PEER-TO-PEER BUSINESS MODELS

Term Paper: 15.358: The Software Business

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Executive Summary

In this study we analyze the evolution of the peer-to-peer paradigm from its appearance into the life of the the common computer users, until now. We also provide considerations on its possible paths in the future. Our aim is to see if the technology can be used to develop more than products for the high risk horizontal market by entering more vertical markets in the corporate sector.

We begin our discussion with the application that placed the expression "peer-to-peer" into the every-day vocabulary of millions of computer users around the world: music file sharing. We will see how this application has turned legal in recent years and is now collaborating with major recording companies to provide content to their clients. A step further from music file sharing is video stream distribution. Though the concept is similar, the differences are considerable both in terms of the technology and in terms of the business models, as the target is no longer the end-user directly, but rather the network operators such as Comcast. Also in the service portfolio of a network operator is a Voice-over-IP service which can be sustained by a peer-to-peer network infrastructure such as Skype - the second largest VoIP provider to date.

We transition to the corporate sector by noting that VoIP is used in this context to reduce the cost of telecommunications. Even more, business users can take advantage of integrated collaboration environments such as the former Groove Networks, now part of the new Microsoft Office suite. Such a system is meant to share and synchronize documents on users' personal computers, but also provide more reliability by having the same document stored on different machines. IBM went even further in this direction and provides "peer-to-peer" replication functionality in its WebSphere storage solutions, though the term "peer-to-peer" is arguably a misnomer in this context.

From all the study cases we conclude that a pure peer-to-peer system does not present a viable business solution and that the technology can only be used to enhance, supplement or reduce the cost of existing services.

Introduction

The peer-to-peer idea is an altruistic concept that stems from individuals giving help to one another applied to networks and computing resources. This has nothing to do with business reality. What made the concept really popular to the general public was Napster which allowed millions of people to easily share and download digital music. As a result, in the real world of business, peer-to-peer technologies have been perceived as a technology that threatens copyright and encourages illegal distribution of content, and has been associated with a 'rebel' culture, thus restricting its adoption and growth. The following quote summarizes the common perception of the technology:

> *"Through the music-sharing application called Napster, and the larger movement dubbed "peer-to-peer," the millions of users connecting to the Internet have started using their ever more powerful home computers for more than just browsing the Web and trading email. Instead, machines in the home and on the desktop are connecting to each other directly, forming groups and collaborating to become user-created search engines, virtual supercomputers, and filesystems."* [Minar, Hedlund]

Interestingly enough, the concept is not at all new, and in fact the Internet originally embodied a peer-to-peer model as it grew out of ARPANET by adding nodes to the network and by connecting various networks to share computing resources between remote sites. At that time every computer that connected to the network had equal rights. As applications developed, both the client/server model (FTP, Telnet) and the peer-to-peer model (Usenet, DNS) were embraced.

As more and more people started using computers and as more computation power was needed, the cost of computing and the need for security and reliability in the network encouraged server based approaches to networking to become the dominant design with "in" network firewalls that divided the network. Also, in the 90's, as the World Wide Web became the most widely used application and interface to the Internet, client/server model became the dominant paradigm for e-commerce and web based applications. As a result, many of the Internet services provide, even now, asymmetric connectivity to their subscribers: download throughput is generally larger than upload throughput.

The phenomenon of people collaborating to share their resources turned around the usage models that Internet Service Providers were envisioning for their businesses. When the WWW opened the Internet to the world, users were only consumers of information, mainly because they had nothing to share. Rich multimedia capabilities were still years away: nobody had a photo or a video album online as there were no digital photos or videos.
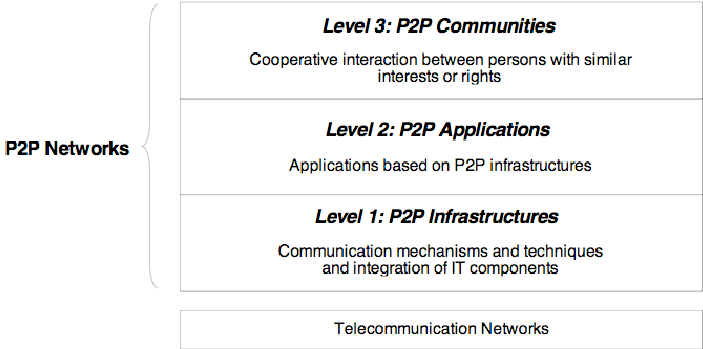
However, as multimedia formats were developed and larger disk space and larger bandwidth became available to normal users, this asymmetric assumption started to break. It

led the people to explore the usage of the abundant computing and networking resources and led to the creation of peer-to-peer applications such as Napster. The result was that the user's started to upload as much data as they were downloading. This created a disruption on the bandwidth usage on the Internet which has not been monetized appropriately then and is only now, slowly, sliding into mainstream market.

TECHNOLOGY

Peer-to-peer software has the capacity to grow and scale in an unplanned manner with very low cost of ownership. As new nodes or persons join the p2p network, they increase the total value or capacity of the system. Also because of its decentralized architecture it becomes much more robust to failures.

Peer-to-peer software can be categorized in the following three levels according to [Schoder, Fischbach]: peer-to-peer infrastructures (Level 1), peer-to-peer applications (Level 2) and peer-to-peer communities (Level 3).

P2P Networks	**Level 3: P2P Communities** Cooperative interaction between persons with similar interests or rights
	Level 2: P2P Applications Applications based on P2P infrastructures
	Level 1: P2P Infrastructures Communication mechanisms and techniques and integration of IT components
	Telecommunication Networks

The most widely known peer-to-peer software applications are used for file sharing, voice communication and streaming. However, there has been a lot of research in universities, as well as companies, to provide peer-to-peer middle-ware and software API's to provides mechanisms, communication techniques, data structures and API's such as JXTA (Java) and Jabber for building applications in Level 2. At Level 2, there are many applications ranging from sharing and finding information to collaboration, communication, sharing of computation (SETI@Home, Cancer Drug Search) and overlay networks that allow people to utilize routes that are not fully exploited to provide larger bandwidth. Most well known and widely used peer to peer software on the desktop would fall into this level. Finally, the 3rd Level is the least technically sophisticated part of the peer-to-peer network, but probably the most important for the growth of the p2p network. Peer to peer communities that form through the connections established by the software and the network provide the network externalities for people to adopt and use peer to peer technologies. As these communities grow, they can change the value chain of an industry and create opportunities for new businesses. It also allows consumers to create value among themselves by sharing what they have with each other or build consumer

based individual business opportunities. Web 2.0 does not use the technical p2p network, but it illustrates the power of human peer to peer network and community that is willing to contribute to each other.

Peer-to-peer networks can be categorized into structured and unstructured networks. Unstructured networks find files and necessary resources through queries that flood the networks. Nodes are assumed to join and leave arbitrarily in the sense that they simply connect to a random node that is already in the network. Popular data is usually replicated more and easily found in such topologies due to the limited range of flooding. As a result, it is difficult to find rare data in such networks, which resulting in poor search efficiency.

Structured peer-to-peer networks use data structures such as distributed hash tables (DHT). In such networks each peer node is responsible for a particular part of the total content in the network, know apriori. Content and nodes are hashed and mapped such that there is a comprehensive coverage of content by the nodes. Search is guaranteed to return a result if an item exist in the network. However, the network incurs additional maintenance overhead because the new node joining the network needs to take charge of a segment of the data space and have all the data items pertaining to that segment moved to the new nodes. Similarly, upon departure, the network must ensure that the content managed by the departing node is replicated on other nodes and remains available.

The latest work on peer-to-peer networks are the so called 3rd generation peer-to-peer networks. These networks involve anonymizing the identities of users by routing traffic through other user's clients or anonymizing nodes. They use strong encryption to resist any traffic analysis and monitoring by third parties. Friend to friend networks allow one to use only those "friend" nodes to anonymize traffic and route queries. These software are in need by those users who support freedom on the Internet, but also can be misused for illegal distributions. Another downside is that due to the overhead of supporting encryption and anonymizing algorithms, the software is slower and harder to use, making user adoption slow for average users..

Peer-to-Peer versus Grid Computing

Peer-to-peer and grid computing are two approaches to distributed computing that are confused with each other due to their similarities in architecture and large scale computational capabilities. Both are concerned with organizing computing resources in a scalable manner. However, grids are much more structured systems that can use geographically separated resources to provide high performance computing capabilities and are based on a standardized service infrastructure. Grid systems are usually managed by a single authority such as an enterprise to provide powerful distributed computing resources with a static configuration where nodes maintain a lengthy uptime. It has access control to its resources to provide security for authorized users. However, it has its limi-

tations in terms of scaling to millions of nodes and accommodating intermittent availability of nodes due to complexities in configuring and managing them.

Peer-to-peer systems, on the other hand, focus on dealing with instability, transient populations, fault tolerance, and self-adaptation. It is able to handle ad hoc configurations where continual change in connectivity and change in node topology occurs due to users joining and leaving pretty frequently. To date, however, peer-to-peer developers have worked mainly on vertically integrated applications, rather than seeking to define common protocols and standardized infrastructures for interoperability.[Theotokis, Spinellis]

In summary, one can say that "Grid computing addresses infrastructure but not yet failure, whereas peer-to-peer addresses failure but not yet infrastructure".[Foster, Iamnitchi]

DRAWBACKS OF PEER-TO-PEER

Depending on what kind of application the technology is used for, different disadvantages may appear more or less important.

For file sharing and community building, we've noted that the main advantage of peer-to-peer software is the ability to take advantage of all the individuals that contribute. However, the main disadvantage here is that individuals can be very selfish. Free riders are those users that connect to the network for a short time only to get what they want and log off. Such behavior only consumes and does not give back to the community, hindering the growth and value of the network. In the case of file sharing, in order to provide incentives to upload files as much as they download, a *tit for tat* strategy has been used in most systems where users can only download as much as the user uploads.

In a business context, peer-to-peer may result in low cost services, but the technology cannot guarantee that all data items are retrievable at all times: the probability that some document is not available can be lowered arbitrarily, but it can never reach zero. This may not be acceptable to a hole range of companies.

The Beginning - Music File Sharing
Limewire

The p2p frenzy started with the possibility of compressing music files in a format that is easily transfered on the Internet. This required a way to quickly find the shared music files and p2p technology filled the void, embodied by Napster. Though the short life of Napster is an extremely interesting phenomenon in itself (especially its business model which relied on vengeance of some non-aligned music artists[1]), in this section we look at

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[1] as stated by Napster founder S. Fanning in a press conference in April'02:
http://www.ink19.com/issues/april2002/features/napsterBusinessModel.html

one of the last survivors of the free p2p music sharing phenomenon: Limewire LLC. We are interested in them because, first, they have survived so far and, second, they appear to have a more sustainable business model than Napster had.

COMPANY DESCRIPTION

Limewire LLC is a 12 people organization that essentially does the same thing Napster did 5 years ago: it facilitates the sharing of [music] files between individual users. Unlike Napster, it does not store or index anything on it's own servers, but instead only provides users with the means to do so on their own.

P2P ADVANTAGES AND DISADVANTAGES

Peer-to-peer technology was in this case the enabling technology, without which such a company would never have been possible. Though technically it is possible to have everything stored on a central server, the costs would be so high that it would completely change the business model.

In terms of disadvantages, excluding legal ones, we can only identify one for the end customer and none for the company: The end users are subject to an additional threat for their personal computers because they have to give public access to parts of their computer, without the possibility to exhaustively control permissions. Had this been a centralized system, a simple private/public key system would have been enough to ensure that the communication is done only with the authorized client or server. In fact, there is already a spam system on Limewire (SkyRider) which posts fake music files with advertising messages at the place of the filenames. The network is protected more by its 'coolness' factor rather than active security measures - the fact that it is a rebel system protects it against virus attacks. Had Microsoft built it, we would have seen hundreds of viruses trying to get it down.

HOW IT MAKES MONEY

One would expect such a network to make money through advertising, since it is base on an 'everything should be free' kind of idea. However, looking at a screenshot of the interface, we can see no space for advertising. The advertising model could only work in the case of software that requires a constant interaction with the user. It is not the case here because the users just select in a few minutes a lot of files to download and then minimize the downloading window and move on to do other things.
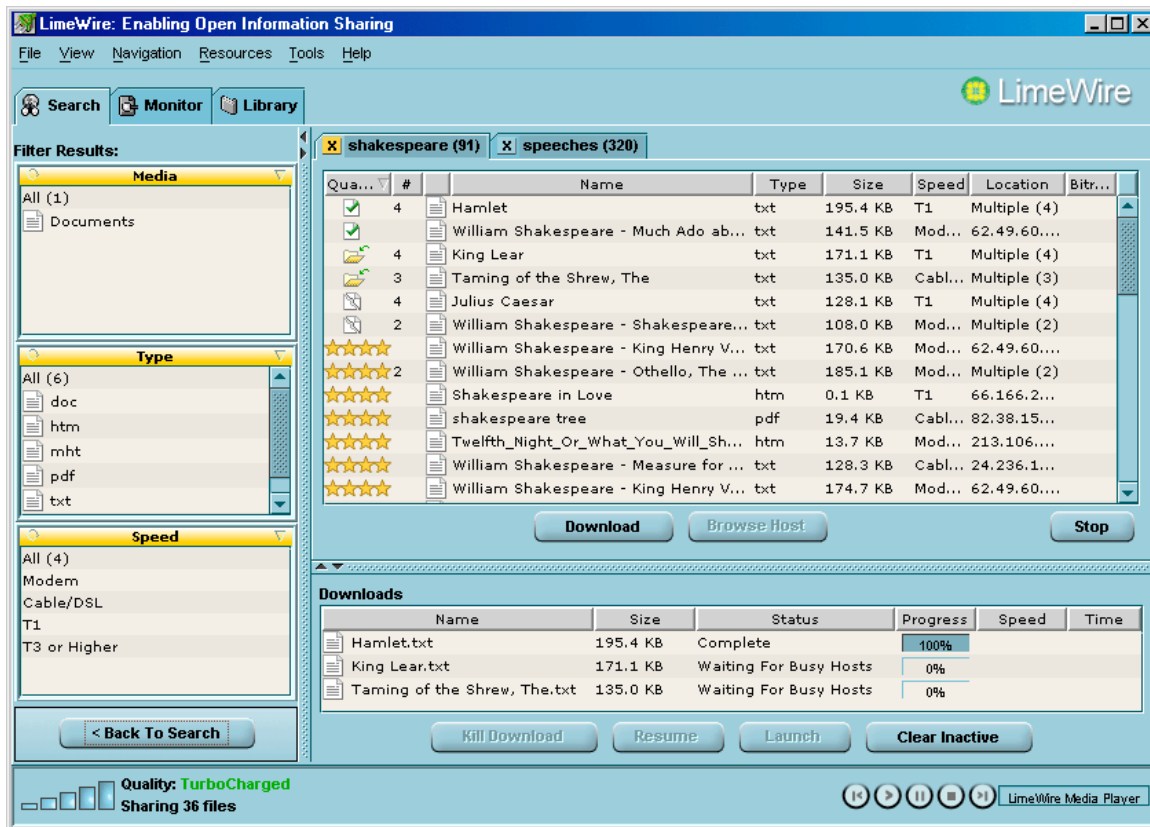
Limewire LLC relies on two types of revenues: a one-time license fee for its Pro version (only $18.88 for a one-time up-front fee) and selling additional merchandise (T-shirts, mugs, etc.)[1]. Though there are no figures on how much revenues they have, it does not appear to us that they are making a lot of money and, even more, their business model is not sustainable. The one-time license fee includes perpetual tech support by email and a 6-months free upgrade. The fact that they advertise tech support for a one-time fee of less than $20 should be very disturbing as it means that either they provide a terrible service or they go bankrupt trying to answer all requests appropriately.

Despite the low revenues, the company has survived because it has an extremely low cost of operations. Having only 12 employees, we would estimate their annual cost of operations at less than 500k, because the p2p system does not require the company to have particularly large storage systems or bandwidth needs. That cost would be covered by the selling of an average of 2200 one-time licenses per month. An August'06 survey shows that it ranks third among music content websites, which makes the 2200 figure possible, though the advantages of owning the Pro version seem not as compelling as they should be. Even more concerning for its business model is the fact that, with the exception of YouTube which we know specializes in video content, the rest of the sites in the top 10 provide copyrighted content legally.

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[1] the merchandise site was down at the moment we wrote this report

Limewire should take advantage more of its large community and build a stronger network externalities effect around a product or service that can be then monetized through charging complementary products, as well as charge a membership fee rather than a one-time license fee. An example of this is the "Rhapsody" service from the company RealNetworks: The consumers have to pay $14 a month and they have access to listen any song in their collection of more than 2 million songs using online streaming. This has the constraint that the users have to be connected to the internet all the time. The consumers are able to post their comments of the songs, rate the songs and recommend songs to friends. Consequently, RealNetworks builds a community with a strong network externalities effect. The company uses the data of the preferences to provide useful recommendations tailored to each user that are based on preferences of other users with similar profiles. In this case, Real generates revenue not only by charging the subscription but also, if the user wants to download the song to store in their computers or if the consumer wants to burn a CD with that song and others, they have to pay 79 cents per song. Moreover, Real sells a proprietary hardware called Sansa –similar to an IPod from Apple- that enables the consumer to be connected all the time to their streaming service. Furthermore, the company sells advertising positions in their software to the record labels to advertise new albums.

Web Site that US Adult Internet Users Go to Most Often to Download or Stream Video or Music Content, by Gender, July-August 2006 (% of respondents)

	All Internet users	All adults who download video/music	Males who download video/music	Females who download video/music
iTunes	7.6%	11.8%	13.2%	9.8%
Yahoo	3.9%	6.1%	6.0%	6.3%
LimeWire	2.8%	4.3%	3.2%	5.8%
YouTube	1.3%	2.9%	3.7%	1.6%
AOL	1.2%	1.8%	1.2%	2.8%
MSN	0.9%	1.5%	1.5%	1.5%
IGN	0.7%	1.8%	3.0%	0.1%
Google	0.7%	1.3%	1.6%	0.8%
MySpace	0.6%	1.1%	0.8%	1.6%
Rhapsody	0.5%	0.7%	0.6%	1.0%
WalMart	0.5%	0.7%	0.6%	0.8%
Music.Yahoo	0.5%	0.9%	0.7%	1.2%
iFilm	0.5%	1.1%	1.4%	0.6%
BearShare	0.5%	0.7%	0.5%	1.1%
Real	0.4%	0.7%	0.7%	0.7%
Other	13.4%	21.7%	23.9%	18.3%
No preference	63.9%	40.9%	37.5%	46.1%

Note: n=15,167 (all Internet users, ages 18+); n=4,987 (all video downloaders, ages 18+); n=2,942 (male downloaders, ages 18+); n=2,045 (female downloaders, ages 18+); based on respondent write-ins and no prompts from researcher
Source: BIGresearch, October 2006

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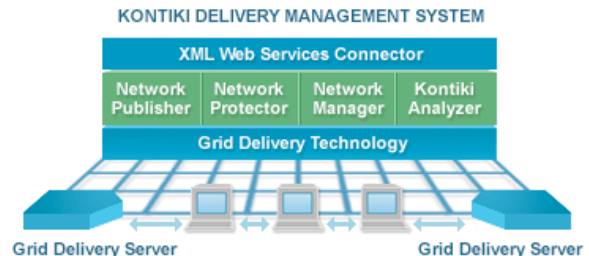
CONCLUSION

The current situation of Limewire does not look rosy. Though the p2p technology has enabled it to provide services for a very low cost and thus survive so far, it is unlikely that it will be able to continue with this model. It has been already sued in August by the major record labels and, though it has counter-sued in September, it is unclear how it will be able to pay the legal fees or maybe a settlement that it will have to reach. The company has not addressed the issue of copyrighted content correctly and has only taken reactive measures by supposably filtering out copyrighted files based on a new technology of sound signature that it has licensed recently. Even more, the success of iTunes and Yahoo Launchcast, legal music providers, proves that free music sharing is not a long term suc-

cess story. We can imagine P2P technology being used by iTunes, Yahoo or Rhapsody to reduce the costs of managing the music collection on their servers, by maybe even buying Limewire after it will be go bankrupt as a result of the law suit against it.
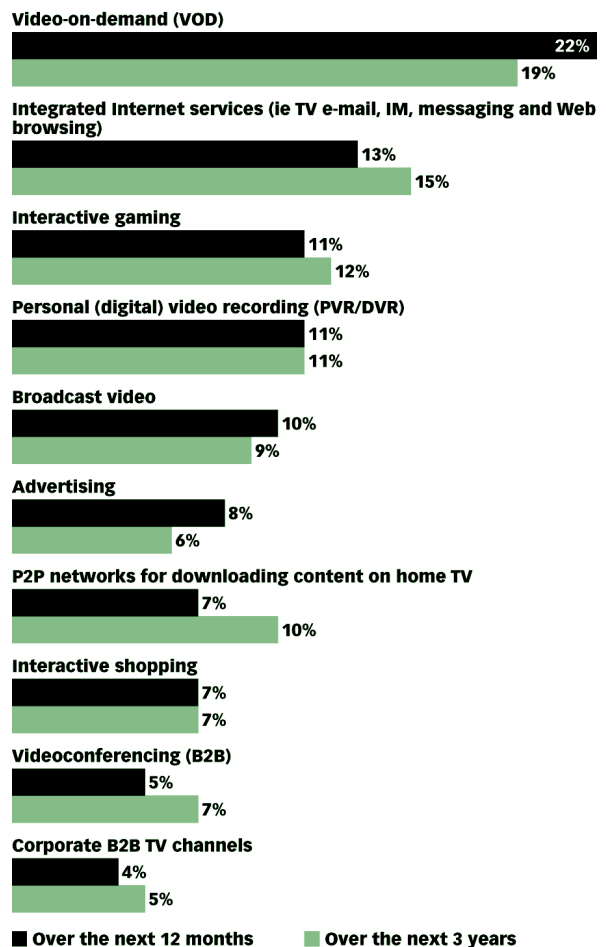
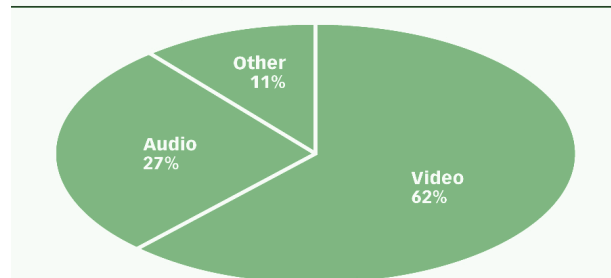# Bigger, Better and Legal - IPTV
Kontiki

A natural step in providing greater entertainment beyond music is through video. IPTV is the industry term used for the next generation of video distribution over the Internet. It includes not only video on demand, but any kind of video streams including real time and non real time for personal entertainment, commercials and broadcasts that are currently provided by traditional TV broadcasters and studios. Also it is becoming very easy to create your own video content and share with others through various Internet distribution mechanisms with many active viewers. Another application where we see an interesting opportunity, that has not crossed the chasm yet, is in legal movie downloads and video on demand. It could be interesting to see an application with the advantages of P2P to share video content while implementing a similar revenue strategy as the Rhapsody service in the music industry to a new market. We believe

KONTIKI DELIVERY MANAGEMENT SYSTEM
XML Web Services Connector
Network Publisher | Network Protector | Network Manager | Kontiki Analyzer
Grid Delivery Technology
Grid Delivery Server   Grid Delivery Server

IPTV Service that Will Offer the Most Significant Revenue Increase in the Future according to IPTV-Related Business Executives Worldwide, April-May 2006 (% of respondents)

Video-on-demand (VOD)
22%
19%

Integrated Internet services (ie TV e-mail, IM, messaging and Web browsing)
13%
15%

Interactive gaming
11%
12%

Personal (digital) video recording (PVR/DVR)
11%
11%

Broadcast video
10%
9%

Advertising
8%
6%

P2P networks for downloading content on home TV
7%
10%

Interactive shopping
7%
7%

Videoconferencing (B2B)
5%
7%

Corporate B2B TV channels
4%
5%

■ Over the next 12 months ■ Over the next 3 years

Note: n=302; numbers may not add up to 100% due to rounding
Source: Accenture and the Economist Intelligence Unit, June 2006

Worldwide P2P Market Share, by File Type, 2006 (% of Internet traffic)

Other 11%
Audio 27%
Video 62%

Source: Cachelogic and Yankee Group, March 2006

that the companies that are currently better positioned to offer this type of service are Netflix and Blockbuster.com. In an interview with the founder of Netflix, he believes that the market for movie downloads will not be mature until several years from now and he is positioning the company selling physical DVDs to create a community with network externalities and brand equity waiting for the right moment to shift the strategy.

In this section, we discuss a company that provides a peer-to-peer infrastructure to enable a large scale distribution of various types of video content on the Internet and investigate its business potential.

COMPANY DESCRIPTION

Kontiki provides peer to peer software for high quality video on demand (VOD) distribution. They license the software package called "Delivery Management System" (DMS) that customers can install on their servers to manage what they publish and distribute. They also provide hosting of these network solutions on their site. Kontiki's customers include Time Warner, BBC, SKY, Cnet and Nextel.

P2P ADVANTAGES AND DISADVANTAGES

Video distribution requires a lot of servers and high bandwidth in order to provide scalability and reliability. P2P mechanisms are proven to handle these distributions very well due to their inherent capability to scale. One of the main drawbacks here is securing the copyrights of the content. Companies like Kontiki provide secure mechanisms to distribute high quality content. The Delivery Management System system allows customers to control the content they publish and the rest of the network solution delivers it in a secure manner. The distribution system also utilizes under-used PC's in the enterprise to distribute the content in a peer-to-peer manner. The main disadvantage seems to be that for contents that are distributed through the web instead of the Kontiki client, it does not use the end users' computing and bandwidth capabilities, but use the customers' (providers of content) infrastructures to secure the content and distribution. As a result, it still requires the customers of Kontiki to have a good amount of servers for distribution to the public. This shows the importance of first creating a network of users: in this case the end-users do not have the Kontiki browser and thus cannot participate in the sharing of the content. Had Kontiki more actively promoted its network, it would have had more resources to leverage for its DMS.

However, for internal video communications in a company, it uses the under utilized PC's in the enterprise for distribution.

How it Makes Money

Video on demand and IPTV are technologies that are becoming more and more popular, as the following charts illustrate.

Top 10 Video Properties Ranked by Number of Streams Initiated			
August 2006, Total US - Home/Work/University Locations			
Property	Stream initiated by US users (millions)	Share of streams initiated	Rank by unique visitors to web property
Total Internet	6,980	100.0%	
Fox Interactive *	1,404	20.1%	6
Yahoo sites	823	11.8%	1
You Tube	688	9.9%	32
Viacom Digital	284	4.1%	12
Time Warner Network	238	3.4%	2
Microsoft sites	186	2.7%	3
Google sites	102	1.5%	4
Ebaumsworld.com	53	0.8%	182
Comcast Corp.	45	0.7%	34
Real.com Network	44	0.6%	28

Source: comScore Video Metrix

* As of August 2006 data, MySpace.com is included as part of the Fox Interactive property

Note: Streams are attributed to the property that provides the stream. For example, the Youtube data include streams that occurred on the Web property and on other properties whereby Youtube provided those streams. Copyright 2006 Rider Research

IPTV can also be delivered using client server based infrastructure, but since most TV programs are watched by many people, it is more efficient to deliver it in a p2p manner reducing the content provider's server load and distributing the bandwidth usage. Kontiki currently provides software licenses for their DMS software and some services to help customers create content. They focus not only on public end users of the customer's content, but also infrastructure for delivering video based communications materials inside enterprises. Competing companies like Arroyo who provide content servers and cache servers for cable operators has integrated TANDBERG's Adpoint system to provide on demand advertising that allows advertising to be inserted to video streams on demand [1]. Such mix of licensing, service and third party on demand advertisements seem to be the best way to generate revenue for IPTV solution providers.

CONCLUSION

The two companies mentioned, Kontiki and Arroyo, have been acquired by Verisign and Cisco respectively. Currently, it is difficult to judge from the public information how big a revenue they can generate, but such acquisitions indicate potential market growth for VOD and IPTV. Peer-to-peer networks are not the only way to distribute video content to large masses, but it is the most scalable and efficient way of distributing this kind of high bandwidth content. We believe that this is an ideal segment for peer-to-peer software to be used with these corporations providing the mechanisms to secure content through DRM's and centralized way of publishing and managing content.

Besides these companies, there are companies like Bittorrent that are partnering with major studios such as 20th Century Fox, Lionsgate and Paramount Pictures to distribute their legal movie contents. Bittorrent has also signed deals with Walmart to provide value added service to the existing DVD sales by allowing users to download the movie for $1.97 to be viewed on portable devices [2].

The Complete Packages - Voice over IP
Skype

The case of Skype is another successful hybrid case in the p2p infrastructure segment. Skype offered their software for free that allowed a voice over IP (VoIP) communication platform with great quality of sound. They also enabled the users to make phone calls from their PCs to regular phone numbers in several countries in the world for a very competitive price. Although the company offered the basic PC to PC service for free, they were able to monetize the calls that were made to regular phone lines. It is possible also to buy a Skype phone that can provide a better "usability" of Skype, more similar to the one of a regular physical phone. We believe that Skype could introduce other sources of revenue like advertising to complement charging for the regular phone calls.

COMPANY DESCRIPTION

Skype was founded in 2003 by the founders of Kazaa. This was not about file sharing, but it was about voice communications. By utilizing the few billion dollar infrastructure that was provided by the Internet and the PC's, Skype was able to use their peer-to-peer software to create a network of phone switches that allowed people to talk to each other from their computers. The best part is that it can provide better voice quality than traditional phones.

Initially Skype marketed itself by cobranding with major portals in different countries. The Skype software has been downloaded by more than 100 million users world wide in

27 different countries and has the second largest user base in US VoIP market.

P2P Advantages and Disadvantages

Skype has an architecture that consists of super nodes and normal nodes. The users download the software from Skype's website and register with the Skype login server. The Skype software probes user's computer and if it has a lot of processing power and bandwidth it can decide to use the host as the super node. [Analysis of Skype Paper]. The normal nodes connect to super nodes for easy discovery of other peers and super nodes connect to other super nodes in a peer to peer manner to route voice calls and find other users. Because voice calls are routed through PC's the Skype software at the end points can decide to communicate in different voice quality instead of being bounded by a standard voice quality as in traditional phones. As a result, the audio quality is sometimes

| US VoIP Households, by Provider, January 2006 (thousands of subscribers and % market share)		
Vonage	1,861	47.5%
Skype	463	11.8%
AT&T Call Vantage	218	5.6%
Verizon Voice Wing	196	5.0%
Google	97	2.5%
8x8 (Packet 8)	67	1.7%
Other VoIP providers (excluding cable companies)	1,013	25.9%

Note: includes VoIP providers who actively promote their service as Internet telephony and excludes cable companies who offer "digital phone" services since they are not promoted as VoIP
Source: Telephia, March 2006

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Worldwide Registered Users of Skype, Q1 2004-Q3 2005 (millions)

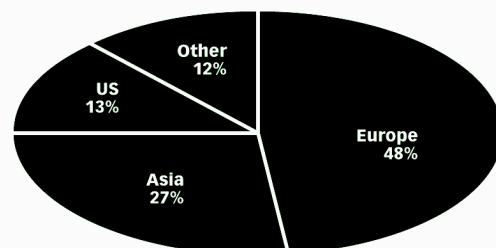|	
Q1 2004	4
Q2 2004	7
Q3 2004	12
Q4 2004	20
Q1 2005	33
Q2 2005	44
Q3 2005	57
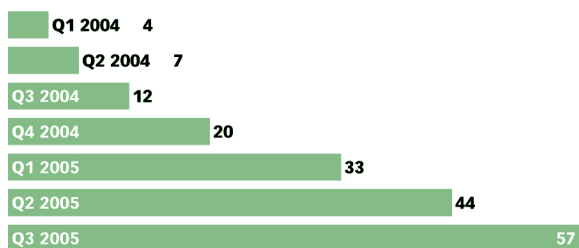
Source: Morgan Stanley, October 2005

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Worldwide Skype Revenues, by Region, Q2 2005 (% of total)

- Europe 48%
- Asia 27%
- US 13%
- Other 12%

Source: Morgan Stanley, October 2005

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better than traditional phones, provided both end points have a good bandwidth.

The disadvantage is that because it is PC based, it is tied to user's communicating through their PC's or laptops. However, there are new Skype enabled IP phones that are coming out to provide user's with mobility. Skype also has SkypeIn and SkypeOut service to allow user's to receive and make calls to standard PSTN phones.

How it Makes Money

Skype had an exponential increase in number of subscribers during its inception and as a result it was acquired by eBay in 2005. It's current revenue model is based on SkypeIn and SkypeOut. It is doing a lot of cobranding with various VoIP based accessories for PC's and WiFi mobile phones, but this represents only a small portion of the revenues:, as indicated in eBays's 10Q report: the "large majority of this revenue is generated from

Skype fees charged to users that connect Skype's VoIP network to traditional telecommunication networks".

Market data shows that currently Skype is second place in the VoIP market share.

Conclusion

Skype started as a piece of small software that users could install on their computers and freely call other people. The main advantage of p2p here is an initial low cost of deployment, as the company did not have to install a large number of servers in the different countries where it expanded. Also the technology is able to route around firewalls because it was based on peer-to-peer

networks instead of having to go through a central server. As more user's adopt it, it is able to build a global phone switching network utilizing the massive amount of computing available by millions of users. Peer-to-peer mechanisms of Skype is not well known to most people and people use Skype because it works well and is free. It seems that the current business model can generate sustaining revenue with the services it provides through SkypeIn and SkypeOut.
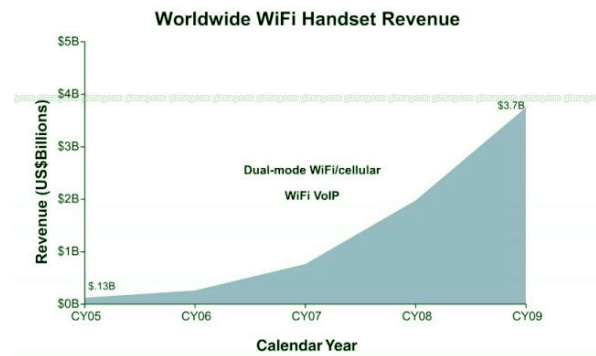
With increasing WiFi phone market [3], it could potentially become a significant player in the telecom industry. Its impact would be significant since it will affect the existing businesses in the telecom value chain where most revenue was acquired by the service providers. VoIP is still pretty small compared to existing telecom services and mobile phone market, but as it increases its share in carrying voice traffic, peer to peer based mechanism will provide more efficient connections and scalability to the network.

From Play to Work - Business Collaboration
Groove Networks

So far we have seen applications that targeted mostly entertainment services (music and video sharing, personal communication). Skype is the one that makes the first step from the personal realm to the business domain, as more and more organizations are introducing VoIP systems to reduce their telecommunications costs. Groove Networks (now MS Office Groove 2007) goes a step further and provides a rich client where users interact with each other live, share and collaborate on specific documents and projects. Globalization has made this product a must-have for even medium enterprises that have offices or partners away from their headquarters.

Company description

Groove Networks was founded in 1997 by computer visionary Ray Ozzy. It's main product, Groove Virtual Office, provides an integrated collaboration environment where users can chat, exchange and modify files, while the application maintains a versioning system making sure that two simultaneous edits on the same file do not corrupt or lose data.

Now Grove Networks is included in the Microsoft Office Suite, under the name *Microsoft Office Groove 2007*, providing an added feature to the already "featuresque" office application.

P2P Advantages and Disadvantages

In this case the p2p technology has brought the ability to handle frequent changes in connectivity status: users are able to leave and join the network at any time without affecting the system. The lack of a central point of failure is also an argument used to sell the product: the fact that documents are replicated on all participants' PCs results in reliability that even a RAID storage system cannot provide (e.g. a natural catastrophe would destroy all the RAID components because they are collocated in the same building, but it would not destroy all the copies in the Groove network because those could be half way across the world).

The main disadvantage of the p2p architecture of the system was the fact that IT managers within the client companies were extremely reluctant to accept it. First because the term had been associated with copyright infringement and second because the IT department likes having everything in its own backyard and not allowing individual users to manage all their data locally.
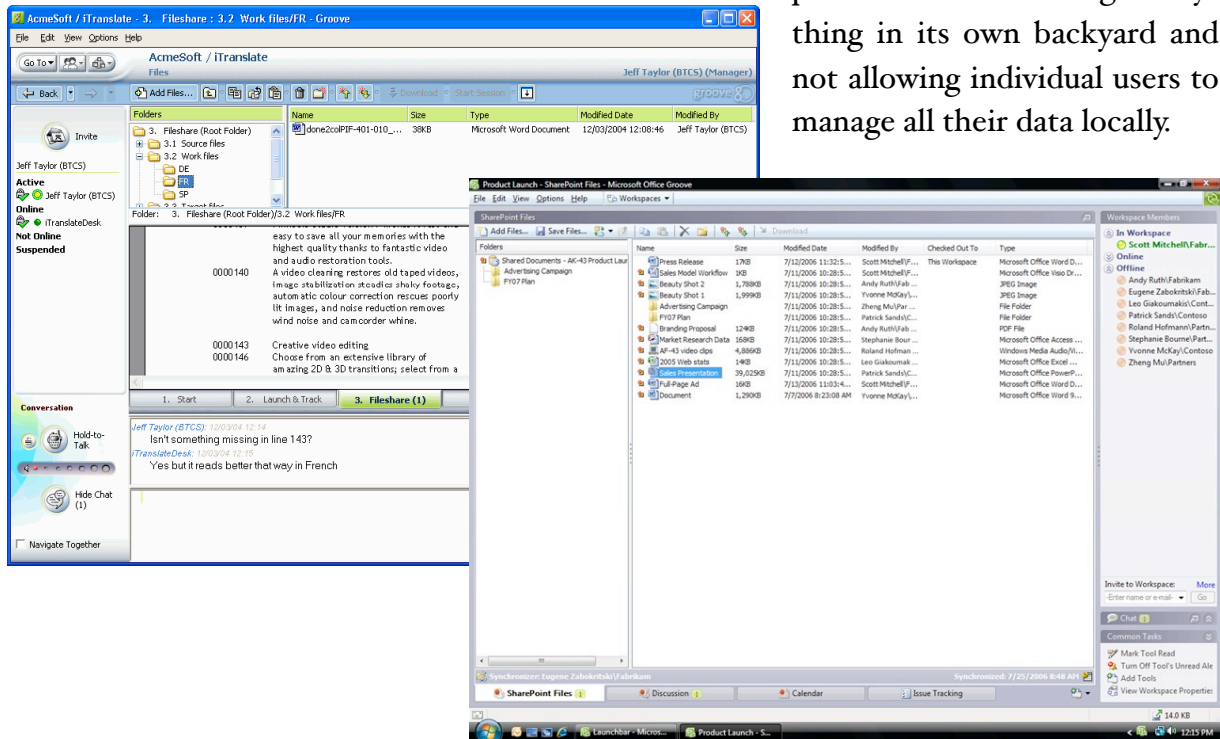
How it makes money

Until it was acquired by Microsoft in 2005 the company had significant sales but was never profitable, as it invested a lot in development to meet specific requirements of particular large organizations[1]. This was more of an error on the managerial part than a fault of the application architecture. As Brian Halligan commented, the company chased two rabbits: the SMEs as well as the large organizations (DoD, Top 500 companies). These two categories required very different business models: the first required a horizontal approach while the second a vertical one. The high development costs were due to the fact that large organizations required all sorts of features and integrations with their existing infrastructure. Their universal pricing plan, based mainly on a one-time license fee, proved wrong with big companies that required a lot of support and customization. In Brian's opinion it would have been better to go bottom-up: start from SMEs and then, as the application gains in experience, adapt it to larger customers while also providing a different pricing plan (this is how Skype grew from a free service provider to being the second VoIP provider in the US).

Now, with its incorporation into MS Office, it is extremely hard to see how much revenues will come from the p2p part of the application, but this shows an important trend in business applications of peer-to-peer technology: the architecture is used as a side-issue, it is removed from the focus of attention of corporate clients.

Microsoft is able to make additional revenues on account of the Groove Office by selling Enterprise servers to larger organizations that need additional insurance that all the files will be available all the time, even if none of the participants is online. To this extent, their business model resembles that of a 'common' p2p network: give away for free (in this case bundle with Office) the basic version and sell additional software products and services to those that require more.

Conclusion

The example of Groove Networks shows what are the difficulties in bringing peer-to-peer technology into the corporate sector: the bad name of peer-to-peer, and, more importantly, the reluctance of IT departments to give up a centralized system where they have absolute control. The way Microsoft has by-passed these obstacles is by including the product into its well known office suite and eliminating the use of the expression *peer-to-peer* from all marketing materials.

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[1] Based on discussion with Brian Halligan, founder of HubSpot and former VP of Sales for Groove Networks

The Total Business Solution - Storage Services

As we have seen in the previous section, there exists some penetration into the corporate sector, but there are high perception and technological barriers to cross before a large organization will have all its data in a peer-to-peer architecture. As indicated by Dinesh Verma, senior manager of the Autonomic Systems and Networking department at IBM TJ Watson research center [Verma], there is no significant technical difficulty in developing a storage system that takes advantage of the available space on employees' computers. Yet there is no such system available, not even from IBM.

PRODUCT DESCRIPTION

Here, rather than discussing a company or an existing product, as we have done in the previous sections, we describe the envisioned system and present existing related products.

The idea is simple: provide a low cost storage system that takes advantage of the fact that the amount of disk space that comes with new PCs has increased constantly throughout the years, while the size of a normal office file has remained more or less constant. Assuming that an employee creates a rather large office file per day (1Mb), in two years, the lifetime of an average office PC, he or she would have occupied less than 500Mb out of the minimum 40Gb that each PC comes with these days. There is obviously a lot of space to take advantage of.

IBM has a few of storage products that use the expression *peer-to-peer* in their description: *IBM TotalStorage Enterprise Storage Server*, *Websphere Information Integration & Replication* and *IBM TotalStorage Peer-to-Peer Virtual Tape Server*. However, a deeper look into their specification reveals that they have little in common with the above scenario. Instead, IBM sells storage solutions that take advantage of a subset of the peer-to-peer technology features, but rely mainly on a small number of large server machines.

P2P ADVANTAGES AND DISADVANTAGES

In our scenario, the peer-to-peer technology provides the means to store and retrieve the data items, including reliability provisions to make sure that all documents are available at all times *with high probability*, despite having a subset of the nodes offline. Scalability is also a great advantage: the more users there are, the more available space exists. The disadvantage is that a pure p2p architecture does not prohibit the situation where all nodes that hold a copy of a document be offline, thus making the document unavailable to further requests (a targeted attack against a particular document is one of the possible causes here).

How it makes money

We have seen that the technology is there, the users could eventually be convinced to accept the notion of peer-to-peer, and yet the only systems that are available have little in common with a truly scalable and reliable distributed system. Everything else being eliminated, the only possible reason for the lack of adoption is that no company has found it sufficiently motivating to introduce such a system. Let us try to understand why.

First, let's remember what our imaginary product is supposed to do: use the existing machines within an enterprise, to provide a reliable, self-healing storage architecture. What could be a good business model for this? We would not be making any money from the hardware part, since the application would be using the existing infrastructure. Pay-per-usage is not an option because the application runs on the company's machines and advertisement-based is not even in the picture for the corporate environment. The remaining options are a license fee, maybe with a limited free version, plus a service fee.

The business arguments for our scenario seem less and less compelling if we consider the fact that the price of off-the-shelf software is dropping fast and one of the main claims of peer-to-peer is a system that requires low maintenance (thus low service prices).

Conclusion

Though the technology exists, we see that IBM prefers to use the research to improve its existing products and continue to bundle the hardware with the software in a package to provide complete services to the client and to guarantee high revenues for them. The system we had imagined seems indeed to have little chances of success because its technological advantages are its business disadvantages: ability to use existing infrastructure eliminates hardware sales, self-healing and reliability reduces service costs.

Conclusions

Even though peer-to-peer technology has been adopted with enthusiasm by the personal users, it has been facing a staunch resistance from business users and it has been very difficult to find a way to monetize the networks generated by the P2P software.

The successful applications of peer-to-peer have involved using a hybrid technological approach. In the cases that we analyzed, the p2p technology was usually combined with more traditional centralized approaches. For example, in the case of Kontiki, the service developed is partially using p2p and partially using centralized servers to distribute content.

Moreover, the only profitably successful applications of peer-to-peer use a "hybrid" revenue model. In this model, the companies are using peer-to-peer software as a way to generate a community or infrastructure and monetizing the network effects through other complementary sources. This model uses the effects of double network externalities and seems to be the most appealing and viable revenue model. Usually, the companies will "subsidize" one of the sides of the double network externalities, for example, Skype giving away the software to do phone call between each person, and monetize complementary products that are part of another side of that double network like making phone calls to line phones.

On the corporate side we will continue to see the research being applied to enhance existing products, as we have seen in the IBM example, but it is most unlikely that a corporate client will rely 100% on a pure p2p solution. Even for SMEs, the 'best effort' that is characteristic of peer-to-peer networks will prove to be a powerful deterrent that will not resist against centralized products that are also becoming more commoditized and, consequently, cheaper.

Further business potential exists in the development of the future market in game/ software downloads on mobile phones. Slowly mobile phone downloads are becoming popular for games and videos (YouTube on Verizon) and as it gains momentum, the network will require greater bandwidth support. A peer to peer based network will facilitate greater scalability for distributing software content to large masses. The mobile phone operators might benefit from the use of content distribution servers and peer to peer software packages as the IPTV operators are doing.

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