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# HOW P2P TECHNOLOGY CAN CHANGE BROADCASTING AS WE KNOW IT

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## ABSTRACT

Although streaming over the Internet has been a reality for some time now, the traditional method has not offered a sound business model. The price per viewer has been so astronomical that neither advertising nor any other related revenue can compensate for the costs. In addition to the costs, high-quality streaming to a large number of people has been virtually impossible from a technical standpoint. For these reasons, streaming on the Internet has been carried out on a relatively small scale, and for many broadcasters it has been a costly, need-to-have technology.

Recently, however, organizations and broadcasters, such as AOL, the Eurovision Song Contest, and Deutsche Welle have begun to use P2P (Peer-to-Peer) technology for streaming. This technology has matured and it is changing the situation radically. There is now a sound business model for broadcasting on a large scale over the Internet.

In this paper, we will review traditional cost challenges and other hindrances to broadcasting over the Internet, and give examples of how this new P2P technology can revolutionize business conditions, change the value chain, and transform the competitive landscape for broadcasters.

## INTRODUCTION

Broadcasting over the Internet has been challenging to say the least. In fact, when done on a large scale, it can even be cost prohibitive or simply impossible to carry out from a technical point of view. On the other hand, more and more consumers are coming online, and the popularity of new media is doubling every year. For many broadcasters, streaming over the Internet using traditional technology has been a success in terms of increasing their customer base. But at what price?

### **P2P Technology Can Clear The Way.**

Traditional broadcasting technology may be a business minefield, but the use of P2P (Peer-to-Peer) technology is forging a path for business success. In February 2006, the European Broadcasting Union (EBU) held a seminar entitled "From P2P to Broadcasting" with participants from more than 30 TV and radio stations and also a large number of leading IT companies. According to Kozamernik [3], the message taken from the conference was that P2P technology has now matured to the point where it offers broadcasters a sound business model for streaming on a large scale.

Besides offering a huge cost reduction, P2P streaming also improves scalability, reduces machine and maintenance costs, and offers much higher quality streaming. Several large companies have already adopted the new technology, for example, the BBC, AOL, and BskyB.

The competitive landscape for delivering media to consumers is under radical change. Traditionally, broadcasters and Business to Consumer (B2C) content distributors have had to split the revenue pie. But P2P technology will transform the value chain opening up a new world of opportunities for broadcasters.

With P2P technology, broadcasters can now have their own (P2P software) distribution network. This makes P2P a disruptive technology that frees broadcasters of their dependency on existing distribution companies. What's more, it offers a much easier way for broadcasters to distribute on a large scale.

### **What Does All This Mean?**

It means that we will probably see a more fragmented consumer market. It means that the revenue pie can be divided in a whole new way – between many broadcasters. Furthermore, content owners have started streaming directly to the consumer, bypassing traditional broadcasters. And Internet Service Providers (ISPs) have begun to buy up content and are acting as broadcasters in their triple play strategy – voice, video, and data in one bundled service.

In this paper, we will take a look at:

- The high cost of business (for traditional broadcast streamers)
- How a new, disruptive technology can change everything
- Examples of P2P streaming today
- The consumer experience

Note: In the appendix, we elaborate more on the general concept of P2P.

### **THE HIGH COST OF BUSINESS (FOR TRADITIONAL BROADCAST STREAMERS)**

In this section, we will focus on the distribution costs of live streaming. When using traditional streaming methods, each viewer needs to receive his own unique stream. The result in terms of cost can be represented by this formula: No. of Viewers x Quality = Cost

Hence, tripling the number of viewers or doubling the quality will triple and double the respective costs. Furthermore, increasing the load in either way can be impossible using traditional methods due to local bottlenecks on the Internet.

For a reliable and robust traditional solution, the cost of streaming is typically €1 per Gbyte. (Gbyte is the most common traffic volume measure when selling/buying streaming capacity over the Internet.) Prices can, however, range from €5 to 0,1 per Gbyte, and even sometimes be offered for free under specific conditions. In the appendix, we elaborate more on price issues. We recommend the paper by Hoch and Rayburn (1) for insight into current price structures.

### **The Numbers Add Up To A No-Win Situation**

A user listening to a radio station (sending 100 kbps quality) or viewing a TV station (600 kbps quality) will consume approximately 35 Gbyte or 200 Gbyte respectively in one month. This means that it would cost €35 or €200 respectively. Consumers are not, however, listening non-stop. Typically, the average number of people over a month getting a specific signal is a third of the peak for that same month.

This means that a radio or TV station would respectively have to pay approximately €12 or €67 per month per user simultaneously receiving the same signal. There is very little content that can return enough money to justify these costs. Broadcasters are therefore in a situation

where increasing success in terms of customers implies higher costs rather than increasing revenue – a no-win situation.

Note: For ISP's offering streaming via their own network to their own DSL-customers, the price structure is markedly different. Short running events of high value, such as boxing matches will produce much less traffic and could generate revenue even with existing technology.

## **HOW A NEW, DISRUPTIVE TECHNOLOGY CAN CHANGE EVERYTHING**

As already explained, it has almost been impossible to make a sound business model for streaming over the Internet. Furthermore, it has been technologically difficult or even impossible to offer good quality for a large-scale audience. P2P technology changes all this. It offers a sound business model for large-scale streaming over the Internet. Before delving into the potential of this technology to disrupt existing modes of business, however, we will take a little look at distribution platforms and consumers.

### **Meet Tomorrow's Distribution Platform, It's Called The Internet**

Today, many new platforms and buzz words are emerging – but by tomorrow, they could all be forgotten. It can therefore be difficult for broadcasters to know if an investment in a new infrastructure and distribution model is a good long-term investment. The Internet, however, is the one technology that everyone would agree is here to stay. The Internet is growing and as a society we are getting more and more dependant on it. There are more users online. There are more services available in different situations. Even hardware businesses, such as cell phones, TVs, and coffee machines are moving online in one way or another. For examples, see Kozamernik and Mullane (2).

### **We Mail, We Chat, We Message**

The words *Google* and *Skype* have become verbs. (Skype is in fact a type of P2P network technology where users help each other facilitate free phone conversation over the Internet.) So, it feels safe to say that the Internet will be around for a long time. The Internet is:

- Becoming available everywhere with WiMax. See [www.wimaxforum.org](http://www.wimaxforum.org).
- Accessible for many people both at work and home.
- Rapidly growing. See [www.dslforum.org](http://www.dslforum.org) (3).

As it becomes possible for people to go online using TVs, set-top boxes (STBs), and game consoles, the Internet will move into the living room.

### **What Kind Of Entertainment And Information Exchange Do Users Prefer?**

There have been countless papers on consumer behavior. In this paper, we will touch on just to two aspects:

1. Analyses of user behavior have shown that users are extremely loyal to their favorite TV and radio stations. For example, consumers listen on average to 1.5 radio stations.
2. Young people hardly watch TV anymore; they spend much more time in front of the PC gaming, mailing, chatting, Skyping, and consuming new media.

These observations point towards the Internet as the future distribution platform of choice.

What's more, with P2P technology providing the possibility for a sound business model, one can expect that the growth of Internet streaming will increase even more rapidly. Because consumers are extremely loyal – listening to the same radio station over the Internet at work that they listen to while driving on their way to work – the broadcaster that is first to adopt P2P technology will have advantages on all platforms. The early adopter will get his reward.

### **The Numbers That Industry Leaders Are Throwing Around Are Astounding**

In Kozamernik (3), it is reported that Ashley Highfield, BBC Director of New Media and Technology, shared a vision of future television with Microsoft's Bill Gates pointing out that the broadcast distribution costs are falling. He said that the price could fall from £7 million a year for terrestrial broadcasting to £70,000 over the Internet.

However, the development of this disruptive technology is not only advantageous for existing broadcasters; it also implies a much broader competition. Today, users can access several thousand radio and TV streams. (For a great list of TV-stations, see [www.mediahopper.com](http://www.mediahopper.com).)

It is true that most of these stations are only available for the Internet. However, as more people get wireless routers (one of the most popular consumer products these days), and it becomes possible to go online via hardware other than computers, we will be facing a new situation where the competition will be enormous. With P2P technology for live streaming, existing stations will have the right tool to grow, and it will be easier for new stations to enter the market.

There have also been several examples of content owners who used to deliver content to broadcasters in the traditional way and now have started to deliver the content directly (without the broadcasters) to the consumers. Once again, with P2P technology this will be an easier step to take.

Finally, one should also take into account that ISPs are trying to become active players by introducing triple play on their "local" network and buying up a lot of content. So, to sum up, some of the factors pushing towards Internet broadcasting growth and changing the value chain are:

- Users can access content from an almost unlimited number of TV and radio stations.
- ISPs have started buying content and offering triple play services.
- It is easier to enter the market because the establishing and maintenance distribution costs are dramatically falling.
- Content owners have begun to broadcast directly to the customers.
- Young consumers prefer to use the Internet to access media.

Most of the prerequisites for successful live streaming over the Internet have been present for quite some time. Now there is a feasible technology that will lay the groundwork for a sound business model. We are on the brink of a revolution, and we can only guess at the consequences. But one thing is certain: tomorrow's winners are those who move first today, especially if consumers stay as loyal to broadcasters as they do currently.

### **EXAMPLES OF P2P STREAMING TODAY**

**There Are Some Notable Examples Of Downloading Services.** BBC online service is extremely popular and, as a result, the cost of distribution has been high. For this reason, the BBC have introduced the BBC Integrated Media Player (iMP, <http://www.bbc.co.uk/imp/>), which uses P2P technology to reduce costs. In this case, the P2P technology is only for

downloading media files. It is not used for live streaming. Live streaming is where people simultaneously watch or listen to a continuous broadcast, as we know TV and Radio today.

Kontiki deliver a solution to broadcasters for P2P downloading (including iMP). Their solution increases quality and at the same time reduces the distribution cost by approximately 80 percent.

P2P for downloading has been around for a long time – and in the past was associated with distribution and copyright infringement. This illegal activity is responsible for negative connotations associated with the technology, which has caused some broadcasters to avoid it. However, as with any other technology, P2P can be used both with good and bad intentions.

As a result of the negative connotations, serious P2P companies have been focusing a lot on Digital Rights Management (DRM), technology used to enforce predefined policies and protect copyrights. In some cases – as with Kontiki – they not only coexist with DRM, but also offer extra security for the content. Other examples of broadcasters using P2P downloading are Time Warner, BskyB, OMN, and NBC.

### **P2P For Live Streaming Has Also Existed For A Number Of Years**

For example, there are many open source projects and old companies (measured in Internet time) offering P2P live streaming solutions. This involves challenging technology issues, since transmission and delivery occur in real time. Therefore, most of these solutions only offer limited services (they don't scale, don't reduce the cost much, and so on).

The revolution for P2P live streaming technology happened recently with the enabling of Grid technology (a somewhat advanced form of P2P technology). Grid technology offers the same advances for live streaming that ordinary P2P provides for downloading. In fact, the saving in costs can be up to 99 percent and the scalability almost unlimited with this strong technology. We refer to Alstrup and Rauhe (4) for a detailed explanation and elaboration of the different technologies for streaming including P2P, Grid, Multicast, and Unicast.

There are many new and established companies claiming they offer or will offer this potentially lucrative technology, and broadcasters should observe caution before investing. Some examples of Grid (advanced P2P) live streaming today are:

- The Eurovision Song Contest ESC-TV
- Deutsche Welle
- World eSports Games 2006 Master
- Studio Brussels
- Smooth Jazz

The streaming services offer variations in the way they are presented to the consumers. For example, Deutsche Welle allows the consumer to choose if they prefer the traditional, low-quality or the new, high-quality Grid service. Others, such as ESC-TV, only offer the new high-quality Grid service.

### **THE CONSUMER EXPERIENCE**

Up until now, we have focused on streaming seen from the broadcasters' and distributors' point of view. Now, we turn to the consumer experience. As with anything else, if consumers do not have a good user experience, they will not want to experience it at all.

And in fact, users face a number of problems in receiving streaming (to their PCs). We will

walk through some of these problems and explain why Grid (advanced P2P) technology – in addition to its main benefit of facilitating efficient streaming on a large scale – can solve most of these problems.

The goal is not to give a full and detailed explanation of users' problems. We only want to illustrate that streaming – despite some people's unbridled enthusiasm – does still involve a number of non-trivial issues.

To access a stream over the Internet, users need a media player, codec, and an Internet connection that is compatible with the stream. Furthermore, users often need to perform non-trivial tasks such as increasing the buffering time in the media player.

**Integration challenge:** The player, codec, Internet, and stream have to match. Otherwise there will be no streaming. Making that match should not be a burden on the users like it is to some degree today. Furthermore, some of the media players insist on trying to play all codecs - including the ones they cannot play – as if to say, “If I cannot play the stream, no other media player should.”

**Integration solution:** P2P and Grid technology always comes with a plugin. The plugin can (though not all will) control and take care of all these issues without user interaction, making a perfect match.

**Wireless router challenge:** Today it is quite popular to have wireless routers both at work and home. Wireless routers have higher packet loss than wired connections. Streaming high quality (using TCP) with high packet loss (and ping time) constantly interrupts the stream. This especially happens if, for example, one is near a microwave oven or vacuum cleaner that is being used.

**Wireless router solution:** True Grid technology compensates for this problem by sending a few more packets than needed. In this way, packet loss is no longer a problem: a solution which is not achievable with traditional (TCP) streaming. In fact, even if you tuned in to Grid streaming from an airplane, it would work for you.

**Internet-sharing challenge:** The user might have a high internal connection (e.g. 100 mbps) at home or at work. However, externally the connection would typically be much lower and be shared by other people. The typical scenario is that the more users, the less Internet capacity available per user. For this reason, many companies have now forbidden their employees to listen to Internet radio.

**Internet-sharing solution:** The stream is sent once inside the company and then the plugins inside the company spread the stream. Since the internal network capacity is more than sufficient for streaming, one can now have an almost unlimited number of people receiving a popular stream. At the same time, they will only use very restrictive external bandwidth for one stream. This same principle is used on the whole Internet – always minimizing the load through a given link – which once again makes Grid technology more scalable than any other technology.

## **Summary Of The Consumer Experience**

Today, users face a number of problems when they attempt to receive streaming in good quality. A Grid (or P2P) plugin can solve these problems to a large extent and in this way make it a mainstream consumer service.

## **CONCLUSION**

Streaming on a large scale over the Internet has been a high profile area of focus for some time now. However, looking at the business and technology side of it, it is easy to see why

streaming is currently only doubling its number of consumers annually:

- Lack of a sound business model
- Lack of a feasible technology
- Unsatisfactory user experience

With these core obstacles eliminated by a new disruptive technology, streaming can increase much faster. But the new opportunities also introduce new competition and a radical change of the value chain. Who are the broadcasters of tomorrow? What should today's broadcasters be doing? In this paper, we have argued that the Internet is and will be an inherent part of our society and therefore a safe investment in the long run. We are aware that this paper provides more questions than answers. But hopefully, we have succeeded in communicating why we believe streaming represents such great potential for us all.

## **APPENDIX**

### **Variation Of The Price For Broadcasting On The Internet**

Below we list some of the explanations for why the price for streaming can vary quite a bit:

- In a local geographical area, there may be a dominant Internet Service Provider (ISP) that offers streaming to large broadcasters in that area only, at a very low price (perhaps even as a free service). The ISP looks at the broadcaster content as a market driver pushing consumers to buy DSL-products. However, in the long run – when the majority of ISP consumers have DSL – one would expect the price to go up. Furthermore, many ISPs are currently going for the triple play, buying content, and could wind up being competing broadcasters.
- In a local area, there can be many ISPs, and the competition thus lowers the price.
- Broadcasters with a need to stream worldwide on a large scale will typically have very few distributors to choose from. In this case, they are forced to use one of the few and expensive offerings from Content Delivery Networks (CDNs).
- Small local hosting centers can also offer very low prices. However, since they will rely on traditional (TCP) streaming, poor quality (for example, constant buffering) when streaming on a large scale is almost inevitable.

### **P2P, The Technology Revolutionizing The Internet Today**

Skyping is a simple form of P2P technology. Anyone with Skype is part of one huge powerful network. When two people are Skyping, the conversation is facilitated via the idle resources of other Skype users. In this way, users help each other to talk free of charge over the Internet.

The same principle can be used for Grid (advanced P2P) live streaming: Consumers receiving a stream can also (partially) forward the stream to other consumers. This may sound simple but the technology behind grid technology is, in fact, extremely complicated. This also explains why we had to wait several years going from downloading to live streaming using P2P technology. A technical explanation of Grid technology for live streaming can be found in Alstrup and Rauhe (4).

P2P technology got on the map with Napster (used to share mp3 music), and P2P is still heavily used today. In fact, approximately 70 percent of today's traffic on the Internet is P2P

traffic according to CacheLogic, see Kozamernik and Mullane (3). Well-known programs are BitTorrent, eDonkey, and fasttrack. However, it is only recently that the technology has matured enough to offer a valid solution for broadcasters.

P2P technology clearly offers dramatic cost reductions. In addition, it can also spread the traffic burden over the Internet and eliminate bottlenecks by not sending all the streams from one source. This makes it possible to stream on a much larger scale than with the traditional method.

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