S. spending on entertainment media

Sales \$ (billions)	1998	1999	2000	2001	2002
Videogames	13	14,5	14	13,5	15,5
CD	11,5	13	13,5	13	12
DVD	0,5	1,5	2	5,5	9
Audio cassette	1,5	1	0,7	0,5	0,2
Total	26,5	30	30,2	32,5	36,7

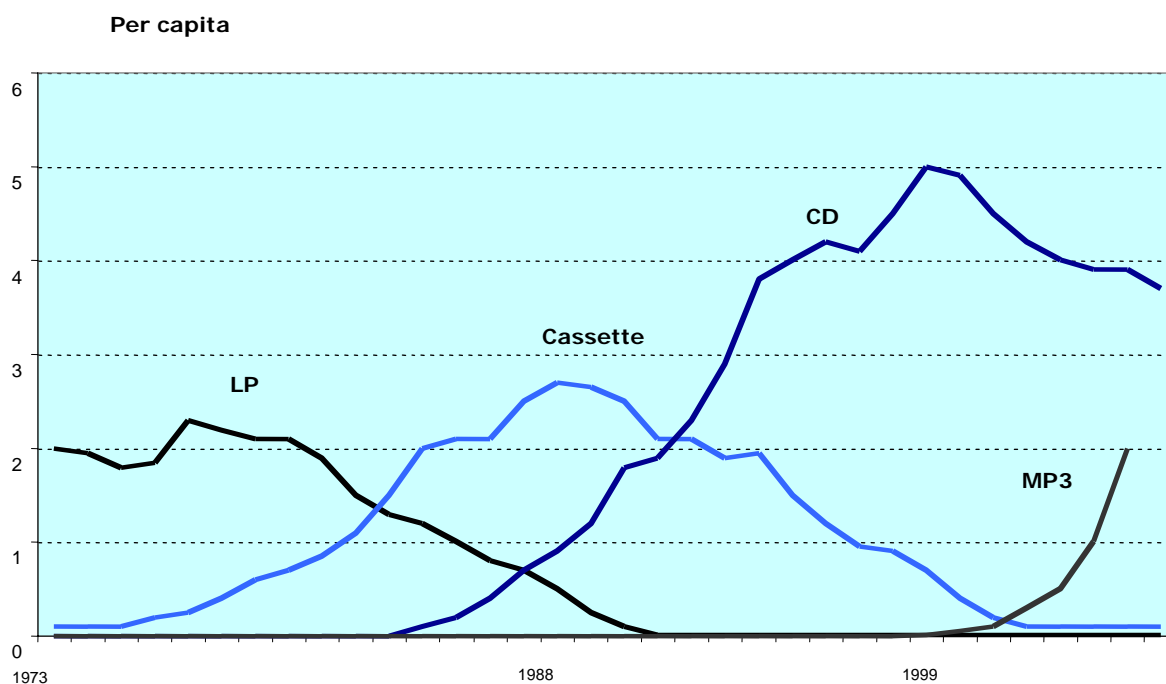
Source: Sound & Vision, June 2003 (RIAA, Ernst&Young, Screen Digest)

There seems to be a small decline in CD sales after year 2000 and at the same time people are spending more of their entertainment budget on DVDs and videogames which cost slightly and considerably more. The result is an increase in total sales but a drop in CD sales.

3.6 New technology and new formats replace old

If we consider CD sales in a longer perspective we can see that the CD as a format for distributing music became more and more popular during the 90ties with its optimum in 2000. At the same time audio cassettes sales were lagging. In the same ways as records were replaced by cassettes and cassettes were replaced by CDs, we are now witnessing a new format change when CDs are beginning to be replaced by music DVDs and MP3s. So we have just seen the CD peak in 2000 as the Cassette peak happened 1988-1989. Then the CD decline after 2000 has not so much to do with file-sharing as with a change in format. But all the formats will all coexist for many years.

Diagram 6 Music format changes



One-channel TV was replaced by two-channel TV sets, TV2 were replaced by colour television and later replaced by satellite TV, cable TV and now digital television. The 78 records were replaced by the LP record, the LP replaced by cassettes and later CD, DVD and now digital MP3 files. Looking at the life cycle of the last music formats we can see that their sales values have been around 15 years. The digital music market online has shown a strong increase

(tenfold) during 2004 and that seems to be even stronger 2005. However, it is difficult to find an overview of MP3 statistics. The diagram is based on U.S. data.

Even though there are differences between various statistic sources where sometimes the sales of CD are combined with the sales of DVD or videogames, there is a drop in CD sales after year 2000. In a longer perspective the drop does not seem to be so dramatic and the format CD has been around in 20 years given increasing profits for the music industry. Only 8% of the cost of a CD was royalty that went to the music creators, the rest to tax, to the music companies and the music shop owners (*Nordicom: Mediesverige 2004*).

3.7 Econometric studies

Napster claimed that file sharing merely allowed customers to get better information and then buy what they knew they liked. They could sample and dry out songs in advance of purchase.

The recording industry claimed that file sharing substituted for the purchase of a record. However in the Napster trial 2001 there was not presented any good evidence to support the claim against Napster and there were little evidence of any decline in record sales. And as we have seen the number of CDs and the sales value did not show decline until 2001.

Liebowitz (2003) tried to explain the drop in CD sales using different economical sales figures. It could have been the economical recession who influenced the sales drop, or the high price or the reduced number of titles that were released during these years. But he could not find any statistical significant relations. File sharing could have had an effect, but only a minor one not yet strong enough.

Oberholzer & Strumpf (*The effect of file sharing on record sales. An Empirical analysis. March 2004*) used observation of actual file sharing, tracked music downloads over 17 weeks in 2002 and matched the U.S. weekly sales data. Even high levels of file-swapping seemed to translate into an effect on album sales that was "statistically indistinguishable from zero". They found that file sharing had a very limited effect. They estimated that five thousand downloads are needed to displace a single album sale. They also found that, for example, high selling albums benefit from file sharing.

Even so, during the 1990s – through good times and bad – younger people steadily migrated away from buying records. In 1988, most purchases were made by people younger than 25. But by 1998, most records were bought by people older than 30. And 1998 was still before the audiences had heard of Napster. Like other electronic media industries, the music industry seems to obsess about young consumers who have relatively modest disposable incomes. That could be one reason why file sharing, used most frequently by young people, have minor effects on sales.

3.8 User studies

A common method to estimate the effects of file-sharing is direct questions to those users of Internet who are practicing downloading and file-sharing. The RIIA evidence against Napster presented in the "Fine report" showed that sales fell in stores near a college campus compared

to more typical record stores. College students were supposed to make up the main body of file sharing. But it was later shown that this was not an effect of file sharing as the sales fell in student shops the year prior to Napster as well as ~~for~~ the year following its birth (*Liebowitz, 2003. not 42.*)

Research 1.

RIIA report say that 23% do not buy CDs because of P2P.

But the drop was only for audio tapes, CD singles, vinyl records and music videos. CD sales up 3%.

Research 2.

(Jupiter Research May 2001. 3319 persons interviewed)

14% say that they stopped buying, 34% by more and 52% like before.

So 86% of people downloading buy as before or more, 14% buy less.

Research 3.

(IPSOS Raid. August 2002.)

81% say their purchases remain the same or more. 19% buy less.

84% informs themselves on the net about music, their favourites and how to purchase.

Half of them had bought CD on the basis of this information

One third have changed favourite genre.

Research 4.

(IFPI:05, Forester Research. August 2004)

A later study showed that among those who are downloading music monthly or more often, a majority (62 %) answered that the downloading had no effect on their purchase of music. 28% said that they buy less and 10% said that they buy more.

72% % of people downloading buy as before or more, 28% by less

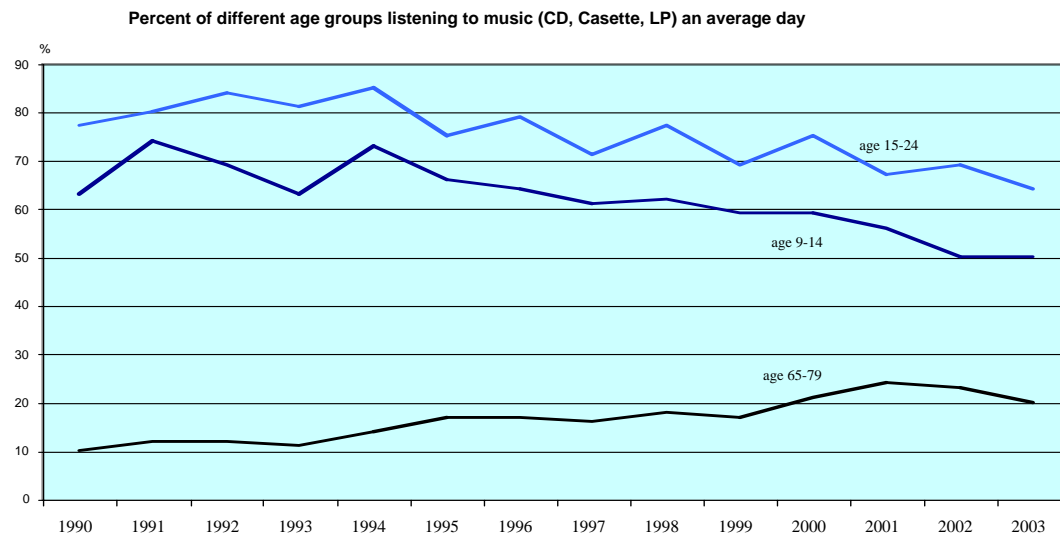
So even if 3 of 4 downloaders say that they buy music as before or more, it seems to be a small but not negligible negative effect. How strong this effect is in reality is difficult to say. It seems that this kind of self-estimation is not always in harmony with other independent measures.

It is for example, as was discussed earlier, often said that Internet use has an negative effect on television use. Those who use Internet watch less TV. And if we ask users, especially heavy users of Internet, they say that they watch much less television than before. But looking at audience figures collected by people meters or other time use studies, the decline of the TV audience after the introduction of Internet is hard to find. In Sweden more people are watching television today - when two of three Swedes have Internet at home - than during the 90ties. But the subjective experience of many users is that their Internet use takes time from TV.

An interesting fact that shows that the downloading of music has limited effects is the decline in music listening among young people. The same thing is happening in many countries but below are Swedish data (*Mediebarometern 2003*). Older people are listening more to music today than before but among young people there is a contrary trend. They are spending less time listening to music. A similar long time trend is found among those who buy music. The

middle-aged generation who used to often listen to music when they were young have taken this habit with them when they got older.

Diagram 7

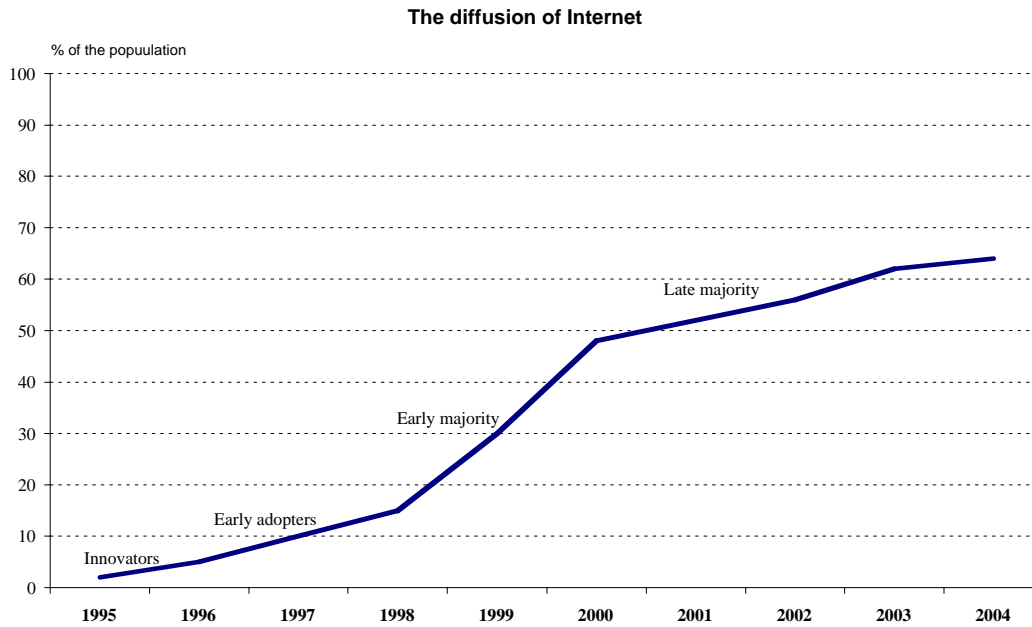


3.9 The diffusion of Internet

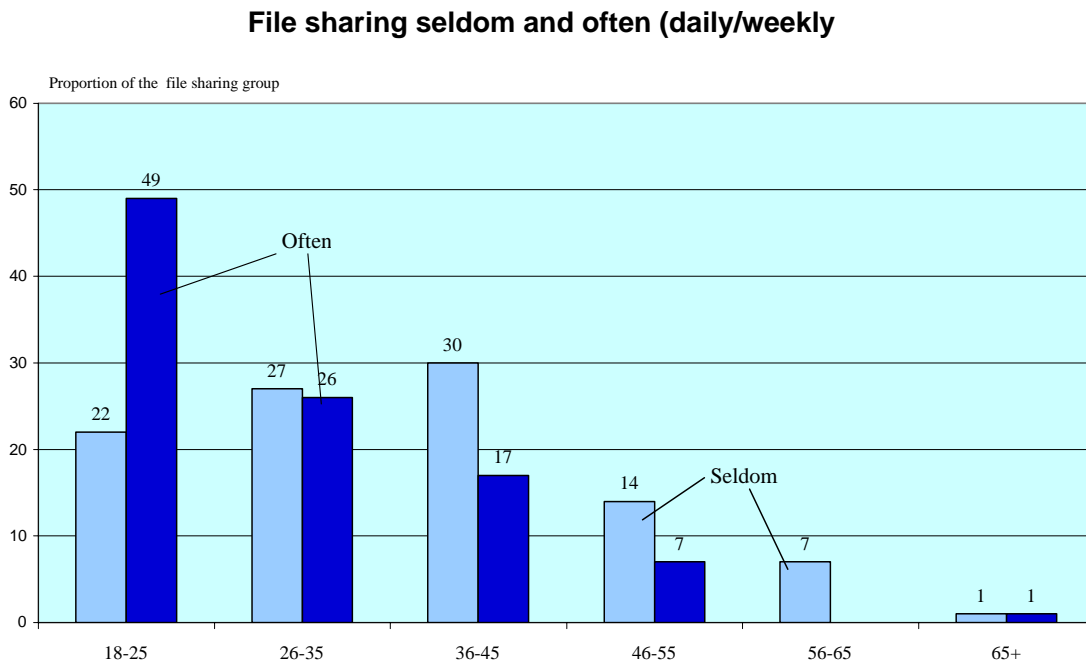
An other general finding from studies of new media and new technologies is that the diffusion in the population follows the shape of a S-curve. The speed, as we saw earlier in the comparison between TV and Internet, is however different for different media, as well as the equality of the diffusion process.

Traditional socioeconomic factors like gender, education and income are important. That was also the case for Internet, although education seems to have a minor importance among young people. When it comes to file sharing the diffusion of this technique has just started. The innovators have used it for some time and the early adopters also.

Diagram 8 The diffusion of Internet in Sweden



In 2004 around 7% of the population (18+ years) were practicing file sharing. Most of them, 83%, were men and 17% women. (*Findabl, O. Internet and the Swedes 2004. World Internet Institute 2005*). Even if there are file shares in all ages it is the young ones who are most frequent.

Diagram 9 File sharing in Sweden, seldom and often (daily/week)

3.10 Conclusion

If the annihilation theory was correct MP3 downloading would have resulted in a CD sales decline during 1999 and 2000 when Napster became popular, but that did not happen. Later when an increasing number of people are using file sharing services one would expect a continuous drop in sales but that has not happened. In 2004 and 2005 sales are increasing but this time people are less buying music in shops, but online using the MP3 format. According to Pew Internet & American Life Project (2005) 34% of current music downloaders say that they now use paid services. In the beginning of 2005 the music industry is heard to hum: "Happy days are here again". (*AP Online, 01-22-2005*)

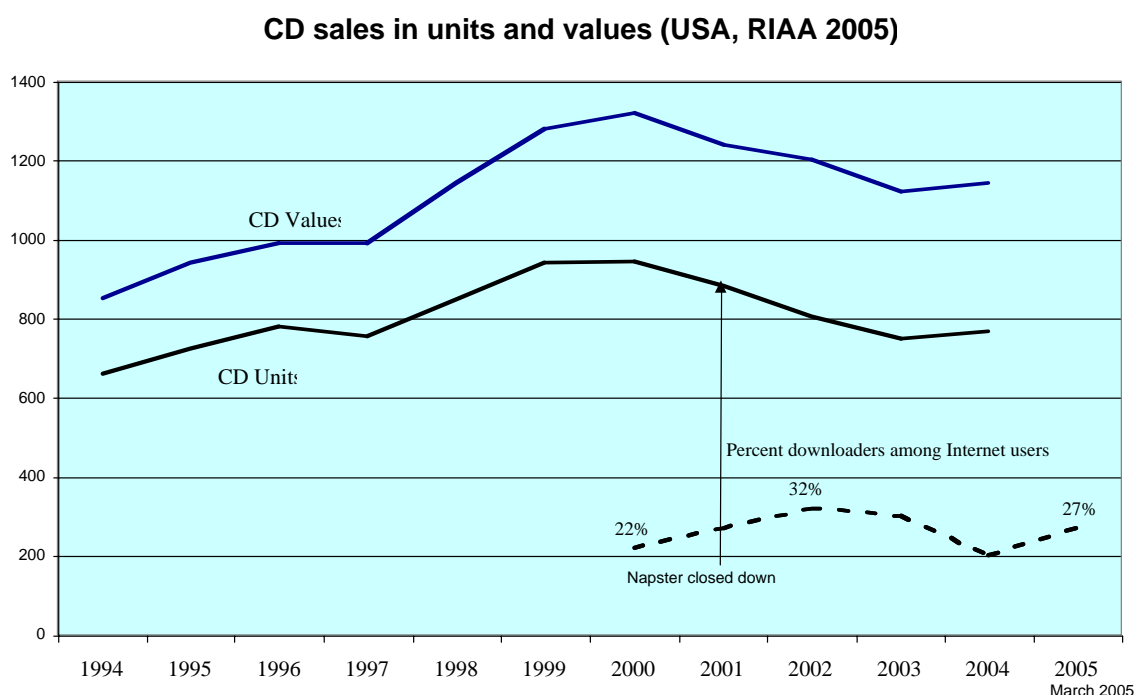
The econometric studies could not find any significant effects of file sharing on music sales. The user studies, however, showed that there is a smaller group who say that they buy less music but the majority (80 - 85 %) answered that their purchases remain the same or more.

Music file sharing can not explain the sales drop in 2000 and after. What happened was a change of music format from CD to MP3 and the music industry was too late and not sensitive enough to respond to this change.

However, it seems also to be some effects of file sharing on sales, both positive and negative. Some people, mostly young with less money, do not buy music but download. It is mostly not a lost purchase because they will not buy anyway. Other people will listen and inform themselves and later perhaps buy or not buy. Still other wants to collect a library. The

surveys give some indications that there are at least two groups of people with different characteristics downloading. What is still needed is a more in-depth study in combination with a longitudinal user study where the individuals can be followed over time.

Diagram 10 CD sales in units and values (USA, RIAA 2005)



4. File sharing at Swedish universities

4.1 Introduction

Swedish university computer network (Sunet) is used by students and staffs at 32 universities and colleges all over Sweden. In 2003 the capacity of transmission was upgraded to 10 Gigabits/s in the backbone network and with local terminal networks of 2,5 Gigabit/s at each university. Sunet is connected to the European Research Network GÉANT⁹ as well as to the university network of Nordic countries NORDUnet.

Shortly after the upgrading a major user study was carried out among students, postgraduate students, teachers, research scientist and technical/administrative staffs⁹. The aim of the survey was to examine the use of Internet for educational purposes and as a research tool.

At many universities the students' accommodations are connected to Sunet. It had then been observed that a high percentage of the broadband capacity was occupied by the accommodations, in many cases higher than from the university institutions. The Internet use for private purposes among the students could be divided into three different categories; ordinary surfing on the web, on-line games and file sharing of music and films. Traffic analysis carried out, indicated that the file sharing activities answered for the dominating part of the capacity use.

In order to investigate the spread of file sharing activities and the related user behaviour, questions about use of file sharing services were added the survey.

4.2 General overview

The use of file sharing services among student and staffs at Swedish universities is widely spread. At the time for the survey Kazaa was the most popular service with approximately 100 000 users. One third reported a very sporadic use.

Table 5 Use of file sharing services – Estimated number

	Every day	Once or a few times a week	Once or a few times a month	Less often	Never	Do not know	Total
Kazaa	7 895 3%	32 431 12%	24 332 9%	27 432 10%	125 674 48%	43 974 17%	261 738 100%
Other file sharing services	11 786 5%	20 358 8%	18 886 7%	24 715 9%	107 901 41%	77 296 30%	260 942 100%

⁹ The size of the population is approx. 270 000.

It should be underlined that a majority of students and staffs do not use any file sharing services. Furthermore a large number of respondents “don’t know” if they are users or not, probably an indication that nor they are users.

Only a few percent are using file sharing services on a daily bases.

4.3 Regular users

Those respondents that are using one or several file sharing services at least once a month are classified as *regular users*.

Table 6 Regular use of file sharing services – Estimated number and shares (%)

	Est. number	Share of total	Share of regular users
One file sharing service	53 917	20%	64%
Several file sharing services	30 886	11%	36%
Sum of regular users	84 802	32%	100%
Not regular users	184 196	68%	
Total	268 998	100%	

The number of regular users is estimated to 85 000. Approximately two third or 54 000 of the regular uses are using only *one* file sharing service. 30 000 are using *several* services.

4.4 Gender distribution

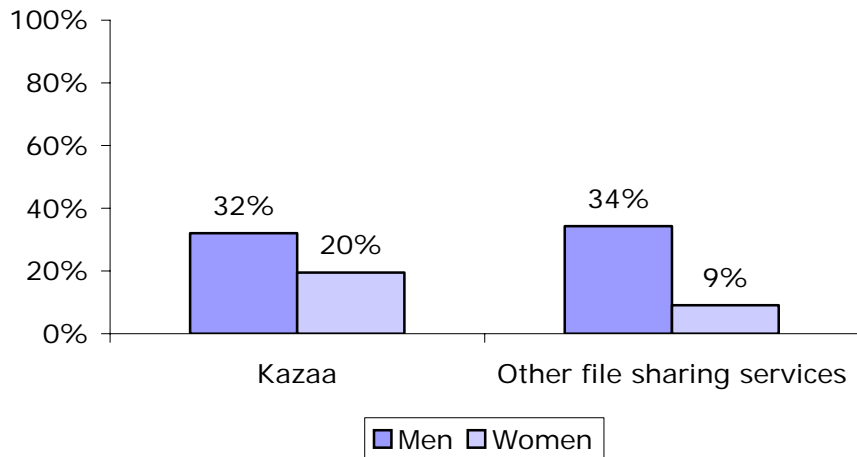
Looking at *number* of users, Kazaa is fairly equally distributed among men and women. Then one must keep in mind that the number of women in Swedish universities is superior that the number of men. Thus the *share* of Kazaa users is higher among men.

Table 7 Regular use of Kazaa and other file sharing services among men and women – Estimated number

	Men	Women
Kazaa	34 713	29 945
Other file sharing services	37 173	13 857

Among male users there are as many users of “Other file sharing services” as of Kazaa, while Kazaa is by far the most popular among female users. Men are also to a higher extent using more than one file sharing services.

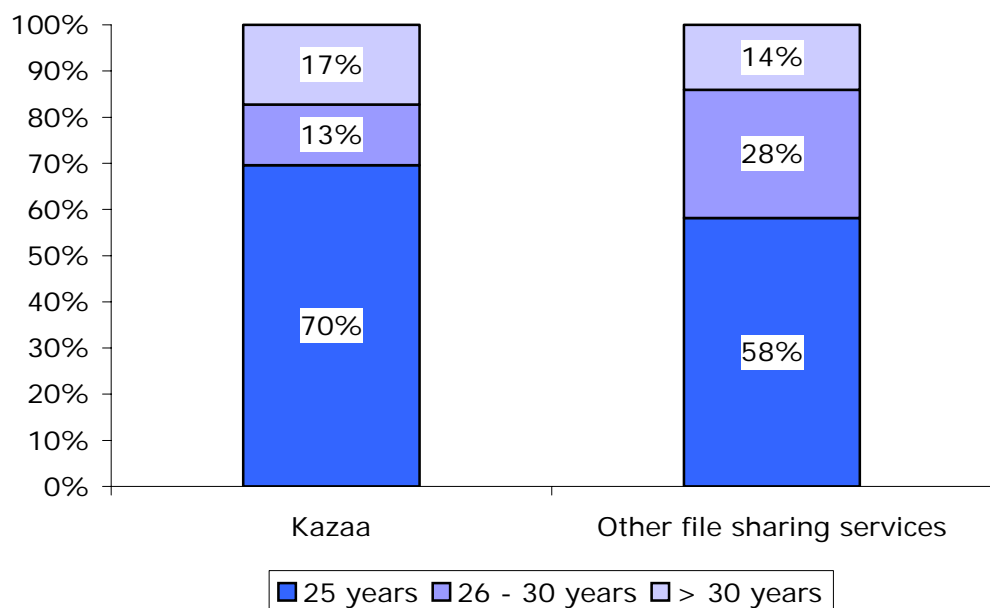
Diagram 11 Regular use of Kazaa and other file sharing services among men and women – Percent



4.5 Age distribution

The majority of file sharing users are 25 years or younger. This is particularly the case among Kazaa users. In the age range of 26 – 30 the situation is reversed with “Other file sharing services” twice as popular as Kazaa.

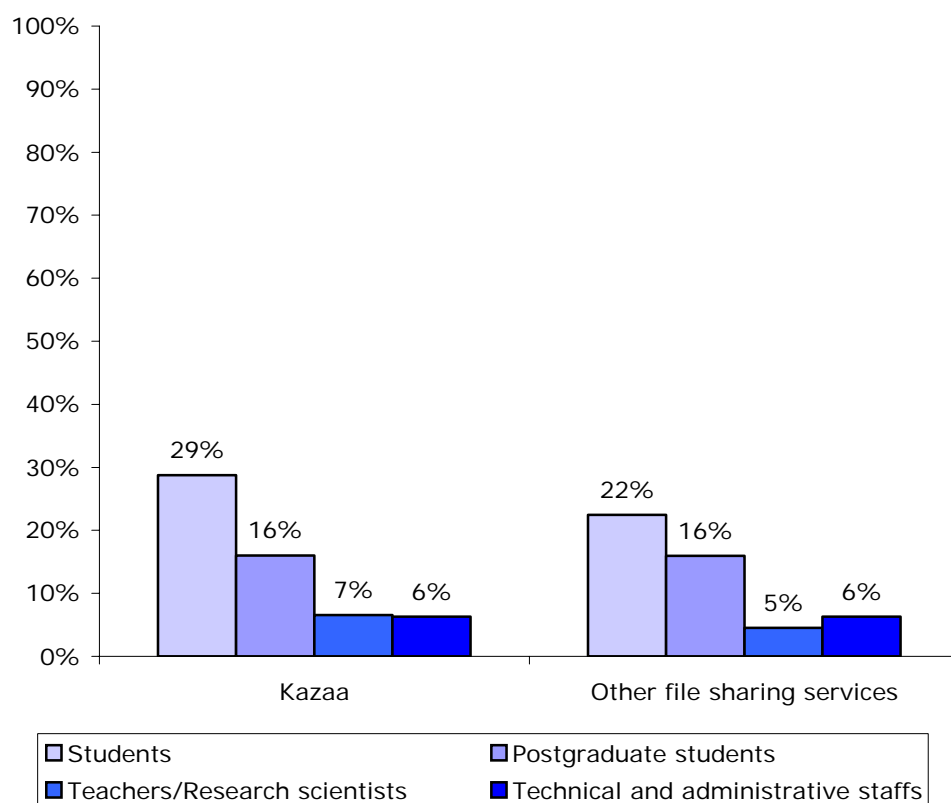
Diagram 12 Regular use of Kazaa and other file sharing services. User ages - Percent



4.6 University categories

Within the different university categories, the share of regular users among students is close to 30 percent while among postgraduate students the share is considerably less, 15 percent. Among the teachers/research scientists and other staffs the share of regular users is 6 – 7 percent, which is very close to the average for the Swedish population as a whole.

Diagram 13 Regular use of Kazaa and other file sharing services. User categories - Percent



4.7 Patterns of Internet use

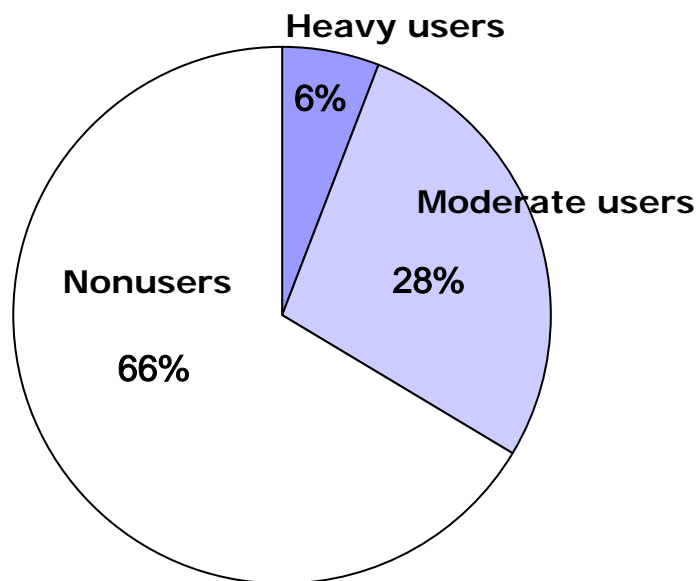
In the forthcoming activities of the User study work package we will try to identify the profile of P2P users in terms of general Internet use for different purposes;

- Educational
- Other purposes, such as
 1. Private consumption
 2. Recreation
 3. Social matters, relations

The users will be described in terms of skills, in what academic discipline they are active as well as computer skills.

Three user groups will be examined:

- Heavy users, reporting daily use of at least one file sharing service
- Moderate users, using file sharing at least once a month up to several times per week
- Nonusers, reporting less than once a month, never or do not know.



As mentioned earlier in this chapter, the majority of students and staffs – two thirds – are nonusers, while 6 percent of the population are heavy users.

5. Other business areas where P2P is emerging

5.1 P2P – A style of working

In every country, all over the world, peer networks emerge. Some are purely physical and for no other purpose than to socialise, but some are electronically enhanced and can have various purposes. Sharing files is the dominant purpose for electronically enhanced peer networks, and when using direct or semi-direct connection between the peers we call them peer-to-peer (P2P) networks. Not all P2P networks are for file sharing. Some are even purely social networks, where emotions and thoughts are shared through communication. Some still are spontaneous and short lived.

P2P is not a protocol but a style of working. P2P has to some extent been touted as a revolution for companies and the way business is conducted, and it is seen as a panacea that will relieve network bottlenecks, enable collaboration within ad hoc workgroups, and unleash untold computing power from underused processors throughout an enterprise.

5.2 Software

Ever since the introduction of the home computer, or the PC, the sharing of software programmes has been a reality. The sharing of copyright protected software for leisure as well as for business soon became more organised and wide spread. Although the software industry equipped their products with copy protection mechanisms, these were circumvented and the software was copied and shared physically. Soon small networks emerged – often referred to as “sneaker nets” (Becker E. *et al.* “*Digital Rights Management*”, 2003) – in which copies were distributed, either in a face-to-face manner or by mail.

5.3 Film, games and books

From the floppy disc (re-)distribution to the CD-ROM (re-)distribution up till today’s file sharing in P2P networks, users have almost always been one step ahead of producers, although some organised (re-)distributors have been taken out of business as a consequence of persistent tracing of illegal activities in order to bring the perpetrators to justice. Today, a lot of focus is on the music and film re-distribution (file sharing), but areas as video/PC games and e-books are gaining speed in this respect. Even artistic and professional images and graphics are starting to emerge in P2P networks.

Recently, the sharing of big files for film, TV and multimedia has been facilitated by a new kind of P2P protocols, based on the concept of cooperation between clients (users). At the same instant someone is downloading a film, he or she is also uploading other clients in a parallel process. Cooperative distribution can grow almost without limit, because each new participant brings not only demand, but also supply. As each new participant brings new resources to the distribution, the scalability is limitless.

A great number of e-books from a variety of thematic fields are available on the net for file sharing. Most of them are in English, Spanish or German. Manuals for software and games are frequent, so are comics and cartoons, in particular the classics as Carl Barks or Tintin. A number of titles with political or religious content are also available. Popular novels and bestsellers can be downloaded as e-books but to an increasing extent as audio books as well. The latter category has grown in importance during the last decade.

5.4 Television

Television is a rather new business area in this context, though similarity to film distribution is apparent. Recently BBC chose to embrace the new technology and business opportunity announcing they would soon start re-distributing most of their television programs using P2P technology (*BBC News, January 21, 2005*). The files would be locked for seven days after airing, making rights management easier to control.

Though BBC are trying to make attractive programs available through legal P2P services, television programs have been present in bit-torrent like P2P networks for some time now. Sports events are available soon after the broadcasting (if broadcasted), and television series, like sit-coms, can be downloaded from a P2P network way ahead of the scheduled transmission of an episode in most European countries. An informal system of TV-on-demand is emerging where popular television series can be downloaded unabridged.

5.5 Education and learning

When looking at educational applications and the use of P2P, the similarities are less obvious. However, to some extent P2P networks, in the sense we normally refer to them, are used for distributing learning resources and educational material. The physical P2P networks are present at all universities, as peer learning is part of a student's daily work. But also technology based P2P networks are used. Communities using electronic portfolios are making content available, either to whom it may concern or to a group of peers. Even Educational Institutions like Uppsala University and the Royal Institute of Technology (KTH) in Sweden have initiated P2P networks for learning and educational purposes.

One aspect of P2P learning is the adjacent search-engine learning, where students tend to google to find out more about something or to learn how to solve a certain problem. Googling is often used when the local network of peers cannot satisfy the need for information. Search engines can be looked upon as a legal and non-secluded central-index based P2P network for information sharing.

Sharing of copyright protected material is being done every day in the physical realm, and the distribution almost exclusively is client-server (teacher-learner) based. Given the evolution on software and, foremost music and films, one can estimate that this area will increase its level of presence in P2P, as well as its level of importance for businesses providing technology solutions for legal distribution.

5.6 Telephony

Another “new” business area when it comes to P2P technology is telephony. Skype and Hong Kong based Hutchinson Global Communication (HGC) signed a co-branding agreement in early February, 2005, where the SkypeOut users (using Skype Internet telephony service to call to a fixed line subscriber) would be offered lower rates than would be the case otherwise. Of course the Skype to Skype calls over the Internet would still be free of charge. This agreement was the first co-branding agreement signed with a fixed-line operator, but Skype has been co-branding with Internet portals like PChome Online in Taiwan and Tom Online in China since mid 2004. Allan Turnolillo of Probe Financial Associates foresees over one million downloads in the Hong Kong area within the first six months of the service, adding to the success in China, where over two million were registered users by the end of last year. (*Red Herring, February 7, 2005; Business Wire, February 6, 2005*) Skype released yet another new business application in April, 2005, when their SkypeIn solution (call from a fixed line to a Skype Internet telephony user) was introduced to their whole business concept.

In this context it is also essential to mention some of the effects that has been noticed after the free licensing of the Skype source code in late 2004. Ben Chamy of CNET News.com says it is creating a coattail economy as hungry developers rush to cash in on its popularity. (*CNET News.com, April 4, 2005*) An estimated 1,000 programmers have jumped on the bandwagon so far. Together they have created dozens of free and commercial products for the service. Voice mail, SMS and ring tones are some of the free services, and in the works are Skype-based advice lines selling legal and medical information, astrology forecasts and other services. The phenomenon is quite similar to the one seen in conjunction to Linux operating system, and Skype’s intention is to extend and formalise the software developer programme with time.

5.7 Banking and financial services

Even this area of business has started to slowly embrace the P2P technology. One main driver is to lower cost, both for the company as well as the customers. Other drivers are to simplify and speed up financial services. As early as 2001 Citibank introduced an online P2P payment service that allowed transfer of funds between individuals for a range of personal business transactions such as returning borrowed money. (*Ken Young, May 23, 2001*)

5.8 Corporate Information

P2P networks can be used to replace the Corporate Intranet (or Extranets), as far as file sharing is concerned. Most larger companies have already strict policies for using corporate computers, and what information must be stored on a central Intranet server for all, or a group of, users to be able to access that information. This will be most efficient in mobile organisations, where the employees are using mobiles and PDAs as a tool in their work. For other, but similar, organisations P2P technology can be used to load balance computing, and to make computing resources available even when working out of office at hard to reach places, when travelling, etc.