Risks and opportunities of P2PTV (peer-to-peer television) for the television industry

Designing a risk framework as decision support tool for the key actors in the television industry

SPM5910 SEPAM Master Thesis Project

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June 2009
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Preface

The thesis lying before you is the result of several months of research and hard work. Deloitte ERS kindly offered me the position of thesis intern, which enabled me to research this subject in an environment that is professionally involved with risk management. During the time spend working on this project I have learned a great deal, not only about the subjects of P2PTV and risk management, but also about myself.

I would like to acknowledge the complete graduation committee consisting of Dr.'s Bouwman, Van den Berg and Lemstra for their guidance during this thesis research. Especially Dr. Van den Berg, who as first supervisor guided my throughout the whole process and helped me a lot from start to finish of this thesis project. Besides them I would like to acknowledge Mr. Jan-Jan Lowijs and Mr. Marc Verdonk, who supervised this research from within Deloitte ERS. They have greatly guided me throughout my research and were available to help me when I would hit some bumps in the road towards the completion of this research.

I dedicate this thesis project and my graduation to my wonderful and sweet mother, who I know would be very proud. And of course I want to thank my father for the support he has given me in several areas. To my girlfriend and all my friends I say sorry for the many times I had to show a-social behaviour when I had to work on this project, but thanks for your support as well.

I sincerely hope this thesis can interest the reader as much for the subject of the possibilities of P2PTV for the television industry as I am interested in this and that this research is seen as a contribution to the P2PTV debate.

Executive summary

In this research we have set out to design a risk framework, representing the risks and opportunities that P2PTV can have for the television industry, that can be used as a decision support tool. In order to design the risk framework have formulated several research questions and presented a research approach with the main research question being; *What are the risks and opportunities that the emerging P2PTV technology can impose on the key actors in the current television industry?* We define risk as any future development that is expected to negatively affect an actor's business. And opposite of that we define an opportunity as any future development that is expected to positively affect an actor's business. To answer the research questions and design the risk framework we identified the risks and opportunities for the key actors in the television industry by performing a scenario based analysis of risks and opportunities that was based on three what-if scenarios we have created.

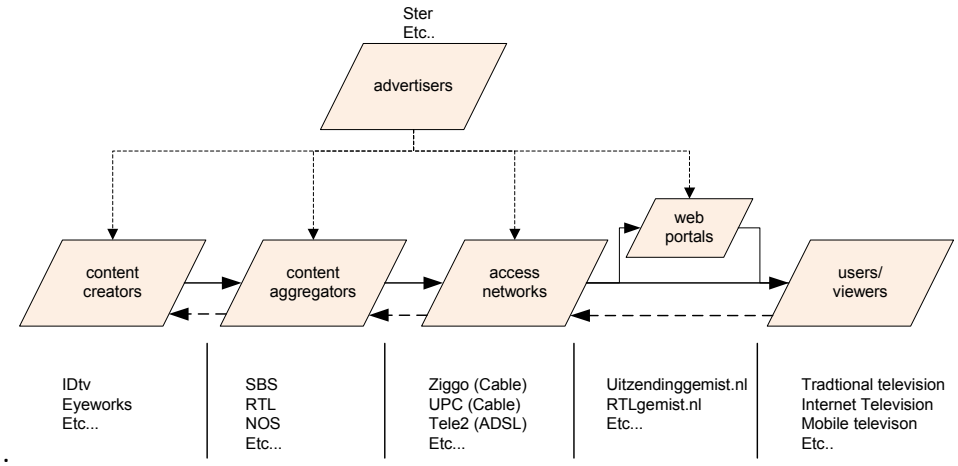
We have started by researching the P2PTV technique and its possibilities. P2PTV is and will be capable of distributing HD-quality video content over the internet making use of the user's upload capacity, at low costs and with guaranteed QoS. This will even become more true as consumer bandwidth grows to the probable state where the capacity of consumer bandwidth is raised to 100 Mbps upstream and 10 Mbps downstream. The largest advantages P2PTV can offer the television industry is low costs of content distribution and worldwide availability of their content. However the P2PTV technique also has some technical implications. The biggest of which is the ability it gives the user to become a broadcaster and with that give him to possibility to (illegally) re-distribute the content he receives to either non-paying viewers or viewers outside the region the broadcast is designated for.

After establishing the functioning of P2P and its possibilities an actor- and network analysis was performed to gain insight in the current television industry. We identify the following *four key actors* in the value chain of the current television industry, which are the key actors because the roles that these actors fulfill are at this time imperative for the processes from content production to the content consumption by the viewer:

- The content creator, which produces the television content
- The content aggregator, which acquires licenses to content and compiles a package of content to offer to the consumer through an access network
- The access network, which operates and maintains the physical network to the consumer so they can receive content and watch television
- The user, which is the consumer of the television content

From these four key we identify *three key supplying actors*, which we can call the key supplying actors because these three actor roles are imperative in the supply chain from content from television content creation to the delivery of this content to the user. The key supplying actors are; the content creator, the content aggregator and access network. The value chain of the current television industry is linear as the content flows from content creator, to content aggregator, through the current access networks to the user (see figure 1 below). Money flows in the opposite direction; the user pays a subscription fee to the access networks, the access networks pay carriage fees to the content aggregators and the aggregators in turn pay licensing fees to the content creator. Advertisement money is injected from outside this value chain. Mainly towards the content

aggregator for whom advertisement revenue is the largest part of their total revenue, in exchange for the advertisement time they offer on the television channels they operate. And in much lesser amounts also towards the content creator and the current access networks. Although advertisement money is of great importance for the functioning of the current television industry, we do not see advertisers as key actor, for they are not imperative in the supply chain from content creation to content consumption. The following picture represents the value chain of the current television industry.



1. Value chain of the current television industry

We then researched the possible futures of P2PTV that can make up for the what-if scenarios that are used for the scenario based analysis of risks and opportunities. From the start we indentified the fact that P2PTV can influence the developments within the television industry even if the industry would not use P2PTV as a distribution method. If the consumers were to misuse the P2PTV technology by re-distributing television content over the internet through P2PTV networks this can also harm the current television industry. For content aggregators using P2PTV could be of interest as a new method for distributing their television content with the potential to reach every consumer that is connected to the internet. Where the costs of this distribution method are relatively low as the consumer's upload capacity is used for distribution. For the consumer the P2PTV technology might offer them the possibility to receive content that was otherwise not available to them. The most important trends we refer to that influence the possible futures of P2PTV are first of the amount of time the consumers spend on watching television online, as this is one of the crucial factors determining the consumer adoption. Also the advances in hardware used for watching television, like possible Internet TV's and STB's with P2PTV capabilities, that make viewing of content distributed by P2PTV system possible on a TV screen, instead of on a computer screen only, are of importance to the impact of the risks and opportunities for the key actors.

We define two dimensions that determine the possible futures of P2PTV within the television industry, which are; the *consumer adoption* of P2PTV and the *industry adoption* of P2PTV. The industry adoption consists of content aggregators using the P2PTV for content distribution. Even though the industry adoption is defined by one actor, we use the terminology of industry adoption to clearly make a distinction between the industry and the consumer. Three different directions in which the future of P2PTV could evolve are defined that are used for the creation of what-if scenarios. These three what-if scenarios are named:

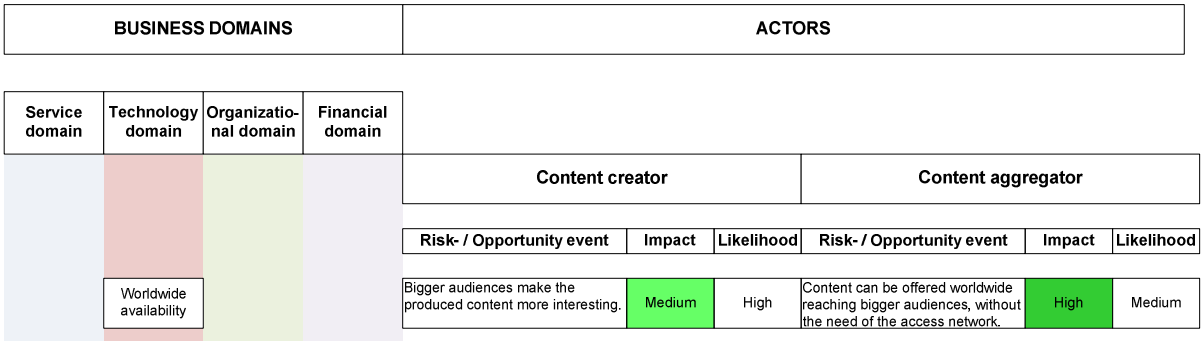
- P2PTV takes over television; in which we describe a future in which both the industry adoption of P2PTV and the consumer adoption of P2PTV are high.
- Over anticipated P2PTV; in which we describe a future in which the industry adoption is high, i.e. content aggregators start using P2PTV for television content distribution. But the consumer adoption turns out to be low.
- P2PTV underground; in which we describe a future in which the industry, i.e. content aggregators, do not use P2PTV for content distribution. The technology is however highly adopted by the consumer in this what-if scenario.

We have then designed the framework that incorporates the elements that we have identify that are needed for the risk framework to function. This supplies us with the risk framework that can be filled with the risks and opportunities we identify in the scenario based analysis of risks and opportunities. We will provide an example of the functioning of the risk framework later on in this executive summary that will also present these elements. The needed elements are:

- The actors; in order to describe to whom of the four key actors the risk or opportunity is addressed
- The business domains; in order to present from which business domain used for risk- and opportunity characterization the risks or opportunity originates
- The three what-if scenarios; in order to present the risks and opportunities per actor in the different possible futures
- The risks and opportunities that are identified per actor in each what-if scenario, along with the business domain it originates and its likelihood and impact.

We then create the three what-if scenarios and per what-if scenario identify the effects the developments in that what-if scenario have on the key actors. Based on this we perform the scenario based analysis of risks and opportunities, which supplies us with the risks and opportunities that the emerging P2PTV technology can impose on the key actors in the current television industry in these different possible futures. The what-if scenarios provide us with the possible changes the different futures can have on the roles of the key actors and the revenue models of the key supplying actors, which enables us to identify the risks and opportunities and the domains from which the risk or opportunity originates. The risks and opportunities described per actor for every what-if scenario are presented in *Appendix B - Identification and characterization of risks and opportunities*, which answers our main research question.

The result of the scenario based analysis of risks and opportunities form the contents for the risk framework. *The risk framework represents the different risks and opportunities per actor per what-if scenario, with its likelihood and the impact for that actor within a specific what-if scenario, also representing the domain from which it originates. The full framework is presented as a foldable poster in Appendix C – Risk framework* due to its size. The following figure is a selection taken from the risk framework that we will use to exemplify its functioning.



2. Exemplary selection of the risk framework

In Figure 2 above we describe the risk- or opportunity events for two key actors coming from a change in the technology business domain named worldwide availability. Worldwide availability indicates the fact that television content could be broadcasted worldwide at the same time from a single source by using P2PTV (according to the developments in one of the what-if scenarios). This change brings an opportunity for both the content creator and the content aggregator. For the content creator the opportunity event is described as the event that bigger audiences can be reached by a single broadcast by the content aggregator, the produced content can become more interesting. This event has medium impact and high likelihood. For the content aggregator the opportunity event is described as the possibility to offer the content worldwide and so enabling the reach of bigger audiences. The impact of this for the content aggregator is decided as high and the likelihood medium. For the full listing of the risks and opportunities and a description of and reasoning on the risk- and opportunity events, impact and likelihood, we again refer to Appendix B of this thesis.

The risk framework can be used in several different ways by the actors in the television industry (and also by new entrants or companies consulting actors in the industry) as a decision support tool;

1) The first possible use of our framework is for the actors within the industry to be more prepared towards the effects that the developments of P2PTV might have on the industry. When and if P2PTV will be adopted by the industry or the consumer, the different actors are able to use the framework to examine which risks and opportunities these developments can have for them. They can look up which what-if scenario resembles the true developments and identify which risks and opportunities will come in to play for them or every other actor, their possible impact and likelihood and the domain from which the risks originate. This information can be used to support decision making and form a strategy in their risk management activities.
2) Alternatively the framework can be used by actors within the industry to assess whether or not they favor future developments in the direction that one of the what-if scenarios represents. If an actor oversees the different risks and opportunities that the future represents, he can research and decide if the opportunities outweigh the risks, how certain the risks that are in that what-if scenario can be mitigated and how the opportunities can be maximally exploited. And with this information decide to steer the future towards that what-if scenario, if he has the ability to do this.
3) Besides these uses for actors already involved in the television industry, the framework can also be of interest to new entrants. With the arrival and usage of P2PTV, parties that do not have the funding or market potential of commercial channels could easily broadcast their

content at low costs. The way these broadcast can be received, if this is only possible on computer systems or also through Internet TV's, depends on the future developments of P2PTV and the television industry we have come across in this research. These possible new entrants could make use of this framework in identifying pitfalls for the set-up of their channel and possibly even try to influence the industry towards favorable future developments.

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1 Introduction

With the rise of video websites like YouTube and Google Video the popularity of watching video online on the internet has been increasing rapidly the last few years (TheConferenceBoard, 2008). These sites offer “low” quality videos that are stored somewhere on a server. The current television industry has picked up on this and several broadcasters have chosen to offer their owned content on the web. The BBC for example has his own iPlayer and several Dutch broadcasters offer the possibility to watch programs for which they have acquired the appropriate licenses online after they have aired, like uitzendinggemist.nl.

1.1 Introduction to internet television

In the past few years the use of internet for the delivery of a complete and user oriented offering of large and worldwide events has been growing. Events like the Olympic Summer Games and the European Cup of soccer were offered by several distributors through the internet, live, 24 hours per day and with the choice of what the user wanted to see. All sports and matches were available and the audiences for these online coverage have been overwhelming (Roettgers, 2008). The Dutch broadcaster Nederlandse Omroep Stichting (NOS; Dutch Broadcasting Foundation), for instance, delivered up to twelve simultaneous feeds to choose from between different events of the 2008 Olympics in Beijing, at a quality of 800 kbps. Here too the viewer numbers were larger than ever could be expected (Berg, 2008). Besides sporting events also major international events like the Eurovision Song Contest and for instance the U.S. Presidential Inauguration can count on broad live online coverage.

Internet television is more and more seen as a great way to expand the audience, next to traditional television coverage for live events. For the current television industry this is a good thing as the rule “the more eyeballs see your content, the better” applies, as more exposure means more value to advertisers. We speak here of the *current television industry*, because in this research we will be discussing and identifying possible changes in the industry. This is why we will speak of the current television industry when we speak of the industry as it is now, before the possible introduction of any changes.

Up till now the large scale distribution of live video content is a costly activity as the cost for this is measured in bandwidth and bandwidth is paid for per Gigabyte uploaded. The distributor of the content pays for the bandwidth that is needed to send (or upload) the content to the consumer. And thus every extra customer means extra costs. Also the bandwidth the distributor has at his disposal is limited. When this available maximum is reached the service is compromised. Depending on the used technologies and distribution infrastructure, this could cause that extra users will not be able to receive the feed or the quality goes down. But it could also mean that the service would no longer be available at all for all users. Because of the high costs that come from raising the quality of the streams and the network constraints most of these programs can only be watched in quality inferior to what people are used to from their television set, which is one of the main reasons many consumers are not appealed to watching internet television.

This way of video distribution is called *unicast* or server based content delivery. Every stream is distributed from the server containing the content to every user that requests to receive the content

one on one (whether or not with the support of a Content Distribution Network (CDN) service). In recent years much effort has been spent on searching for methods to advance the video technologies and lower the server load. IP multicast was proposed for this but has proven not to be feasible (Liu et al., 2008). Now an emerging technology called peer-to-peer television (or P2PTV as we will call it hereafter) is being developed further and further and seems to be able to cope with the problem that the current solutions have of being incapable of serving very large quantities of viewers at the same time at acceptable costs (Alstrup and Rauhe, 2006).

1.2 Introduction to P2PTV

P2PTV is a technology in which all users receiving streaming content simultaneously upload the received content (to some extent) to other users. This way every viewer contributes to the overall capacity of available bandwidth. When a user joins a certain channel, the P2PTV software or plug-in contacts a tracker server that registers the addresses of peers who are watching and thus distributing that channel. It then contacts these peers to receive parts of the feed from one or more users. The tracker records the user's address, so that it can be announced to other users who wish to view the same channel. Swarms are formed of users who are as close to each other as possible in order to reach maximum distribution speeds. In this way an overlay network is created on top of the regular internet for the distribution of real-time video content. This means that, in theory, the content distributor only has to upload the content to a small number of users, which in turn pass this on to a small number of other users, and they in turn do the same thing, etc... In this way a tree is created of users receiving the content when only a small number of viewers are served by the original distributor (see Figure 3). In practice users will receive and send different small parts of the stream from and to a multitude of peers depending on the quality needs and swarm size.

The use of the upload capacity of internet users for video distribution would mean great cost reduction for the distributor of this content, which makes this technology very interesting for the current television industry for offering live event coverage worldwide or for broadcasting television channels in real-time over the internet (Branch-Furtado, 2005).

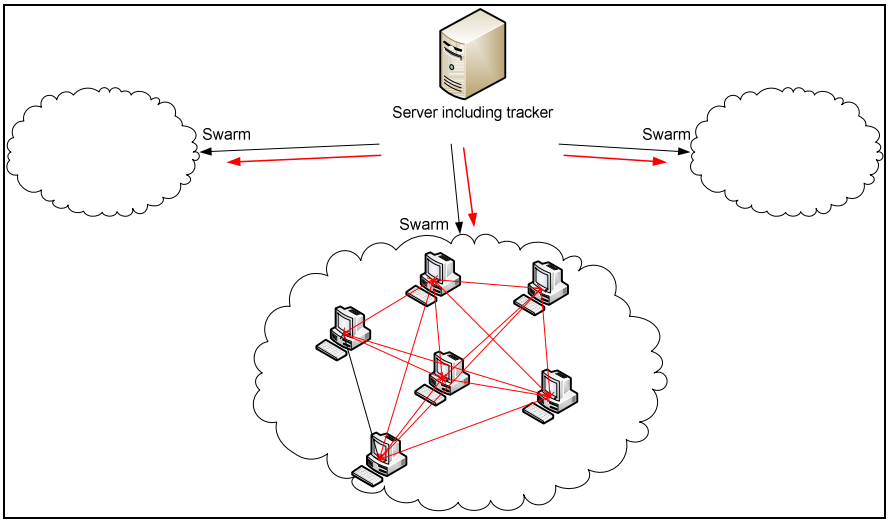


Figure 3: Example of a P2PTV network

At this moment the P2PTV technology is mostly used by consumers using P2PTV applications for broadcasting. P2PTV applications enable the user to share video material with a large number of others over the internet in real time, without the high bandwidth burdens that this would normally cost with unicast. These types of applications are typically used in Asian countries for sharing and watching live sporting events and programming that is offered by paid American television networks. Examples of P2P streaming applications are: Sopcast, TvAnts, PPMate and LiveCast. All of these P2PTV applications enable users to receive and view live streaming video content which is distributed through software that is capable of doing this. This content is streamed directly to users that connect to their "channel", which in turn join the swarm of users and forward their received content to others to create a live stream. This is often used for the distribution of copyrighted material, which makes this an undesirable activity for the current television industry.

A clear distinction needs to be made between P2PTV (or peer-to-peer television) applications and peer-to-peer video applications. Peer-to-peer video applications enable users to share the video's they have stored locally, which is called Video on Demand (VoD). Examples of these kinds of peer-to-peer video applications are: Joost, Tribler, Miro and BBC's iPlayer. These offer a database in which people can search and select video's that other people share. When viewing, the content is gathered from all users that share that video. The technology for these types of applications is advancing to the point that it is possible to watch the video directly while downloading (streaming), but this is very different from P2PTV where the stream is used once and only at a specific timeframe (live streaming), which is what the P2PTV technology is aimed at.

What makes the possibilities of the use of P2PTV technologies even bigger is the fact that the consumer bandwidth market is also constantly growing, because the demand for higher bandwidth from consumers is rapidly increasing (Evans and Manning, 2008). Cherry even claims that the growth of telecommunication data rates are as predictable as Moore's law (Cherry, 2004). With more upload bandwidth capacity available to consumers, P2PTV can become more usable for high video quality content distribution.

Besides the actors in the industry itself, companies that advise and aid the industry in risk analysis and management are also following the advancements in the telecommunication, media and technology world. Deloitte Enterprise Risk Services (ERS), one of the leading companies in consulting on risk analysis and risk management, follows these advancements and has concluded that internet television, in whatever form, will contribute alongside normal television, not replacing it. They, like most other consulting firms, focus on IPTV (Deloitte, 2008). But P2PTV is still a green field, due to the fact that only very first steps are taken to potentially exploit it on a commercial basis.

As we will identify and discuss later on in this thesis, we identify three types of key supplying actors in the current television industry:

- The content creator, which produces the television content
- The content aggregator, which acquires licenses to content and compiles a package of content to offer to the consumer through an access network
- The access network, which operates and maintains the physical network to the consumer so they can receive content and watch television

Actors in the current television industry, not only the mentioned key supplying actors but also advertisement agencies and ohers, have fiercely been trying to figure out how to make money from web video and other live online content. The combination of the evolution of P2PTV and the growth of consumer bandwidth together could make for P2PTV to be the disruptive technology that makes high quality live video distribution over internet possible on a large scale. The market is clearly interested in the potential. But it is still unclear in which way the current television industry can use this technology to their advantage and if the emergence of the technology could have negative outcomes for the key actors.

1.3 Problem statement

The current use and the continuous development of the P2PTV technology together with the continuous growth of bandwidth available to consumer internet users can influence the way the distribution of broadcast television, live events and paid content takes place. P2PTV can achieve huge reduction in the cost of the distribution of live streaming content and enable the possibility of broadcasting up to a sheer unlimited amount of viewers simultaneously over the internet. A lot of research has been done on the technology behind P2PTV and on how this can be improved to ascertain a high Quality of Service (QoS), but no studies have been found that address the possible negative effects that could arise from P2PTV for the actors in the industry. Especially for the current television industry that generates, produces, sells and distributes the professional content that could be interesting to distribute through P2PTV.

At this point we must elaborate on the distinction of P2P video distribution methods we made earlier and make a very clear distinction about what we mean with P2PTV and other streaming media solutions. P2PTV, as we see it, is used for *real-time* and *time-dependant* distribution of video content. This means that no information (except from the buffered video for viewing and sharing) is required to be stored on the user's local computer systems. Other streaming solutions like Video-On-Demand (VOD), with or without the use of P2P strategies, do not have this real-time and time-dependant character. This makes P2PTV suitable for broadcasting live events or broadcasting regular television programming, but over internet. In chapter 2 we will further elaborate on the different techniques of online content distribution, but for now this distinction is important for the correct understanding of the problem statement.

So far we see that P2PTV offers possibilities, but P2PTV might also pose certain threats. In this research we will address the risks and opportunities that P2PTV can have for the key actors in the television industry. *We define a risk as any future development that is expected to negatively affect an actor's business.* And opposite of that *we define a opportunity as any future development that is expected to positively affect an actor's business.* According to theory on risk management every future event can have both positive or negative outcomes and in that sense an *opportunity* can be seen as a *positive risk* (Berglund, 2005).

As we will explore further on in this research we will see that both risks and opportunities can come from different parts within a business (service, technical, organizational and financial). But as in all areas of business, in the television industry too "it's all about the dollar" and therefore risks and opportunities will usually results in financial results with positive or negative outcomes.

We can imagine two different settings in which this technology could cause risks and opportunities for the current television industry:

1) First of all the evolvement and a growing misuse by the users of P2PTV can further the illegal rebroadcasting of television content that is now already happening at small scale, to a much larger and substantial scale. This could lead to reductions in revenue for some or all of the actors within the value chain.
2) Secondly the television industry could embrace and use P2PTV technologies in an effort to reap benefits from the use of P2PTV, for instance to reach a larger audience with the benefits of the lower costs for the needed bandwidth that P2PTV creates. But these benefits will come with certain risks.

One way or another, this technology could possibly cause the actors in the current television industry to be forced to change their business models and/or their technical processes they have in place, in accordance with the risks and possibilities this technology can have on their industry. Choices will need to be made by the actors in the television industry on how content will be offered in the future and these choices will also need to be made on basis of the risks and opportunities that P2PTV can possibly cause for the different actors in the television industry.

Seeing the fact that the technological progress of P2PTV could offer both opportunities and threats to the current television industry, it would be interesting for the industry (and organizations active in the advisory in this field) to have clear sight on both the possibilities of this technology on the one hand and the risks on the other hand. They could use this information to be able to make well informed and well founded decisions on if and how P2PTV technology can be used for the distribution of content. There are many risks that need to be identified for the actors within the television industry to be able to use the possibilities of P2PTV to their advantage or deal with the risks.

All actors within the value chain use different business models for creating revenue from broadcast- and internet television. These business models, and the supporting technical processes, will need to be adjusted or altered when P2PTV is introduced. However, all actors and their business models are related to each other. This means that the introduction of P2PTV can affect the whole value chain and different actors will see different threats and opportunities. Large scale usage of the P2PTV technology could influence the value chain in several ways and roles that were held for the past decades could shift. One can imagine that content creators no longer feel the need to sell the rights to their content via content aggregators, because with the low burden to online distribution they can reach the audience (the user/viewer) immediately and they could charge the consumer directly. We will continue on this subject later on in this thesis when we identify the actors and their dependencies within the current television industry and see what changes will come forth from the introduction of P2PTV.

1.4 Research objective

Seeing the fact that P2PTV could become a disruptive technology in the highly volatile business of online content distribution, it is of great interest for the television industry to gain insight in the possible risks and opportunities that this technology could impose on them.

The objective of this research is therefore to design a risk framework, presenting the risks and opportunities that the emerging P2PTV technique could impose on the key actors in the current television industry. This risk framework can then be used as decision support tool by several parties as we will discuss later on.

To be able to design a risk framework we need to thoroughly identify the risks and opportunities that the emerging P2PTV technology can have for the key actors in the current television industry. As already mentioned, this will be done from two viewpoints;
1) what risks and opportunities there are when one or more of the supplying actors in the television industry decides to *make use* of the P2PTV technology and
2) what risks this technology imposes for the key actors from the possible misuse of the P2PTV by consumers, like illegal distribution of copyrighted material, when the actors in the industry *do not use* P2PTV.

We will therefore be sketching a set of possible futures to identify the risks and opportunities in different what-if scenarios on the use of P2PTV in the television industry. We will perform a scenario based analysis of risks and opportunities based on these what-if scenarios according to the method described by Krause and Tipton, which we will discuss in more detail later on (Krause and Tipton, 2008). The research questions will be aimed to support this method. But in order to be able to outline the possible futures, first the current situation of the actors toward which the what-if scenarios will be aimed must be determined.

By creating a risk framework we, the actors in the industry and anyone interested will be able to assess the possible effects in terms of risks and opportunities that P2PTV can have on the current television industry and help the actors within the industry by identifying what issues may arise within the future of P2PTV. The risk framework can also help actors on making decisions in which direction they wish to move in the future. For firms consulting actors in the television industry, like Deloitte ERS, this framework can be used to advise them on future decisions and have insight in the issues that will need to be tackled in different circumstances.

1.5 Research questions

This leads us to the main research question of this research that enables us to design the framework, which is:

> What are the risks and opportunities that the emerging P2PTV technology can impose on the key actors in the current television industry?

In order to be able to answer this main research question and from the stated research problem a number of sub questions can be identified:

1) What are the technical possibilities of P2PTV?
    a. In what differs P2PTV from other distribution methods
    b. What is the current status of the P2PTV technology and the (commercial) use of it?
    c. Is it possible that the development of this technique advances to a stage where it is possible to stream video in high definition, even when it is not used for commercial purposes (thus illegally)?
2) How does the current television industry function?

   a. Which actors can be identified within the current value chain and what are their roles, dependencies and resources?
   b. How is revenue created by the key actors within the current television industry at this time?
3) What are the possible futures of P2PTV within the television industry?
   a. What trends can be identified within the industry?
   b. Which factors determine the possible futures of P2PTV within the television industry?
   c. In what form would P2PTV be used in the possible futures?
4) What changes can P2PTV imply on the key actors in the possible futures of P2PTV?
   a. How can actor roles, dependencies and resources be affected by P2PTV in possible futures?
   b. How can P2PTV change the revenue creation process of the key supplying actors in possible futures?
5) What elements are needed in the design of a risk framework that represents the risks and opportunities that P2PTV might have on the key actors in the current television industry?
   a. What are the components that define a risk or opportunity?
   b. How can the identified risks and opportunities be characterized?

1.6 Research approach

To be able to identify the risks and opportunities of P2PTV for the television industry, ultimately designing the risk framework we are aiming to design, and answer the research questions several issues need to be researched according to the method of scenario based analysis of risk and opportunities we will be using. We will now describe our research approach and present in which chapters in this thesis what will be covered and what research methods will be used:

- First of all we need to gain a thorough insight in the P2PTV technology; it's functioning, why and how it differs from other streaming techniques, its current status and the possibilities the P2PTV technology brings. This will be done by extensive literature research. This will be done in Chapter 2 and answer the first sub question.
- Then an insight in the current television industry is needed, identifying all actors within the value chain of the current television industry and researching the revenue creation processes of the key actors. For the identification of the actors we will be using literature research on the subject and perform an actor- and network analysis. From there we are able to study the revenue models of the key supplying actors within the television industry in order to establish how they create revenue in the television industry is at this time. This will be presented in Chapter 3 and answer sub question 2. The insights gained in this chapter determine the actors to which we will aim the risk framework and therefore determine elements of the framework design.
- After this in Chapter 4 we will introduce a set of different possible futures that are possible for the use of P2PTV in the television industry. First the different trends of watching television and hardware advancements are introduced. After which two dimensions are described that influence the use of P2PTV in the near future and several assumptions are addressed. This will give us a steppingstone for the creation of what-if scenarios and the

scenario based analysis of risks and opportunities we will perform in Chapter 6 and answer sub question 3. Also this will determine several elements in the risk framework design.

- The risk framework should give an oversight of the risks and opportunities of P2PTV for the television industry. In chapter 5 we will present the design of the risk framework that will be filled with the results from the coming scenario based analysis of risks and opportunities. In the previous chapters we have identified the elements that are needed in the risk framework. For the design of this framework we will be basing ourselves on the design techniques that are taught throughout the complete SEPAM curriculum. We will describe the working of the framework and its use as decision support tool.
- We then perform a scenario based analysis of the risks and opportunities that arise from the use of P2PTV within the different possible futures we defined. We will describe why and how the future of the television might change based on the possible near futures we have identified. During the analysis we will assess the possible changes in the actor network and the different revenue models that P2PTV can have per what-if scenario and so identify the risks and opportunities for the key actors that come from these changes. The risks and opportunities that are identified in the analysis of risks and opportunities serve as the input for the risk framework that we aim to design. This will be done in Chapter 6, answering sub question 4.
- With the combined efforts of what we have presented in Chapters 5 and 6 the risk framework is completed. In Chapter 7 we present the validation of the risk framework we have conducted with several parties with expertise on the television industry.
- In Chapter 8 we will present our conclusions on the risks and opportunities of P2PTV on the television industry and the risk framework.
- Finally, in Chapter 9, we will be reflecting on the conclusions, the procedure of this research and its addition to science. Furthermore we will identify certain aspects of the research that could lead to further research.

Figure 4 on the next page gives a schematic representation of the research approach.

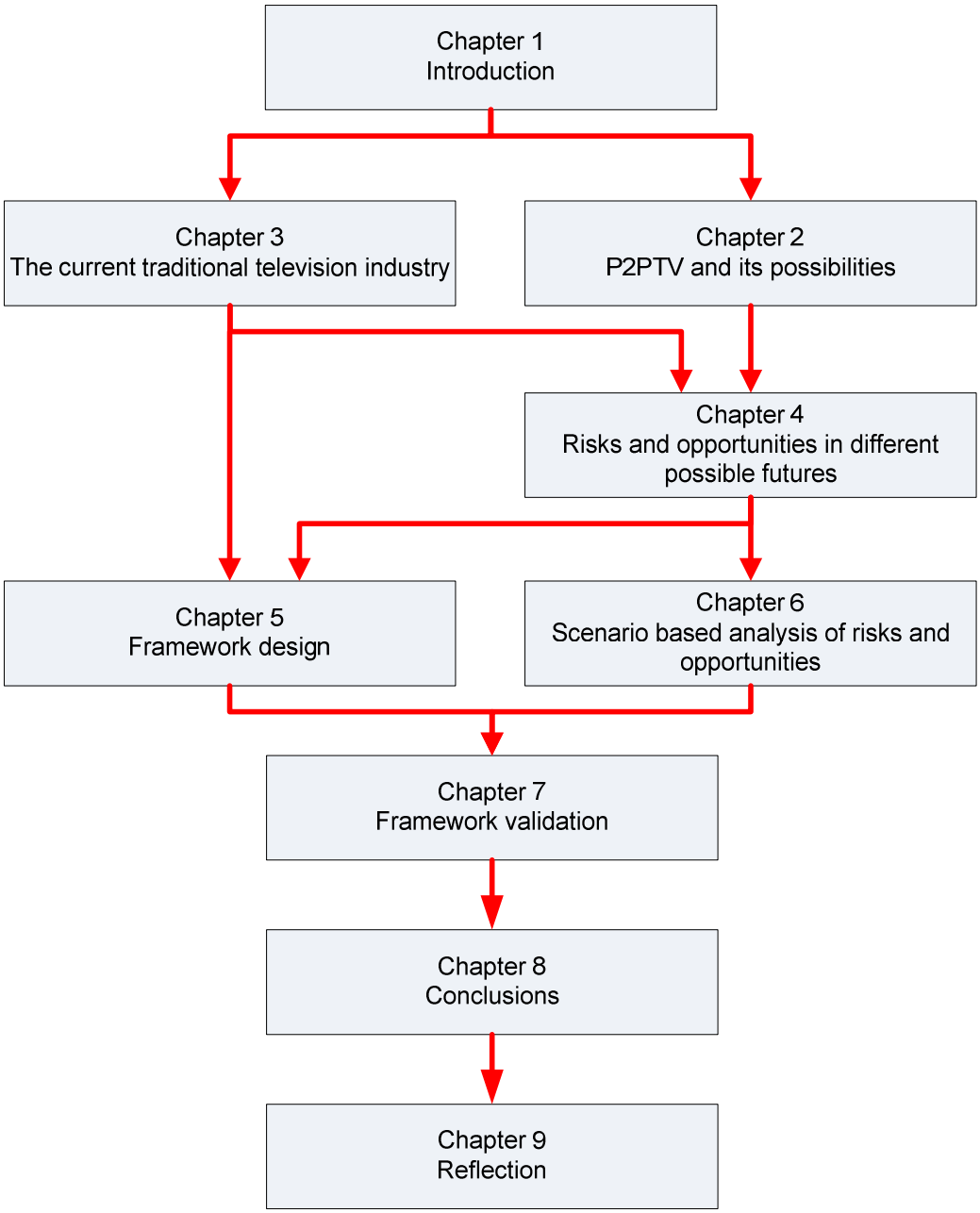


Figure 4: Research approach

2 P2PTV and its possibilities

As we already touched upon in the introduction, P2PTV is a specific internet technology enabling live video content distribution by using peer-to-peer (P2P) technologies. A pure P2P network relies only on equal peer nodes that simultaneously function as both "clients" and "servers" to the other nodes on the network. There are also hybrid systems available, but we will get to that later on in this chapter. In the case of P2PTV system the P2P networking technology is used for the transmission of live feeds from one to many, where every user who receives the stream propagates this to other users in the network.

The distribution of live content is very different from video-on-demand (VoD) systems, where the content is stored in single or multiple locations and can be accessed at any time. Live content can only be viewed at the specific time the events or broadcast takes place. This makes P2PTV suitable for the broadcasting of live events or traditional channels that have an airing schedule over internet.

To be able to identify the opportunities and threats this technique has to offer we will in this chapter delve deeper into what P2PTV is and what it can do. We will therefore first identify the difference between P2PTV and other methods for the distribution of live content over internet. Then we will explore the properties of P2PTV networks. After that an overview of the status of P2PTV applications will be reviewed and the possibilities this technological advancement offers to those who distribute video content.

2.1 Different techniques of content distribution explained

In this section we will explain how P2PTV differs from other methods of online content distribution and point out their advantages and disadvantages for actors in the current television industry. We will start with the technique that is currently used for this, unicast. After that we will discuss another method, multicast, which was proposed for large scale online content distribution. Then we will discuss P2PTV and explain why it is different and what makes it special.

2.1.1 Unicast

In a unicast system the video content is distributed from a single (or multiple) server location(s) to every user that requests the content directly. This means the video is sent from the server to the user one on one. As you can see in Figure 5 the server must upload the same content seven times to all seven viewers. Every bite every user downloads from the server, must be uploaded by that server. And every bit uploaded by the server must be paid to the network operator. Typically content is distributed using the services of Content Delivery Networks (CDNs). These are networks that replicate the content on multiple servers spread across the world. In that way most of the users will be near a server location and because of that have greater guarantees on speed and quality. CDNs also charge their clients per Gbps and are only an extension of the original service, making widespread content delivery an even costlier activity. Unicast is at this time the most used system for live content distribution. As we have mentioned in the introduction delivering the same content to many users can be a costly activity as the costs increase with every viewer. Also the costs grow as the quality of the stream is higher as more bandwidth is needed. We will clarify this with a simple example. When a video is streamed at a bit rate of 800 kbps and 100.000 viewers are downloading (viewing) this stream, the distributor needs 100.000 x 800 kbps of upload, meaning 80 Gbps. Upload

capacity is paid for per Gbps, which means that every concurrent viewer means additional costs. This can be represented by the following formula: Number of viewers x Quality = Cost for the distributing party.

Advantages

- Stable
- Guaranteed QoS

Disadvantages

- Expenses for the actor offering the content grow as the number of viewers grows
- Limited upload capacity, thus limited number of simultaneous viewers
- Because of limited bandwidth, concessions need to made between maximum possible number of simultaneous viewers and quality

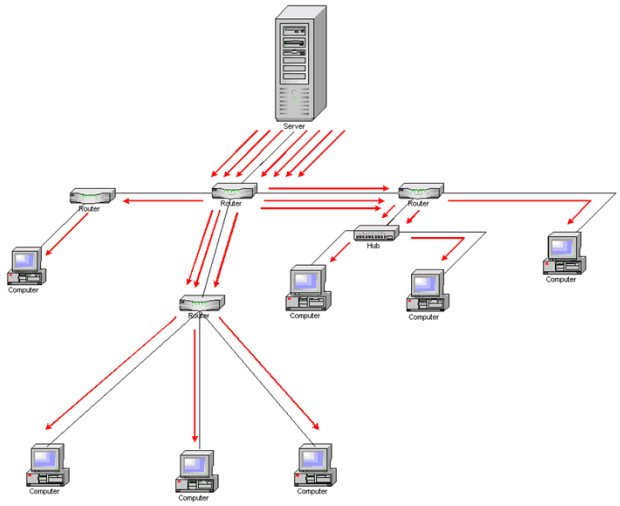


Figure 5: Unicast - Taken from Surfnet.nl

2.1.2 Multicast

Multicast was proposed as the ultimate solution for online video broadcasting. The basic idea is that users can subscribe to certain channels. The content of that channel is streamed up only once from the source to the first router and the routers between the source and all destinations propagate a copy of the content towards all other routers that have known subscribers within their domain (see Figure 6). This would mean that only one upstream is needed. Several studies have however, as Li and Yin summarize, identified that the complete functioning of this otherwise ideal system is not feasible (Li and Yin, 2007). The hardware that all routers through the complete internet need for multicast are expensive and none of the network operators are prepared for these investments. Another bottleneck is the fact that a constant updating of subscribers within all domains is needed. With an expanding number of channels and subscribers this would create an overwhelming amount of overhead, making the multicast system also technically unfeasible on a worldwide scale.

Advantages

- Only once time upload capacity needed

Disadvantages

- Not economically and technically feasible on a large (worldwide) scale

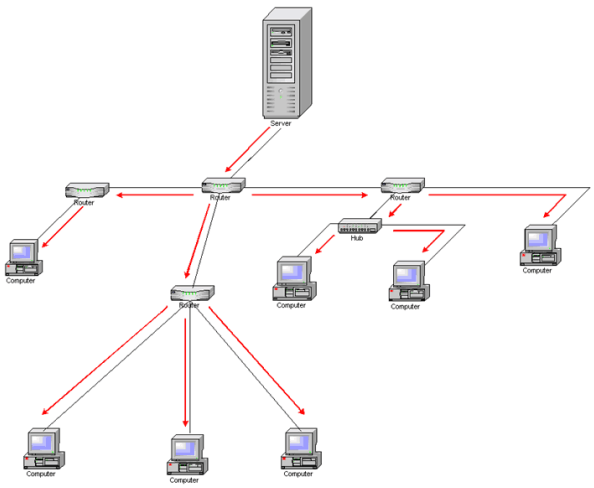


Figure 6: Multicast, taken from Surfnet.nl

2.1.3 P2PTV

In P2PTV systems every user that is downloading content simultaneously uploads the same content to other users who want to receive that content. This means that the more users are downloading a stream, the bigger the overall capacity of available bandwidth that is available for the distribution of the content becomes, as every additional viewer becomes a serving node and his upload capacity is added to the overall bandwidth. Effectively this could mean that every single user could be served the same content at the same time, but there are still some limitations to this, like consumer upload capacity, as we will discuss in the next section.

If a user wants to receive a certain stream, or channel as streams are called in P2PTV systems, he contacts the tracker server that is incorporated at the server containing the content. The tracker server then provides the user's client software with the addresses of other users that are receiving the content and thus are distributing the content. The user software then connects to the other users and receives the feed from them. This is pictured in Figure 7. The tracker server tries to create swarms of geographically close users that share the content among each other in order to receive the maximum quality feed. Theoretically the server only needs to upload the content to a small amount of users, which in turn serve another small amount of users and each other, and so on. This creates a tree structure that could grow infinitely large. In this way an overlay network is created on top of the regular internet for the distribution of real-time video content. In practice the server feeds the content to a number of swarms, highly reducing the upload capacity needed to serve the same number of users that would be needed in a unicast system (see Figure 7). In Figure 5 we see that the server needs seven upload streams to serve seven users. In Figure 7 we see that with a much smaller number of upload streams, a multitude of users can be reached. The tracker is programmed in such a way that users join the most appropriate swarm and decides on swarm sizes and the number of swarms that are formed. We will discuss the economical and technical advantages and disadvantages of P2PTV for any actor wanting to distribute content further in the next section, where we have a closer look at the P2PTV technology in order to define its possibilities and technical risks.

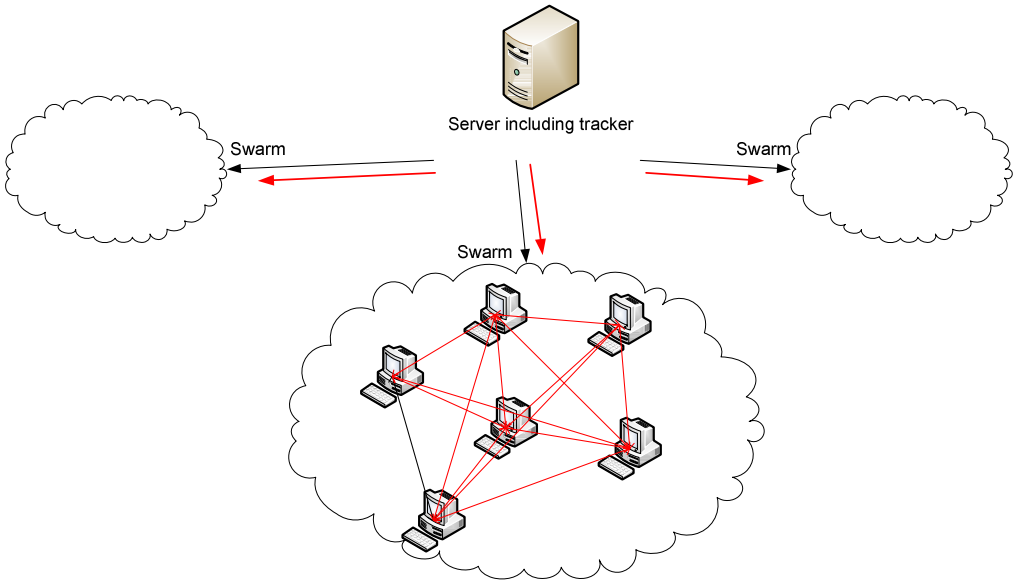


Figure 7: An example of a P2PTV system

2.2 Properties of P2PTV networks

P2PTV can be seen as a real-time version of BitTorrent, which is a technique used for P2P file sharing. Using BitTorrent the original material is chopped into a large number of little pieces. In P2P file sharing the first person offering the material has the full amount of pieces and is called a seeder. Whenever another user has received the complete file he too becomes a seeder, but in the meanwhile has also shared the pieces the he already had received during the download with other users needing these pieces.

We stated that P2PTV is used for *real-time* and *time-dependant* distribution of video content. This means that no information (except from the buffered video for viewing and sharing) is required to be stored on the user's computer system. Other streaming solutions like Video-On-Demand (VOD), with or without the use of P2P strategies, do not have this real-time and time-dependent character. They need for the data (or parts of the full data) to be stored locally and to be available when the video is requested by other users. In P2PTV the content stream is also chopped into several pieces called chunks, like in BitTorrent. When a user requests to view a specific channel a buffer is filled by chunks downloaded from peers in the swarm. So in fact the users are sharing their buffers with each other while the video is playing on the system. The (tracker)server supplies the swarms with the content. In the background the system identifies the chunks it needs and tries to download these from peers, in the meanwhile serving other users with chunks that they need.

2.2.1 Buffering

Every user, or peer, in a P2PTV network temporarily stores a buffer of chunks that is needed for the playback of the content. Figure 8 displays a peer's buffer map and shows the chunks it has currently cached. From the playback point all positions in time need to be filled, which is shown with a purple filled chunk with a 1 above it, in order for the video to playback properly. The white chunks, with a 0 above it, need to be filled and for that the system contacts the tracker server to learn who already has the missing parts in his buffer. It then retrieves these missing parts from the peers in real-time. At the same time providing other users with the chunks that they are missing from its own buffer. The chunks that have already been used for playback are no longer of interest and will be discarded.

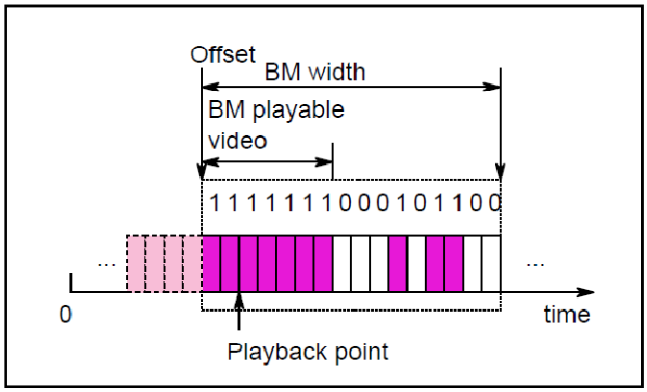


Figure 8: A peer's buffer map, which indicates the chunks it currently has cached, taken from (Hei et al., 2008).

There are software solutions available that store all content that has passed through the buffer. That way a live stream can be recorded for later playback. This means that live events or other broadcasts can be recorded and stored locally on the computer system.

2.2.2 QoS

As a P2P network is an overlay network, build upon the Internet components that are already in place, no special router support is needed. This does make P2PTV broadcasting to a very large number of users feasible in contrast to the multicast solution that we discussed earlier, which was not feasible.

The P2PTV technologies have, according to Kozamernik (2006) from the Electronic Broadcasting Union (EBU) explaining P2PTV using Octoshape as an example, matured to the point where there are now: *"advanced grid-based real-time P2P streaming system. Peers monitor and probe each other to optimize the network flow, so there are no central-server bottlenecks. The traffic burden is spread evenly across the network, thus limiting the impact of peer loss. The efficiency of the system increases with the number of users. In cases of high packet loss, Octoshape simply injects more packets into the network. The system switches automatically between the different protocols as required (http, https, TCP, UDP) and thus guarantees availability.(Kozamernik, 2006) "*

What Kozamernik points out here is the fact that P2PTV systems have evolved to a stage where QoS can be guaranteed as the server injects more packages, in this case parts of the video steam, into the network when needed. This essentially creates a form of hybrid network in which the server lets users replicate the data to each other, but when to little traffic threatens to be received by certain nodes, the server uploads the necessary data to the user directly, like in a unicast system (Agarwal et al., 2008, Garbacki et al., 2008, Hei et al., 2008, Alessandria et al., 2009).

2.2.3 Video quality

The quality of the feed is decided by the person or organization that functions as source. The bitrate at which speed the stream must be received determines the quality. The use of P2PTV for digital video distribution becomes more interesting as the offered quality of the content can be much higher than is standard now. Table 1 represents a comparison of video bitrate standards for media like DVD and HDTV (which is the current term for a digital television broadcasting system with higher resolution than traditional television systems, currently up to 1920x1280 pixels) and some much used video standards that use more compression for online video. New compression standards, like H.264, make it possible to highly reduce the bitrate of video without visible quality loss. In order to be able to achieve the resolution and bitrate that is needed for a HDTV experience that has an uncompressed bitrate of about 20 Mbps, a bitrate of approximately 2,5 Mbps is thought to be needed (Sigurdsson et al., 2007).

Table 1: Comparison of video bitrate standards (Adapted from http://www.videohelp.com/oldguides/comparison)

	DVD	HDTV/BLU-RAY	Avi/Divx/Xvid	MOV/Quicktime	RM/Real Media
Resolution	720x480²	1920x1080²	640x480²	640x480²	320x240²
NTSC/PAL	720x576²	1280x720²			
Video	MPEG2,	MPEG2	MPEG4	Sorenson,	RM
Compression	MPEG1	(WMV-MPEG4)		Cinepak, MPEG4 ...	
Video bitrate	~5000kbps	~20Mbps (~8Mbps)	~1000kbps	~1000kbps	~350kbps
Audio	MP1, MP2, AC3, DTS,	MP1, MP2, AC3, DTS, PCM	MP3, WMA, OGG, AAC, AC3	QDesign Music, MP3 ...	RM
Compression	PCM				
Audio bitrate	~448kbps	~448kbps	~128kbps	~128kbps	~64kbps

kbps = thousand bits per second
Mbps = million bits per second
² approximately resolution, it can be higher or lower
~ approximately bitrate, it can be higher or lower
º DVD with lower video quality, similiar to VCD/SVCD video quality
** the video quality depends on the bitrate and the video resolution, higher bitrate and higher resolution generally means better video quality but bigger file size*

The more users in a P2PTV network are downloading and participating in a stream, the bigger the overall available bandwidth gets. However the speed at which the stream is propagated between peers depends on the upload capacity of every peer. With the current standards for consumer broadband internet connections, which can by either ADSL(2+) or cable connections, the upload capacity is typically capped at 1 Mbps. These are typically asymmetric connections, meaning that the download capacity is higher than the upload capacity. As the demand for bandwidth keeps growing new technical improvements are planned by telecom companies, which have already started to upgrade their VDSL components, and the arrival of fibre-optical solutions, that could provide the consumers with symmetrical connections up to 100Mbps in simultaneous up- and download. Even connections with a 10 Mbps upload capacity would make it possible for every single connection to offer HDTV quality streams over the internet while being able to fulfil all tracker functions (Lo Cigno et al., 2008).

2.2.4 Network usage and ISP's

Already a large quantity, somewhere around 70% according to recent numbers, of the total internet traffic is used for P2P file sharing (Werbach, 2008). Most of this traffic is used for sharing copyrighted video.

Already ISP's have tried to filter or block this traffic which has spurred much debate on whether ISP's have the right to decide what types of packages run through their network. So far ISP's are not allowed to block or filter any traffic and for the remainder of this research we will assume that this will not happen. But as this could change we will bear in mind that the cooperation of ISP's is needed for the usage of P2PTV systems.

2.2.5 Plug-in and software needs

Standard media players, like Windows Media Player or VLC, are not able to correctly use the P2PTV technology as the producers of commercial media players have not adopted the P2PTV technology and implemented this in their software. In order to make correct buffering, tracker contact and

upload capabilities possible a media player plug-in or special media player software package is needed. This means that every user that wants to receive or broadcast a stream will need to install this piece of software.

Like with most new internet services this also means that it will be needed to open up ports in the hard- or software firewalls. In consumer internet setups this will probably not lead to many problems as these are most commonly protected by (the standard operating system's) software firewall, which will prompt the user whether or not it wants to have the port unblocked on first use.

2.2.6 Status and possibilities

The properties of P2PTV that we have described thus far have several technical implications. As we have seen most technical difficulties like guaranteed QoS and the sudden departure of peers within a swarm have been tackled by techniques developed by companies like Octoshape. But besides these kinds of implications P2PTV could have more technical implications.

P2PTV creates the possibility to reach anyone with an internet connection with a single broadcast. This means that the content that is displayed on television channels and is owned by content aggregators can become available worldwide at high quality. They could use this technology for the distribution of live (sporting) events worldwide and in that way attract larger audiences than they can now. Both at the little bandwidth costs that P2PTV needs for video distribution. This little bandwidth costs also mean that "normal" users can start their own broadcasts in high quality.

Every user can become a broadcaster using P2PTV. This implies that any user can forward any incoming stream and re-distribute this to anyone the user likes. If, for instance, a broadcast is only intended for a specific geographic location or country, anyone within this location could receive the feed and re-propagate this using P2PTV techniques to everyone outside the designated location (Arnoldus, 2006). Usually IP-range filtering is used to determine someone's location and control the geographic distribution of content and this same technique could be used in P2PTV only allowing certain IP-ranges into the swarm by the tracker server. In Figure 9 it is pictures how a single user within a broadcast restricted to North American users re-distributes the content to the rest of the world.

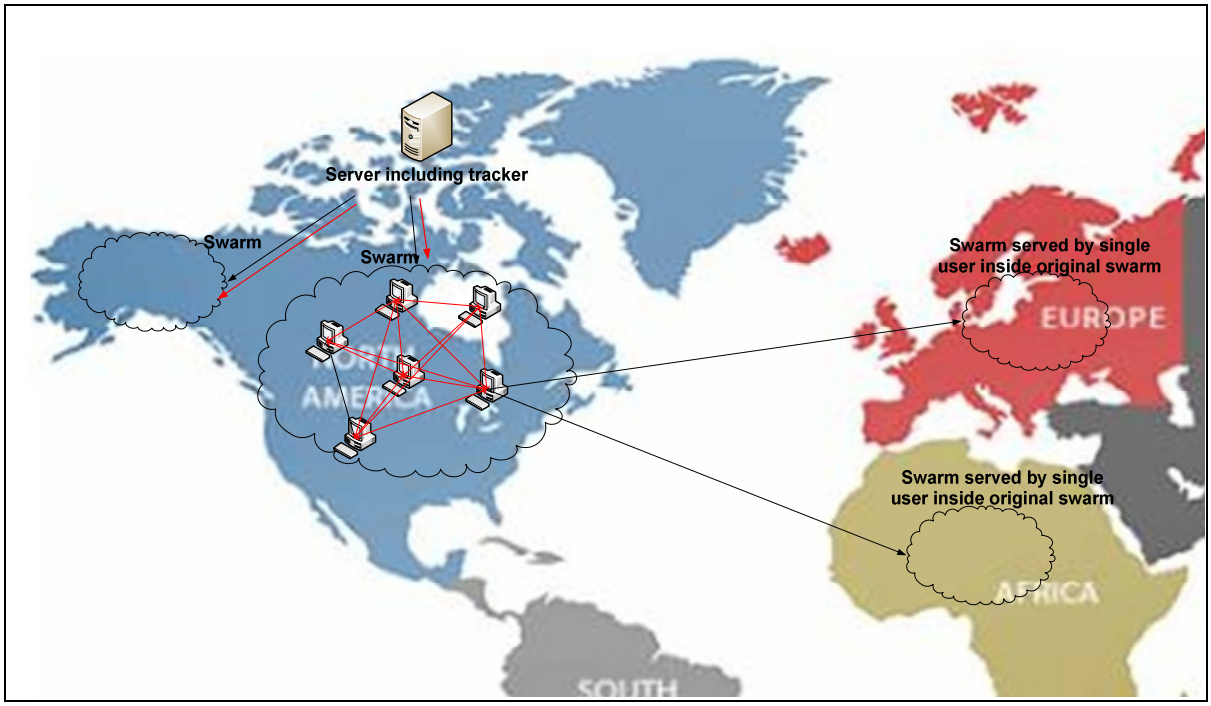


Figure 9: Re-distribution of a P2PTV stream outside the selected region by a single user

The fact that live streaming broadcasts can be received by every user connected to the internet without any special hardware needed opens the possibilities for everyone to use his computer as Digital Video Recorder (DVR). Like with other techniques used for video content distribution we can expect capturing software able of recording the streams received through P2PTV. As P2PTV are real-time and time dependant broadcast we could easily expect recording software becoming available that is capable of automatically selecting the start and end time for a recording. This way consumers could easily create personal recordings of television content and place these on DVD, which could lower the sales of DVD's by the official distributors.

P2PTV is already widely used in Asian countries for the, sometimes illegal, distribution of television channels. A recent article from NewTeeVee.com describes 2008 the year that China dominated P2PTV, *putting the audience numbers of Western online TV offerings to shame* as they put it (Roettgers, 2008). Most of the at this time ad-supported freeware P2PTV applications (PPLive, PPStream, UUSee, Sopcast) are China-based. The commercial software packages like Tribler, RawFlow and the Octoshape software are European based.

Especially Tribler is an interesting application. This application is the result of a research project carried out at the TU Delft and the VU Amsterdam, which is funded by the European Union and is part of the P2P Next project that is joined by many parties involved in the current television industry like the BBC and the Dutch broadcasting network. The P2P Next project is a conglomerate of 21 partners in 12 different countries, which aims to make broadcasting to millions of people possible over the internet using P2P techniques and receives funding from the European Community as part of the FP7 research program. The project website states: "*The P2P-Next integrated project will build a next generation Peer-to-Peer (P2P) content delivery platform, to be designed, developed, and applied jointly by a consortium consisting of high-profile academic and industrial players with proven track records in innovation and commercial success*", with the aim to make online broadcasting to

millions at the same time possible. At the IBC 2008 conference at the RAI Amsterdam participants in the research program exhibited the world's first video end-to-end streaming distribution of professional content to a low-cost Set-Top-Box (STB, used for connecting to television hardware) hardware called NextShareTV (Briel, 2008). This box delivers content on NextShareTV straight to the television using P2PTV techniques. Even though Tribler is not a P2PTV application, but at this time a P2P video application as we made the clear distinction earlier on, and the NextShareTV solution is still a work in progress and does not show commercial content, the P2P Next research project and the European funding clearly shows the interest of governments and the current television industry in the future of P2PTV.

This example shows that video over internet doesn't necessarily means watching it on pc screen. Several initiatives like NextShareTV and Vatata are offering these STB solutions, hardware boxes that can be connected to a television set like digital decoders, which support P2P technologies. This makes watching P2PTV broadcasts on a television set possible. Developments within the television production industry could make the viewing of P2PTV broadcasts on television sets even more accessible as we will discuss later on in our exploration of the trends within the television industry in Chapter 4.2.2 where we discuss the introduction of the Internet TV; a TV with build-in internet capabilities. This, combined with the possibility of every user becoming a broadcaster, makes it possible for everyone to reach every living room worldwide.

The demand for higher bandwidth from consumers is rapidly increasing and ADSL(2+) subscriptions up till 20 Mbps download and 1 Mbps upload are becoming standard throughout Europe and the United States. Furthermore there are actions being taken on installing VDSL components by telecom operators bringing the speed up to 50 Mbps up and down and also Fiber to the Home (FttH) initiatives, connecting fiber optic cables to the home and increasing the bandwidth to 100 Mbps up and down, are being undertaken. The burden that P2PTV would have on the internet network is still somewhat uncertain. Several studies however indicate that P2PTV systems, although quite heavy on the network load, does not impose any threats on the functioning and consistency of the internet (Agarwal et al., 2008, Alessandria et al., 2009, Li, 2008). These studies believe that the total capacity of the internet possibly at this time, but certainly in the near future, is capable of having users in smart geographically located swarms being able to receive and share P2PTV content amongst themselves.

2.3 Summary and risk framework design

P2PTV clearly offers a solution for the online distribution of high video quality content at low costs. Several companies have started the commercial utilization of this technology that meet the requirements of QoS and continuity. Thus far however P2PTV is mainly used by internet users for the illegal re-distribution of licensed content as this is one of the possibilities that comes available with the fact that little bandwidth is needed at the source for the distribution of content through P2PTV. For the television industry P2PTV could mean the possibility to become available worldwide without high costs. Also P2PTV would be very well suited for the distribution of live events that cannot be covered through the traditional channels on the access networks that are used today, i.e. cable, IPTV over the PSTN network and by air (satellite and DVB-T).

What we can conclude is that the introduction of P2PTV for real-time television content distribution requires relatively little investments for the actor that wants to introduce P2PTV. Also the costs for the distribution would be low.

So far we have not identified any elements that need to be incorporated in the risk framework, but the possibilities we have discussed in this chapter will function as input for the formation of possible futures we will be performing later on.

3 The current television industry

In order to evaluate the risks and opportunities that P2PTV can have for the current television industry we must first gain insight in this industry as it is. From there we can identify what the impact of the usage of P2PTV technology can be on the industry. But in this chapter we will be charting the current television industry.

The history of television is a complex and much debated subject and it is impossible to give a simple answer to the question what was the first television broadcast (see www.tvhistory.tv for a comprehensive overview of television history and debate). However since the general start of broadcasted television content over cable distribution networks to mainstream consumers in the early 1950's a lot has happened. From the addition of sound and colour to the received images to the start of the first commercial channels using commercials for the generation of value to the introduction of flat screen plasma- and LCD television sets.

But for at least two decades now the value chain is quite consistent. Content is generated by a content creator and acquired by a content aggregator or "broadcaster". This content aggregator has acquired a piece of the spectrum on an access network. On this piece of spectrum, the channel, the aggregator can present his acquired content to the viewer that has access to that channel. These access networks have for a long time been dependant on a physical cable network, but in recent years new access networks have arrived in the form of DVB-T techniques and satellite distributing digital television signals through space or as additions to existing networks that can now be used for television broadcasting like IPTV networks over the PSTN-network that is already used for internet access. The fact remains that access networks are needed for the physical distribution of the content from the aggregator to the viewer.

Even with the arrival of these new access networks the value chain however has been kept intact as all actors have their own critical resources. With the arrival of P2PTV these dependencies on each other might change to some extent.

For charting the current television industry we will be identifying all actors within the value chain of the current television industry and describing their roles and resources through an actor- and network analysis. We will base this analysis on the instructions from Enserink et al. which have described the process of actor- and network analysis in their study book (Enserink et al., 2008). We will then identify the *key actors* within the industry at present and define a group of *key supplying actors* (a term which we will explain in detail later on) towards whom we will continue our analysis. After that we will briefly discuss the positioning of internet television within the value chain and the role of advertising. From there we will describe the revenue models of the key supplying actors in order to define how revenue is currently created in the industry by these actors. A brief insight in the business models of the commercial P2PTV providers that are active today will round up our explorations.

3.1 Actors and value chain in the current television industry

Based on the viewpoints of several sources we can identify six types of actors in the current television supply chain (Zindel, 28 november 2008, Huiden et al., 2008, Bouwman et al., 2008, Mingione, 2005). Each of these actors has his own role and resources in the distribution of the

content from creation to the viewer, which we will describe per actor. Several actors could have multiple roles. Sometimes for instance the creation of content is by order of a television network (content aggregator), which in this way guarantees itself exclusive rights and licenses to the content. Also there are several production studios (content creators) that also maintain a television network (content aggregator). But in this research we make a clear distinction between roles and types of actors in order to assess the risks and opportunities per actor later on.

For the purpose of this thesis we will be using players from the Dutch television industry to exemplify which kind of companies are meant by the different actor types we define. In this actor analysis we purely focus on the actors' roles, resources and interdependencies. We will touch upon the issue of revenue creation, but this issue will be researched more in depth in the chapter 3.3, where we discuss the revenue models for the key supplying actors.

- Content creator: The content creators are the producers of the content. They have the originality/creativity and the expertise needed for content production in house as resources from with they are able to create content that is interesting for viewers. They either produce the content by order of a content aggregator that needs new content or to sell after production to an aggregator. Examples from the Dutch industry are IDTV and Eyeworks.
- Content Aggregator: The definition of a content aggregator in the television industry is a company or entity that obtains the rights from multiple content providers (creators) to resell and distribute content through other communication channels (the access networks).This is what is popularly called a television "broadcaster" or television "network" when one organization maintains multiple channels. These are the actors that have acquired a piece (or multiple pieces) of the frequencies or spectrum on an access network and are in that way able to deliver content to the viewer on that channel. The viewer can choose to watch the content that is offered by the aggregator over the access network that he is connected to. It could happen that one aggregator possesses several channels on the access network. In The Netherlands the biggest players are the Nederlandse Publieke Omroep (NPO, maintaining 3 non-commercial channels serving several public broadcastorganisations), SBS Broadcasting B.V. (maintaining 3 commercial channels) and RTL Nederland B.V. (maintaining 4 commercial channels). Even though we make a distinction between commercial and non-commercial channels, they are both dependant on advertising for creating revenue.
- Access network: We define the access network as the organisation that operates the physical connection to the viewers. They own and operate their own network either consisting of receivers, fibre-optical cables, coaxial cables and neighbourhood stations for connecting households to their network. Examples from Dutch players are Ziggo, UPC and Tele2. Or the access network consists of a piece of the spectrum of radio waves for the digital distribution of DVB-T signals through space, for which they have acquired a license from the national government. The viewer is then connected through a digital receiver. In the Netherlands only KPN has the rights for this type of content distribution with their Digitenne system. Since the early 2000's the phenomenon 'triple-play' has grown, meaning one access provider providing television, telephone services and internet over the same network. This meant that also ISP's delivering ADSL services have entered the market of television access networks. The ISP's are also the access network in case of internet

television, when the consumer watches television shows online. This will be discussed later on.

- Television advertising companies: As already mentioned commercial, and in fact also non-commercial, channels mainly depend on the sale of advertisement time for the creation of revenue. Most channels have their own sales company or sales department. Otherwise an intermediary advertisement agency can be used that wholesales advertisement time from a channel to sell this to advertisers. The value, and with that the price, of different time slots available for advertisements has grown into an intricate system in which ratings on the amount of viewers and the demographics of the viewers play a large role to determine the pricing. An example of this type of actor in the Dutch market is STER, which is the advertisement sales company for the content aggregator NPO.
- Web Portals: As we already mentioned earlier on, much of the content owned by content aggregators is currently available online. By offering this service content aggregators try to use the internet for expanding their audience. In order for the user to reach the specific feeds, a web portal is used containing an index of specific locations of these feeds. This is needed as the internet has a sheer unlimited number of locations, the URL's. Unlike the access networks where only a limited number of channels is available by the division of the spectrum. Most aggregators operate their own web portals for the indexing of their own programs. Dutch examples are uitzendinggemist.nl for specific content owned by the NOS and RTLgemist.nl for the indexation of the content owned by RTL. Even though these portals at this time offer non real-time (thus non-live) feeds, which is contradictory to the ends for which P2PTV is used namely live streaming content, we include this actor because of their importance in the current offering of online television.
- User (viewer/consumer): Although a passive receiver of the content, all actors in the television industry are dependent on the viewer. For if there are no viewers of the content, it is of no interest to distribute the content. The viewer in turn is dependent on all previously defined actors, for if there was no content to view, the viewer would have nothing to view.
- Device manufacturer: For watching television content a device is needed for displaying the received signal, i.e. transforming the received information to moving images on a viewable service. This is mainly done by television sets. But with technology advancing several other devices with screens like mobile phones, handheld devices intended for gaming purposes and computers can be used for portraying the images. The device manufacturers are in our opinion not part of the value chain of the television industry as they are not part of the value creation process from content generation to content consumption. The device is a onetime purchase needed for portraying the received content. However the advancements in devices will play a role in the future of P2PTV and the television industry and will be considered in our research later on.
- Government – regulator (laws and regulations): Since the arrival of (commercial) television broadcasting the rights and dues of television broadcasting have been adopted into laws and regulations. Ever since the first broadcasts governments have regulated what is and what is not acceptable to be shown on television. Most of this has resulted into what is The Netherlands is called the Mediawet (Feenstra, 2007). However governments are also in charge of the provision of utility services, to which the availability of public broadcasts belong. Also other law and regulations apply on fair competition and spectrum assignment. Because of their power of decision government influence is of importance on the way the

industry functions. They are however not part of the value chain, as they are not part of the value creation process, but are an outside force that needs to be reckoned with throughout our research due to their regulatory role of the television industry.

We can summarize this according to Table 2.

Table 2: Actors, roles, resources and dependencies in the current television industry

Actor	Role	Critical Resources	Dependencies
Content creator	Creates the content for distribution	Originality/creativity and production expertise	Dependent on aggregator buying the content
Content aggregator (channel)	Owner of television channel(s)	Piece of spectrum on an access network	Dependent on acces network for the distribution of their content to the viewer
Access network	Owner of the connection to the viewer	The connection to the viewer	Depent on aggregators offering their content over their access network
Television advertising companies	Selling advertisement time on channels for the creation of revenu	Advertisement timeslots on channels	Dependent on content aggregator for advertisement time slots
Web portals	Indexation of available non-live feeds	Specific locations of content	Dependent on content aggregator for content
Viewer	Receiver of the content	Time/interest	Dependent on all above players for the delivery of the content
Device manufacterer	Producer of the hardware that is needs to be purchased one time for the portrayel of tlevsision images	Know-how on hardware creation	Dependent on the complete television industry for giving the consumer the need to purchase their products
Government (law and regulations)	Safeguard the national population, the task of public information and spectrum division	Power of decision and spectrum authority - regulatory power	All players are dependent on the laws and regulations in place. They define the boundaries of the playing field for the actors in the industry.

Another actor we have mentioned earlier and will mention several more instances in our research are the content delivery networks (CDN's). These networks replicate the content on multiple servers spread across the world so that most of the users will be near a server location. Because of that they can offer greater guarantees on speed and quality for organisation that wants to distribute (video) content on a large scale, i.e. content aggregators. They however are just a service that can be acquired by an actor for offering internet television, but do not play a role in the value chain and are therefore not treated as an actor like the ones we have discussed here and throughout this research.

The most important actors within the supply chain – the content creators, the content aggregators and the access networks – share the same company goal; consistent profit. They are the most important actors because these actors alone could provide the service from content creation to the viewer consuming the content. This automatically highlights the fourth important actor, the viewer or user as we will call this actor from now on. The goal of consistent profit is primarily achieved by attracting as much attention from the public, the users, as possible. For the content creator this means producing content that is interesting/attractive for and watched by as many people as

possible, whether the content is produced by order or in own production. For the aggregator this means attracting as many viewers as possible with the aggregated content they offer on their channel. For the access networks this means getting the highest possible number of subscribers and selling larger packages. The user's goal is *to be entertained and informed by television at minimal costs.* To reach this they want as much quality content available to choose from, at the lowest possible costs, at maximum quality.

As we described the process from content creation to the consumption of television content by the viewer we can see that the value chain at this time is linear, as we have also pictured in Figure 10. With exception of the advertisers that inject money into the value chain at different stages. We can also conclude this from the fact that all actors have dependencies on each other like we can see in Table 2. Figure 10 represents the value chain of the current television industry. In the figure below the solid lines represent the flow of content. The dotted lines represent the flow of money.

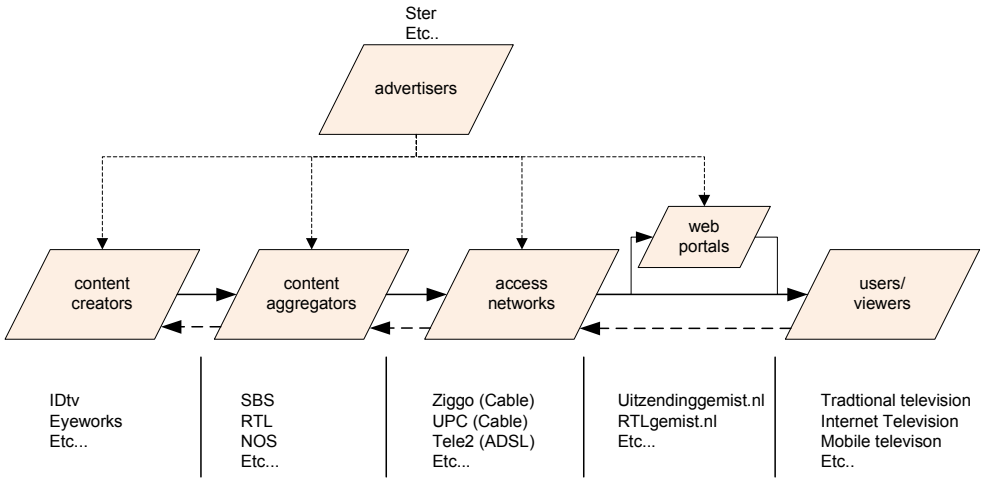


Figure 10: Value chain of the current television industry

3.2 Identification of key actors for further research

From the actor analysis thus far we can see that the actors that play the biggest part in the supply of the content to the consumer and that thus might be influenced by P2PTV are the *content creators*, *content aggregators* and *access networks*. These actors provide the main portion of the provisioning in television content by producing, aggregating and distributing the content to the consumer. These three actor roles are imperative in the supply chain from content from television content creation to the delivery of this content to the user. *The user* is also an important actor as they are the target group and make decisions on whether or not they watch television and what and when they watch television. For this reason from this point on we will focus on these *key actors* in our research. As we have mentioned earlier we will be speaking of the current television industry when we address the industry as it is at present, i.e. before the possible introduction of P2PTV in the industry. This means that when we speak of the *current access networks we mean the access networks now in place*, i.e. the cable network, the PSTN network (used for IPTV) and space (satellite television and DVB-T). We must bear in mind that P2PTV is not a new physical access network, but an overlay network on top of the internet, which makes the internet able to perform the functioning of an access network, i.e. the broadcast distribution of television content.

In light of the upcoming analysis we will be speaking of the *key supplying actors* when we only mean to speak about the content aggregators, the content creators and the access networks. And we will be speaking of the *key actors* when we also include the *user* in the analysis.

3.3 Revenue models in the current television industry

In this paragraph we will identify in what manner revenue is created by the key supplying actors in the current television industry. We will start of by looking at the general revenue model for the current television industry. A revenue model shows how revenue is created for a company or actor, by describing what the different sources of revenue and expenses are for that company or actor. After that we will summarize from what sources and in what manners revenue is created from the delivery of content to the viewer by the key supplying actors. This will gain insight in the way revenue is created within the industry at present.

3.3.1 General revenue model of the current television industry

As we have mentioned earlier, even though many technological improvements have enriched the industry, the way revenue is created in the current television industry has not changed significantly in the past three decades. Based on several studies and magazine articles written on this subject (Mingione, 2005, Huiden et al., 2008) we are able to identify in what manner the value chain that is pictured in Figure 10 generates value for the actors in the chain at present. Some of the actors mentioned in the figure are not presented here because of the focus we have placed on the key supplying actors.

*Generating revenue for the key supplying actors is, like in most commercial businesses, critical in reaching the goal of consistent profit***.** All business processes are aimed at fulfilling this goal, which means minimizing their expenses and maximizing their revenues.

As the content follows its path from content generator to viewer, the basic revenue stream travels in the opposite direction, from viewer to content generator. The viewer that "consumes" the content usually pays a *subscription fee* to the access network for receiving the content on the access network he has chosen to be connected to. The access network system operator in turn pays a *carriage fee* for the right to be able to offer the content that the content aggregator has acquired. They pay this fee to be able to offer a certain television channel to its customers, the viewers, connected to their distribution network. The content aggregator in turn has acquired the content from the content creator, usually a studio. They pay a *license fee* to the content creator for the right to add the content to their collection from which they compile a package of content they can offer as a television channel to the access network.

This standard circular flow model of goods and money which describes the reciprocal circulation of income between producers and consumers (Mankiw, 2006) is complimented with the addition of revenue from advertising. Advertising income is accumulated by all three key supplying actors in the value chain. We will elaborate on this and some other points further on, but we will first present a graphical representation of the revenue model of the current television industry in Figure 11.

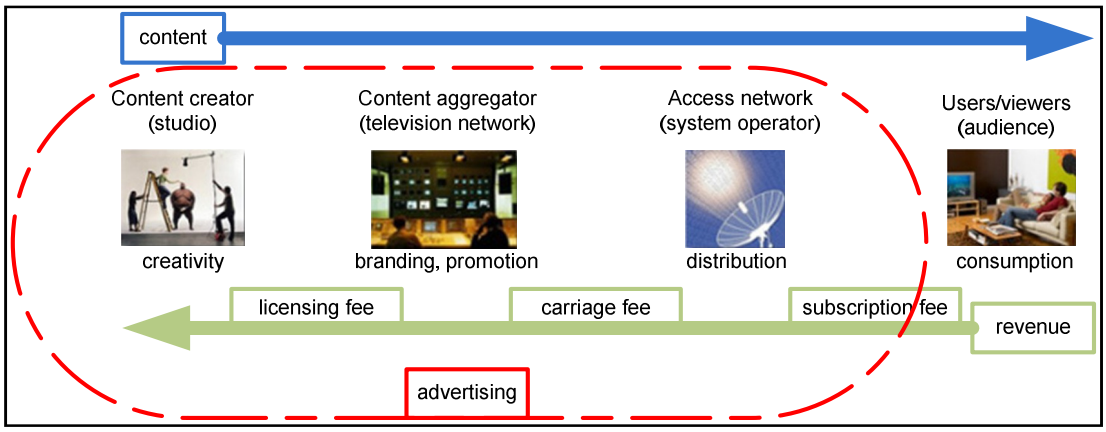


Figure 11: General revenue model of the current television industry

This figure above is a generalization of the industry business. Each role has its own unique specific resources and competencies and there could be a mix in roles as we also described earlier on, where we indicated that one actor can operate multiple links in the value chain for instance. In this thesis however we make a clear separation between roles and will keep doing this in the description of the various revenue models. In the next paragraphs we will further research the specifics of the television industry and the various ways revenue is created by the key supplying actors.

3.3.2 The addition of online television at present

With the arrival and growing use of the internet, this medium has presented itself as an option for the distribution of video content. As we have discovered in earlier chapters this is currently done in three ways:

1) The ability to watch content on demand from a content aggregator's server through a (their) web portal after this has been aired on their channel (video-on-demand).
2) During live events when an aggregator has acquired the appropriate licenses for the online distribution of that event, in real time.
3) The use of IPTV (real time) for digital content distribution over access networks that support the IP protocol.

In cases 1 and 2 the function of the access network is performed by another access network than the current access networks we discussed earlier, i.e. the internet. The connection to this access network is done by an ISP and in that way the viewer pays his "subscription fee" to that ISP in order to be able to receive the content. In a similar fashion the *carriage fee* the channel receives from the access network is replaced by the cost for the aggregator of the bandwidth that is needed to serve the viewers with the content. This means that the content aggregator does not receive a carriage fee and therefore no revenue from that. Revenue in these cases is generated through advertising. But as we have identified earlier, content generators at this time only see online television as a supplement to their regular broadcasting activities and keep the quality of the video low to suppress costs.

The third case of IPTV is not actually an instance of internet television, but the use of a network that was primarily used for internet services for delivering digital television services and in that way becoming a television access network. The access network is changed to an ADSL-connection and more services, like VoD (video rental) and digital recording, can be offered in combination with this. The main value chain in essence stays the same. A normal subscription fee is paid to the IPTV

provider by the consumer and the IPTV provider pays the carriage fee to the content aggregator. In this respect IPTV can be seen as part of what we describe as the current television industry as there are no differences in the value chain and follows the revenue model presented in the previous paragraph.

3.3.3 Advertising

Advertising has a very special impact on this revenue model as it constitutes approximately 80% of all revenue generated within the television industry and money is injected into it in several stages. This revenue is primarily generated by the content aggregator with the sale of advertising time, but in the next chapter we will discuss the different revenue sources per actor in more detail. In this paragraph we will briefly explore the value of advertisement time, the future visions on advertising and the possibilities of advertising in combination with P2PTV.

In the current television industry we can identify different methods for each actor to create revenue from advertising. The content creator can use a method called *product placement* in which a specific branded item is featured in the content. The content aggregator, for which advertising revenue is the main portion of their income at this time, sell *slots of advertisement time*. The access networks' advertising revenue is limited to the *advertising of special packages*. We will elaborate on this in the revenue models for each actor in the next paragraph.

TV advertisement is generally considered the most effective mass-market advertising format. This is expressed by the high prices content aggregators charge for commercial airtime during popular TV events. The annual Super Bowl, an American football game, is as much known for its commercial advertisements as for the game itself. The average cost of a single 30-second TV spot during this game (watched by 90 million viewers worldwide) has reached US$2.7 million. The amount of revenue created from advertising depends on the number of viewers. To calculate the number of viewers several systems are used, of which the Nielson ratings system is the best known. For this they have been using focus groups, either keeping personal *"viewing- diaries"*, digital *Set meters* for digital recording of what is watched and when or *people meters*, another digital device hooked up to the television but with different viewer buttons to record whom within the household is watching. The question of whom is watching is important as audiences are split into several demographics based on their age and gender (adults 18+, men 18+, women 18+, 65+, 12-34, 18-34, 18-49, 25-54, 45-64) for advertisement purposes.

There is a lot criticism on these rating systems. First of all the target group can be biased. Secondly the sample is not statistically random as people need to agree to be part of the sample. Also only households are paneled, not college dormitories, public places and internet television. And finally they do not account for the "empty-room syndrome", where a TV plays without any active viewers.

In the U.S. as well as some other countries experiments are done using so called "banners" or "logo bugs". These advertisements are an ad overlay at the bottom of the TV screen, which blocks out some of the picture, which can take up 5-10% of the screen. Alongside this researches report that the growth of product placement is and will be strong over the coming years (Lafayette, 2007). This is of course good news for the content creator, as this would increase their revenue from this. But the regulations and restrictions on product placement differ per country as this is often regulated by law. This is another issue we must bear in mind in our explorations of possible futures. Future visions are however in disagreement on how the television advertisement industry will unfold. What will

remain is the fact that the more eyeballs are reached with certain content, the more valuable the advertisement time is.

From all this we can see the importance of viewer data availability. With P2PTV the amount of viewers (using the original tracker) can be monitored with great accuracy, increasing the viewer data availability and accuracy. A distributor of television content using P2PTV systems can much more accurately monitor the number of viewers (connected to the stream through the original tracker) and use this information in negotiations with advertisers. Viewers of re-distributed streams are however not monitored. The inability of monitoring more than one television set per household can be overcome. But like now, with the current rating systems, a system will be needed to identify the viewers within their demographic. This issue too must be considered in our explorations of possible futures.

3.3.4 Revenue models of the key supplying actors

In this paragraph we will elaborate at how revenue is created is for three key supplying actors in the television industry. We will be doing this by listing all activities that create revenue, and the processes behind them, per actor. After this we will also have a short look at others actors in the environment of the television industry that generate revenue from content distribution. We will not be focusing on exact numbers, but will try to grasp of where most revenue is gathered from by the different actors, in order to be able to later on identify the possible changes the introduction of P2PTV might have on the revenue models.

3.3.4.1 Content creator

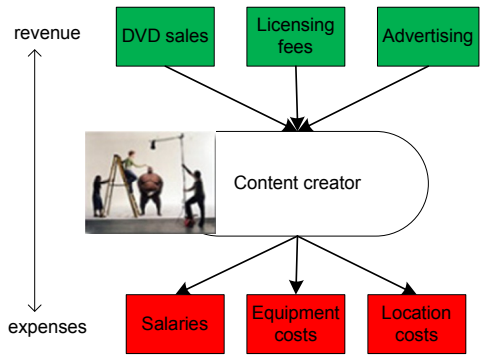
The content creator's primary business process is the production of video content that the viewer wants to see. As we had already identified in the actor analysis their primary resources for this are creativity and know-how. Even though the interest for user generated content is growing on the internet, the television industry will stay reliant on the delivery of high quality content as the main source of content (McQuivey, 2007). In the strict role of the content generator that we define (thus discarding the fact that some actors are mixed into more roles), the content generator either produces content and tries to sell licenses for the distribution of this to content aggregators after completion and generate revenue, like we see in Figure 11. Or they produce the content by order of a content aggregator, selling the license to the content aggregator in full, in that way creating revenue. For the production of content they need personnel (actors, cameramen, stage personal, and so on), the proper equipment and the necessary locations. This makes up the gross share of their expenses. The process of content production will not be altered by the use P2PTV and will therefore not be studied in more detail, as this is not within the scope of this research. The way the produced content is distributed and the value it represents on the other can change due to the use of P2PTV.

A secondary source of revenue is the use of an advertising technique called product placement, or embedded marketing. Product placement is a type of advertising, in which promotional advertisements are placed in media, in this case television programs, by marketing agencies using real commercial products and services, where the presence of a particular brand is the result of an economic exchange (Russell and Belch, 2005). Studies have found that the effectiveness of these type of advertising is very hard to measure and most commonly the worth of this type of advertising, and with that the revenue for the content generator, is based on the expected number of viewers

(Schumacher, 2007, Russell, 2002). This fact is important as we will encounter later on in the identification of threats of the use of P2PTV. Product placement can also be used as a cost saving method when the delivery of a product needed in production is negotiated with the supplier free of charge in return for exposure in the media. This special form of product placement does not create revenue, but reduces the equipment costs.

A third source of revenue is the growing market of DVD sales from (previously) televised series. Many studios release DVD box sets of their content several months after the first air date of the show. Even older series that attracted huge audiences before the DVD was to become the standard as video content carrier are now re-released on DVD, generating large revenue streams for the content generators and bringing the audience closer to the television then ever (Kompare, 2006). With the rise of broadband internet and with that faster downloading speeds, the industry was afraid the DVD sales would go down as illegal copies of these DVD's are widely available on the net. This has to date not happened (Smith and Telang, 2006), but the use of P2PTV can create a situation in which the possibility of easy digital recording of television series in high quality we discussed in Chapter 2 can cause a lowering in these DVD sales.

The expenses of the content creator consist of salaries to be paid to employees for performed services, the equipment costs of the equipment needed for the creation of content and the costs for locations needed for the creation of content. Figure 12 represents the revenue model for the content creator showing the revenue coming in and expenses leaving the organization and summarizing the different revenues and expenses.



Revenue source	Resources	Process
Licensing fees	Creativity and know-how	Video content is created by transforming creativity and know-how, using personnel and specialistic equipment, into high quality video content that is licensed to content aggregators, which are able to get the content distributed.
Advertising	Ability to create high quality content	Advertisers are willing to pay for product placement, having there product featured in the content.
DVD sales	The created high quality content	The created high quality content is placed on the DVD carrier and sold through different distribution methods.

Expense source	Origin	Process
Salaries	Employees	Employees are paid for performed services
Equipment costs	Equipment needed for production	Equipments is used for the creation of content
Location costs	Locations needed for the production	Space is needed in order to film and create the content

Figure 12: Revenue model for the content creator

3.3.4.2 Content aggregator

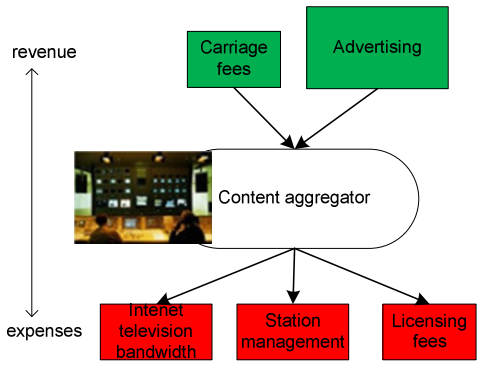
The content generator's initial source of income is the carriage fee that they receive from the access networks that carry the aggregator's channel(s). In order to be able to offer the content, the aggregator must have purchased license fees for the content and deploy station management. In the case of internet television there is no carriage fee from the access network. The distribution of the

aggregator's content over internet is actually a costly activity as we discussed in previous chapters, where the aggregator needs allocate server space and usually uses the services of a Content Distribution Network (CDN). The expenses of online content distribution are redeemed through different online advertising strategies, e.g. pre-roll advertisement clips, banners and pop-ups.

With the arrival of commercial channels the main source of income has become the advertisement revenue. As we have seen in Chapter 3 the very first content aggregator were government funded and in that way able to compile a package of content attractive to the audience. Then came the commercial television channels that use a business model in which advertisement time is sold in order to create revenue. This makes advertising the main source of income for this actor. The amount of revenue that is generated through advertising depends on the number of viewers, as advertising space is more valuable as the number of potential buyers is reached. Therefore content aggregators, usually operating multiple channels, try to profile the package of content that is offered in order to be able to sell more focused advertising time. The ability to profile the viewer and learn about his interest is becoming more and more important, as then more targeted advertising can be done (Katz, 2006).

A final possible source of income can also come from DVD sales, but this only happens if the content was created by order of the aggregator and fully licensed to him. This does not occur often at what we have defined as commercial content aggregators and does not fall within the role of the content aggregator as we have defined this. Therefore we will consider this a revenue source for this actor.

The expenses for the content aggregator consist of station management, i.e. the salaries that need to be paid to the employees that are needed to run the network or channel, the licensing fees that are paid to the content creators for the content they offer on their channel and possibly the costs of the bandwidth needed for the provisioning of online television (either with or without the use of CDN's). Figure 13 represents the revenue model for the content aggregator in the same fashion as in the previous subparagraph.



Revenue source	Resources	Process
Carriage fees	Licensed content and station management	The licensed content is purchased and assembled into a station programming by the station management and sold to access networks.
Advertising - traditional televison	Advertisement timeslots in the programming	In the programming several timeslots have been kept open for advertsing. These timeslots are sold to advertisement agencies in which they can promote their client's products.
Advertising - online television	Licensed content available online	If the licensed content is placed online there are several techniques for advertising when a user wants to view the content.

Expense source	Origin	Process
Internet television bandwidth	Internet television	Bandwidth is paid that is needed for the provisioning of online television
Station mamagement	Employee salaries	The employees are paid for the management of the station
Licensing fees	Content needs	Licensing fees are paid to the content creator for the right to broadcast their produced content

Figure 13: Revenue model for the content aggregator

3.3.4.3 Access network

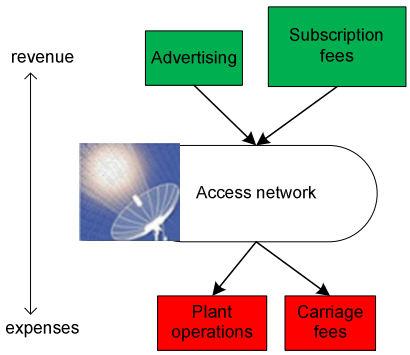
There is many debate on the question whether access to a access networks can be seen as a utility good , or public service, supplying in the must for spreading critical information (Coppens and Saeys, 2006). The fact is that nearly all people in the developed countries have access to an access network and are able to watch television as we know it for a fair price.

It does not matter whether the access network operates within a government-subcontracted monopoly position or within a free market, an access network thrives on the subscription fee it receives in return for its services. And therefore they strive to contract as many subscribers as possible. These subscriptions are the main source of revenue for access networks, typically accounting for somewhere around 90% of their revenue (Mingione, 2005).

Commonly the access network has a number of packages from which a subscriber can choose. This usually ranges from a basic package containing public channels, most national channels and some entertainment channels to very extensive packages making hundreds of channels available to the subscriber. Of course the pricing is higher as more channels are available. In order to be able to offer these channels they have reached contracts with different content aggregators.

A small portion of the revenue, around 10%, comes from advertising income. First of all access networks have their own channel, only broadcasted to their own subscribers, on which they can sell advertisement time. Besides that they receive revenue from aggregators offering special packages (like Sport 1 and Film 1) for advertising these packages to the subscribers alongside the usual content.

The access network's expenses consist of the carriage fees that are paid to the content aggregators in order to be able to offer their content to the subscribers and the expenses for operations of their plant, i.e. employees and hardware. Figure 14 represents the revenue model for the access network in the same fashion as in the first subparagraph.



Revenue source	Resources	Process
Subscription fees	Distribution network and channels	The access network charges the subscriber for having a subscription to an offered package of channels. In order to get the the content to the user, the plants that make up the access network need to be operated.
Advertising	Own channel available to subscribers	Selling advertisement time on their own channel
	Subscribers to which special packages can be advertised	Adertising the special packages to their current and new subscribers

Expense source	Origin	Process
Plant operations	Employees and hardware	In order to maintain the physical network to the subscribers employees are paid and hardware needs to be bought and installed
Carriage fees	Content needs	Carriage fees are paid to the content aggregators in order to be able to offer their content to the subscribers

Figure 14: Revenue model for the access network

3.4 Business models of P2PTV providers

We have mentioned the several parties that are trying to monetize the P2PTV technology, which are: Tribler, Octoshape, and RawFlow. As Tribler is still struggling to get their feet on the ground in transforming a research project into a sound revenue model, we will focus on the way the other two companies are trying to enter the value chain. Octoshape and RawFlow sell the technology they have created as a service. However, there are also non-commercial applications that let anyone make use of P2PTV-technology for online broadcasting like we described in Chapter 2 on the P2PTV technology. However, these offer much less QoS and assurances on performance. So at this time for any actor to make use of P2PTV for commercial purposes, they are forced to use Octoshape or RawFlow technology. In the future more providers of P2PTV solutions could become available, but for now we will focus on the current and future business models of P2PTV solution providers.

Octoshape states on their website (www.octoshape.com/about) that their *"...mission is to lower the costs and increase the quality of live and on-demand streaming. Having created a unique technology for streaming audio and video, Octoshape wants to better the user experience of streaming content, all the while cutting costs for the broadcasters. Octoshape is revolutionizing the streaming media business by widening the scope of webcasting. With Octoshape's gridcasting technology, webcasts can scale to accommodate millions of users, and still provide a quality media experience. And of course without the unreasonable expenses to traditional content delivery networks, providing for a sound business model."*

So their business model is thus far completely focussed on webcasting. They are however starting to form alliances with various parties, including the European Broadcasting Union (EBU) that has just finished off a test called the EBU P2P media portal and NBC Universal, a large US based content generator, now using Octoshape's P2PTV technology for their webcasts. Their services have also been acquired by a leading company in CDN services called CDNetworks – Asia's biggest CDN network provider - for creating a hybrid system like we described in Chapter 2.

The technical background of P2PTV systems is of such difficulty that within the next five years we can assume that the actors within the industry that want make use of the P2PTV technology, will need to acquire the services of companies like Octoshape, as they will not have the expertise for this in house. This introduces the P2PTV system provider as an extra actor within the supply chain from content creation to content consumption. Because the P2PTV system provider in essence offers the same services as CDN's that are now typically used for online content distribution, we do not see any differences in the revenue models for the key actors from this. Also the same requirements on QoS and service delivery will be adopted in Service Level Agreements like this is done now. We do however need to bear in mind that the use of new actors introducing new technologies imposes possible risks, as the reliability of the actor and the functioning of its technology are not known. Also we must not underestimate the importance of this actor when P2PTV would become the leading form of content distribution and the knowhow of the technology is not in house at the distributor of the content by that time.

3.5 Summary and risk framework design

In this chapter we have identified the *four key actors in the current television industry* in the value chain from content production to the viewer consuming the content, i.e. *the content creator, the content aggregator, the access network and the user*. And we have determined their roles and

dependencies in the current value chain. Furthermore we have discussed the revenue models of the key supplying actors, which will be used to assess the effects of the what-if scenario on the key actors in our scenario based analysis of risks and opportunities.

Now that we know the key actors in the current television industry, we know who we will need to address in the risk framework, which introduces the first element of the risk framework we are designing. During the course of this research we will be discovering the elements besides the actors that are needed in the design of the risk framework.

4 Risks and opportunities in different possible futures

After our research on the current situation in the current television industry and the properties and possibilities of the P2PTV technology, we can now start working towards the identification of risks and opportunities of P2PTV for the television industry. To do this, in this chapter we will first elaborate on our definition of risks and opportunities and introduce the method of scenario based analysis of risks and opportunities that we will be using. We will start an exploration of possible futures which will lead to a what-if scenario logic that will function as the stepping stone for our scenario base analysis of risks and opportunities.

4.1 Defining risks and opportunities

All of a business's activities directed towards the assessment, mitigation and monitoring of risks is part of what is called *risk management*. And risk management is cyclic process. During the course of time different threats and opportunities show themselves and decisions on the proper responses to them also change over time (Chew (ed), 2008). Deloitte ERS describes this within their Risk Management Cycle (RMC) which is shown in Figure 15. Risks can be responded to in four ways; avoidance, reduction, transference and retention.

Figure 15: Deloitte Risk Management Cycle

Risk in engineering is usually described as the probability of an event with a negative outcome occurring multiplied by the impact of that event occurring (probability x impact). But this description is mainly focused at the quantification of risks, i.e. the determination of the expected monetary outcome of an event. In this research we are not seeking to quantify the different risks, but to identify the different risks that could occur in possible future developments around P2PTV and qualify them for decision support. Since this is a qualitative risk assessment we will be addressing the risk- and opportunity events that lead to possible risks and opportunities. Besides that we need to identify the likelihood of the risk firing and the impact and categorize them in such a manner that it can offer insights to the actors in the television industry.

There are many definitions of risk that greatly vary in the specific application and the context it is discussed in. *We define a risk as any future development that is expected to negatively affect an actor's business*. The concept of risk consists of two elements; i.e. the likelihood of the negative event during the lifetime and the consequence, or impact, of this negative effect (Berdica, 2002). We will thus discuss both these elements for every risk we will be identifying. But not every event in the future developments must be a negative one. An event can also have *a positive effect in reaching the actor's goals*. Then we speak of an *opportunity*. We thus define an opportunity *as any future development that is expected to positively affect an actor's business* We So in our upcoming analysis we will be identifying all the events that could occur within the specific what-if scenarios and then assess whether these have positive or negative effects for the different actors. In other words whether they are *risks* or *opportunities*. Risks (and opportunities) come from *uncertainties* about future developments. Walker et al. define uncertainty as "any deviation from the unachievable ideal

of completely deterministic knowledge of the relevant system" (Walker et al., 2003). In this research we will identify the risks and opportunities that may occur in different uncertain future developments of P2PTV within the television industry, which we will describe as a risk- or opportunity event.

Because we are determining risks and opportunities in uncertain future developments we will be using a *scenario based analysis of risks and opportunities,* which is based on a technique called Scenario-based risk identification (Haimes, 2004, Krause and Tipton, 2008). A set of possible futures are outlined and from those what-if scenarios are developed and researched to examine in which areas the actors (to which the what-if scenarios are aimed) are affected and what would be the possible extent of the damage or reward in the event that this what-if scenario occurred. The formation of the possible futures is done based on the knowledge that can be gained about the business environment in which the actors operate. We have based the formation of these possible futures on extensive literature research on the possible developments of P2PTV and the television industry and brainstorming sessions with several experts from the Technology Media and Telecommunications department of Deloitte ERS. In order to be able to outline the possible futures, first the current situation of the actors toward which the what-if scenarios will be aimed must be determined, which we have done in Chapter 3. Then in order to outline the different possible futures the possibilities of the cause of future developments, in this case P2PTV, must be determined.

For the purpose of this research it is not needed to identify the expected size of the financial consequences that are concerned when a risk should fire or an opportunity is exploited. The risk assessment will be a qualitative study to identify the different risk- and opportunity events and enable the formation of the risk model which is the goal of this research.

What we set out to achieve with the scenario based analysis of risks and opportunities is to identify the possible risks and opportunities within several different future possibilities and asses their likelihood and impact. From this we will be modeling the risk framework that we are working towards. This means we will be dealing with the steps from "Market opportunities" up to "determine size of risk" within the Deloitte RMC. The risk framework that we will design from the risks and opportunities identified by the scenario based analysis of risks and opportunities can then be used to take the next steps that are described in the Deloitte RMC. The risk framework will enable actors within and outside the industry to have insights in the risks and opportunities of P2PTV for the television industry and the size of the risks and opportunities.

As our analysis of risks and opportunities will be based on a what-if scenario logic, the probability of risks firing is dependent on the probability that a certain what-if scenario will occur in real life. This is however very hard to quantify and therefore we will assess the impact that the risks may have on the businesses in the value network in that specific what-if scenario. The assessment of the risks will be based on the knowledge gathered on the television industry within this research and experts on the subject.

4.2 Exploration of possible futures

Thus far we have identified the possibilities of P2PTV and charted the current television industry, for which we have identified the different actors in the value chain and their roles. Also we have

described the revenue model of the current television industry and those of the key supplying actors.

The introduction of P2PTV in the television industry, whether used by actors(s) in the television industry or used by a growing number of consumers using P2PTV systems, can have an impact on all actors within the value chain of the current television industry. A few examples of the impact P2PTV can have for the actors we can imagine directly are:

- Network broadcasters (content aggregators) do not want people being able to watch content online that they have paid for to broadcast before it airs in the region they operate in.
- Advertisement agencies will want to know how many and what kind of viewers are reached where and when, and might need to review or adjust their strategies.
- Producers (content creators) do not want their content available in high definition quality viewable on computer systems, because this makes storing it locally much easier than it is now. (Currently someone needs to capture a television broadcast on their computer, encode it to a chosen file format, distribute it on the net and making it possible for people to download this file. When high definition content streams could be received over internet, everyone will be able to record this with great ease.)

But the P2PTV technology can also change the roles that certain actors have within the distribution of real-time video content through access networks or the internet, which is what television as we know it is. Several sources, including Leurdijk, Branch-Furtado and Kozamernik identify the change in roles of actors and the value chain that P2PTV could imply (Leurdijk, 2007, Branch-Furtado, 2005, Kozamernik, 2006). With this research we are trying to identify what changes in roles, and with that the changes in (technical) processes of revenue creation, can be expected from the use of P2PTV, in order to assess the different risks and opportunities for the key actors. This however depends on the direction in which the future of P2PTV develops itself and this future is uncertain.

We have seen that P2PTV possibly removes the entry barriers to the television industry. With a technology supporting the reach of large audiences with very little hardware requirements and content distribution costs the market for niche content production can become profitable. As according to the long tail theory by Anderson (Anderson, 2006) these can, with low cost P2PTV distribution, find a sufficiently large audience, because then they can reach small and scattered audiences worldwide and over time (Leurdijk, 2007). Elberse on the other hand shows with her paper on the long tail theory that the empirical numbers do not fully support the theory thus far (Elberse, 2008). Anderson and Elberse have started a debate on the exact thoughts and workings of a long tail theory on the internet[1]. One thing however can be adapted from the theory; with the use of P2PTV niche products that are in the tail of offered products (or channels in this case) can be offered at the same costs. An example: the spectrum of the current access networks is too small and therefore valuable to have many different niche channels. In most parts of the world there is not enough attention for a channel broadcasting ice hockey matches all day for instance. With P2PTV this channel could be set up and maintained at very low costs, offering the small portion of users that are interested in such a channel what they want. More important of all, everyone could be able

[1] see http://conversationstarter.hbsp.com/2008/07/the_long_tail_debate_a_respons.html

to set up this channel due to the low setup and distribution costs as we discussed earlier. What this means for the key actors in the current television industry is that they might get the opportunity to enlarge their content offering with more specialized content channels. But more importantly, new entrants could enter the market offering niche content channels and compete for the viewers' attention with the existing parties.

In order to assess the possible changes in roles the key actors fulfil within the industry and directly address the different risks and opportunities for the key actors, a scenario based analysis of risks and opportunities will be performed in the next chapter. In this paragraph we will address the possible directions the future of P2PTV can develop itself which will be the steppingstone for the creation of what-if scenarios and the scenario based analysis of risks and opportunities.

Scenario analysis is an effective way of getting grip on uncertainties and identifying and exploring possible future developments, based on clearly defined assumptions concerning the relationship between relevant developments and the environment that influence these developments (Bouwman and Van der Duin, 2003). In this research we aim to identify the risks and opportunities for the key actors within possible futures, rather than to predict the future of P2PTV within the television industry. According to Börjeson et al. what-if scenarios investigate what will happen on the condition of some specified near-future events of great importance for future development (Börjeson et al., 2006). The specified events can be external events, internal decisions or both external events and internal decisions. The possible futures of P2PTV for the television industry depend on the internal decision of actors in the television industry whether or not to use P2PTV and the external events of users using P2PTV. For this reason we have chosen to create what-if scenarios to identify the risks and opportunities according to the future developments we are going to describe in these what-if scenarios.

By analyzing and researching the created what-if scenarios we can identify the different risks and opportunities that present themselves in these what-if scenarios due to changes in roles, revenue models and technical processes in the distribution of real-time content. To be able to create what-if scenarios we start with describing the current situation, which will be the starting point from where we can address the dimensions that contribute to the direction the possible futures will develop. We will then state the assumptions on which we will be basing our what-if scenarios and we will define the two dimensions that influence the development of the use of P2PTV within the television industry and describe of what factors these dimensions consist. From there we define three different directions in which the possible futures will move towards in case the specified events would happen and which will be used to identify the change in roles, revenue models and the risks and opportunities that come from these developments.

4.2.1 Current situation

We have started this thesis of with the statement that more and more time is spend on watching online video. Television-watching on the television set is however standing its ground and the time spend watching television in this way stays the same, whilst the time spend on watching online video is still growing (Bradshaw, 2008). This effectively means that more time is spent by consumers watching television (be it the regular way or online) than ever.

The P2PTV technology is to date only beginning to get more attention as a very small number of license holders of live events are just starting to complain about the illegal re-distribution of their

content, which was lately reported in the Dutch newspaper Algemeen Dagblad (Dekker, 2009). Recently the first complaints have been made by paid sports channels offering soccer matches about the fact that many, if not all, of their content that they have acquired by expensive licenses are viewable on the internet. A large portion of these illegal broadcasts are done through P2PTV systems as research shows (Envisional.Ltd and NetResult.Ltd, 2008). According to recent articles they feel threatened in their revenue and their exclusivity (Dekker, 2009, Schoof, 2009).

Furthermore most attempts to commercially deploy P2PTV are just in testing stages. But the consumer P2PTV scene is growing, especially in China as a recent article shows us the large amount of viewers of video content through P2PTV and the large amount of content available on P2PTV systems originating in China, calling 2008 the year China dominated P2PTV (Roettgers, 2008).

But we can conclude from our extensive literature research that to date few actors within the television industry have been researching and testing the possibilities of P2PTV. The few tests that have been done, are done by some government funded national television stations from Poland, Portugal and Slovenia who have been experimenting with this as reports from the European Broadcasting Union (EBU) and the Octoshape website indicate us (Kozamernik and Giorgi, 2006).

Besides that to date very little researches have been conducted or reports are published on the actual loss of revenue that comes from the illegal re-distribution of content by P2PTV systems. The only one we encountered during our research was the Background Report on Digital Piracy of Sporting Events, part of the Sports Report on IP Theft (Envisional.Ltd and NetResult.Ltd, 2008), which we mentioned earlier. This seems to be the first attempt to identify the malpractices of illegal re-distribution of live sporting events in which P2PTV systems are addressed. But it seems that for now the industry as a whole is not fighting these malpractices to great extent, seeing that no reports of claims against services or users providing the tracker function for this over P2PTV have been reported. In the past and present we have seen and see these kinds of claims by different industries towards innovative distribution systems that enable the relatively easy sharing of copyrighted material over the internet, e.g. the cases against Kazaa (which was mainly used for sharing (copyrighted) music) and PirateBay (a website offering torrents for downloading all sorts of (copyrighted) material). We will take these cases in consideration in our scenario based analysis of risks and opportunities.

4.2.2 Trends in the television industry

We started this thesis with the observation that the popularity of watching video online on the internet has been increasing rapidly the last few years. Several studies expect this number to keep growing (Cohen, 2008, McQuivey, 2007). But very few see the demise of the traditional television set to be replaced by watching online television. In previous chapters we have established that the general belief is that watching internet television on a computer screen will not soon replace watching television on a TV screen (Deloitte, 2008, McQuivey, 2007). This has already been discussed for several years, but with the growth of the time spent watching online television, these most recent researches still concur with this belief. We concur with this assumption and can state that at first P2PTV would be used by content distributors for high quality extensive live coverage of (inter)national events and for high quality live broadcasting over internet alongside the television broadcasting as it is done today. This would mean that people would first use P2PTV for watching these kinds of broadcasts on a computer screen only when no television set was available or when it

would offer content that was not available on the regular channels. But we must also bear in mind the fact that the technical possibilities of P2PTV we discussed can create the possibility of P2PTV becoming the main system for real-time video content distribution.

We earlier observed the fact that many aggregators offer an online solution to watch programs, which have aired previously on their channels, online through a VoD system. Researchers predict a growth in the number of users watching VoD- and Pay-per-View content in the near future (McQuivey, 2007, Cohen, 2008). VoD, which is per definition not a real-time display of video content, is of no interest to P2PTV systems, as P2PTV systems are designed for real-time video distribution. Pay-per-view content however *could*, depending on the risks that come from the use of P2PTV, *be an appropriate opportunity* to monetize on the distribution of live content like football matches or other sporting events with the low costs of P2PTV distribution at this time. In the past few years an increasing number of broadcasters or organization with the licenses to broadcast sporting events online have chosen to offer consumers the possibility to watch these sporting events on a Pay-per view basis. Examples of this are ESPN360.com, offering most major American sports, and EredivisieLive.nl, which offers the soccer matches of the Dutch Eredivisie, both on a pay-per-view basis. These types of content are usually filtered by IP-range filters to avoid the content being available outside the region the broadcaster or organization operates in. This is another consideration we will bear in mind for our scenario based analysis of risks and opportunities.

We must too consider the possibilities of hardware solutions using P2PTV technology. An influential trend that is predicted by experts on the subject is the introduction of what is called the Internet TV (not to be confused with the internet television as the watching of television content on the computer system is called)(Deloitte, 2009). The Internet TV is a television set equipped with a network port, which makes it possible to connect the television directly to the internet. This would make internet content, web browsing and email possible directly on the television. For P2PTV purposes the introduction and adaptation of this type of television sets could be very influential as the software inside these devices could be extended to be able to receive P2PTV broadcasts. Another trend we can identify is the switch to digital television which many content aggregators and access networks are implementing, instead of the analogue system that has been used since the introduction of television. In order to be able to receive and display these digital signals often Set-Top-Boxes (STB's), usually referred to as digital decoders, are used which receive and convert the digital signal to signals that can be displayed on the television hardware. These STB's too could be extended with P2PTV capabilities in order to display P2PTV broadcast on the television hardware.

Another trend we can identify is the overall adoption of High-Definition (HD) content. A growing number of aggregators and access networks offer their content in HD quality, which is called HDTV. Early adopters have already invested in hardware capable of showing HD content like HDTV television hardware and Blu-ray discs. More and more the HD standards are becoming standard in the television hardware as well as in television content available. This video quality upgrade does not change the value chain of the current television industry, but is just an upgrade in video quality. The demand for HD content widens the quality gap between traditional and internet television as the video quality of traditional television becomes greater and that of online content stays poor due to the bandwidth expenses. P2PTV however could close that gap as it is capable of distributing HD quality video content, which obviously requires much more bandwidth, at lower costs for the content delivering party.

4.2.3 Assumptions on environmental factors influencing future developments

For our research on the risks and opportunities of P2PTV for the current television industry we will perform a scenario based analysis of risks and opportunities over the upcoming five years from 2009-2014. Because of the high volatility within internet technologies we do not want the what-if scenarios to explore too far in the future. But certain supporting hardware devices, like Internet TV's and internet service provisioning providing higher consumer internet speeds with VDSL or Fibre, will need some time to hit the market. We have therefore chosen a time span of five years to base our scenario based analysis of risks and opportunities on.

Without making any assumptions on the developments within the upcoming five years it is impossible to create any type of scenario, as no one can be absolutely sure about how the future develops. To perform our analysis we make the following assumptions based on the finding of this research so far:

- The consumer (broadband) internet speeds keep growing over the next five years as they have done the past decades. This means that in this period a step will be made in consumer broadband internet to connections offering up to 100 Mbps downstream and 10 Mbps upstream.
- The P2PTV technology advances to a stage where content can be viewed in HD quality, with high reliability and guaranteed QoS. This process grows according to the growth of the consumer internet speeds available, i.e. when higher speeds become more standard higher resolution streams become more standard.
- The ISP's do not and cannot by law limit or filter internet traffic. The users can use their upload capacity for whatever activity they want; there is no P2P traffic filtering and no traffic limits. The law on this is very diffuse on this subject worldwide. In the Netherlands for instance it is legal to download whatever is available on the internet. Whether or not watching the downloaded content is legal or not is another discussion, but from the viewpoint of the ISP this is of no importance. It is however not allowed to offer any copyrighted material for download, i.e. the uploading of copyrighted material is illegal. But in the Netherlands to date it is not legal for the ISP to monitor, filter or block the user's activities and traffic. This is of course dependent on the possibilities to block or filter internet traffic by law. Therefore the government attitude will play a part in this issue as well. *This assumption is one of importance as the practice of filtering P2P traffic by ISP's could cripple the functioning of P2PTV systems, because the upload capacity of the users is needed for distribution.* However the subject of ISP filtering traffic has been a hot issue in the recent months and thus far it has proven impossible by law to deny the users the internet services that have been offered to them, meaning that the use of upload capacity for any P2P application cannot be blocked by the ISP (Roth, 2009). *An ISP cannot block P2P traffic completely, because this traffic is not per se used for distribution of illegal content.* We assume that in the coming five years ISP's will not be able to block or filter content. The regulator will however try to find other ways to disable the distribution of illegal content and we will bear this in mind in our scenario based analysis of risks and opportunities.

4.2.4 Dimensions that influence the possible futures of P2PTV in the television industry

What we already identified from the start of this research is that there are two important different uses of the P2PTV technology that can shape the future of the use P2PTV within the television industry, which we will repeat here once more:

1) First of all the evolvement and a growing misuse by the users of P2PTV can further the illegal rebroadcasting of television content that is now already happening at small scale, to a much larger and substantial scale. This could lead to reductions in revenue for some or all of the actors within the value chain.
2) Secondly the television industry could embrace and use P2PTV technologies in an effort to reap benefits from the use of P2PTV, for instance to reach a larger audience with the benefits of the lower costs for the needed bandwidth that P2PTV creates. But these benefits will come with certain risks.

We have seen that due to the low bandwidth needs that are required to provide the server- and tracker functioning used in P2PTV systems, both industry actors and users can provide these functions. *The ability to both industry actors and users to provide these functions is one of the key factors influencing the possible of futures of P2PTV*. We now need to identify the dimension for our scenario based analysis of risks and opportunities that incorporates this key factor.

Bouwman et al. (2008) already identified several future studies that created scenarios on the possibilities within the telecommunications sectors in which the focus is placed on television. In their studies on a possible business model for IPTV services they have identified “consumer attitudes” and “regulation related to industry structure” as the most important uncertainties (Bouwman et al., 2008). Even though we are not delving as deep in the creation of possible and feasible business models as the mentioned study by Bouwman et al., as this is not necessary for the purpose of this research, we can use the insights of this research for the creation of possible what-if scenarios.

We combined these insights with the insights we gained through extensive literature research and the expertise of several experts from the TMT department of Deloitte ERS for discovering the dimensions that determine the possible futures of P2PTV and that we use for the creation of what-if scenarios. During several brainstorming sessions with experts from the TMT department within Deloitte ERS we discussed the possibilities of P2PTV and systematically listed the factors influencing the use of P2PTV. We grouped the factors and renamed the factors that indicated the same thing in different words. From there we were able to define two different dimensions that influence the future developments that we will discuss now.

The first dimension identified is the *consumer adoption* of P2PTV. This dimension is a gathering of the “consumer attitudes” defined by Bouwman et al. with several factors we identified in our brainstorming sessions. The difference in this research and the mentioned research by Bouwman et al. is the fact that consumers have more influence on the (mis)use of the technique. In IPTV architectures the viewer is to some extent a static entity which has the choice to either acquire IPTV services or not. In this research the consumer’s involvement is more extended and we have branded this dimension as consumer adoption. Another relevant issue the research by Bouwman et al. points out is the distinction they draw between sophisticated and standard consumers. Sophisticated consumers are those users who are fully aware of the advantages of new media products and services, in this case the P2PTV technology. They are the ones who are the first to adopt the P2PTV

technology and will use it for watching television when no TV is available but there is a computer with internet connection available. Standard consumers are conservative when it comes to using new products. They are satisfied with conventional TV, they prefer an easy service configuration and they are price-sensitive. In this case these consumers will only start using P2PTV when it is very simple to receive and when there is absolutely no other way of watching television available to them at a certain time. We will bear in mind this distinction between sophisticated and standard consumers during the scenario based analysis of risks and opportunities. The consumer adoption dimension consists of the following factors:

- Willingness of consumer to share bandwidth/install plug-in: As we have seen in the P2PTV technical exploration in Chapter 2, the user, in order to receive and propagate the content, must install either a plug-in or special software containing a sharing plug-in on their computer system when watching video online. If their attitude towards installing plug-ins or using their upload capacity for propagation is negative, the content will not be available to them, meaning lesser viewers.
- Willingness of consumer to operate (non-commercial) server- and tracker functioning: On the other hand the consumers attitude can be positive to such an extent that the use of P2PTV technique is used by many users in broadcasting their own "channels", but also in the re-propagation of content outside the intended swarm. Leading to several issues as we will identify later on. What we have also seen from the technical backgrounds of P2PTV in Chapter 2, the barriers for this are low, meaning that both the users as the industry have the ability to use P2PTV for content distribution as they both can act as tracker and content server. Another fact that enforces the importance of consumer attitude is that the more users are connected, the higher the performance of the whole network is. The consumer attitude is about demand and usage. If the user feels a growing need for the services that P2PTV can offer, they will use it.
- Growth of time spend by consumers watching online television: Another important influence is the growth and popularity of watching video online. Research shows that the amount of time spent watching video online is growing. Question is whether this will continue to grow or has reached its peak. This is crucial for the start of P2PTV as like we discussed at first P2PTV will be introduced as a way to watch online television.

The second dimension that was identified is the *industry adoption of P2PTV.* For two of the three key supplying actors we discussed, i.e. the content generator and the content aggregator, P2PTV could be interesting to use for content distribution. The content creator could decide to broadcast his own content through P2PTV systems. And the content aggregator could decide to distribute the content licensed to him through P2PTV systems. The other key supplying actor, the access network, only distributes content of other actors over his network and thus P2PTV systems are in that sense of no interest to them to use. A recent study by Huiden et al. concludes that *at this time and in the near future most content creators are not willing to take on the broadcasting of their own content directly* (Huiden et al., 2008). Because of this *we will be focussing on the content aggregator as the actor from within the television industry that could be using P2PTV* for their content distribution. The possibilities that P2PTV could offer content creators for the broadcasting of their own content could however make them interested in taking distribution in their own hands. But for the purpose of this research, the design of a risk framework that identifies the risks and opportunities of P2PTV, we will

keep the focus on the content generator as the actor from within the industry that adopts P2PTV. *This means the industry adoption of P2PTV is determined by the content aggregator adopting P2PTV for content distribution*. This would mean that we could just have named this dimension "content aggregator adoption", but we want to clearly point out the difference between the consumer and the industry that are both capable of performing the server- and tracker functioning in P2PTV networks and therefore will stick to the description of "industry adoption". This does not mean that any future developments would only influence the content aggregators. All actors could be influenced by the adoption of P2PTV by the content aggregators.

According to these two dimension and the factors within those dimension we will create a set of possible directions the future could move. Table 3 gives an overview of the uncertainties and the possible changes of these uncertainties in the future on which we will be basing our scenario based analysis of risks and opportunities.

Table 3: Overview of the factors within the dimension and their possible developments

			possibilities		
Dimensions	**Consumer adoption of P2PTV**				
		Willingness of consumer to share bandwidth/install plug-in	low	medium	high
		Willingness of consumer to operate (non-commercial) server- and tracker functioning	low	medium	high
		Growth of time spend by consumer watching online television	low	medium	high
	Industry adoption of P2PTV				
		Content aggregator adoption	low	medium	high

4.2.5 What-if scenario logic

Based on the specified dimensions and the assumptions above, three possible futures are defined from which the what-if scenarios will be created in the next chapter;

1) *P2PTV takes over*:
   with Consumer adoption high – Industry adoption high
2) *Over anticipated P2PTV*:
   with Consumer adoption low – Industry adoption high
3) *P2PTV underground*:
   with Consumer adoption high – Industry adoption low

The following figure (Figure 16) represents the position of the different possible directions the future could develop, i.e. the what-if scenario logic that will be used as steppingstone for the scenario based analysis of risks and opportunities, within a coordinate system. The horizontal axis represents the dimension of *Consumer adoption* which can range from low to high according to the development of the different factors that make up the uncertainty. The vertical axis represents the dimension of *Industry adoption* which also can range from low to high. We have chosen to create three what-if scenarios that are at the extreme ends of the dimensions that determine the possibilities of the future developments. Of course it is unlikely to expect the future developments to evolve according to these extremes without the dimensions influencing each other. But by

choosing the extremes for the creation of our what-if scenario we are better able to discover most of the possible risks and opportunities for the key actors.

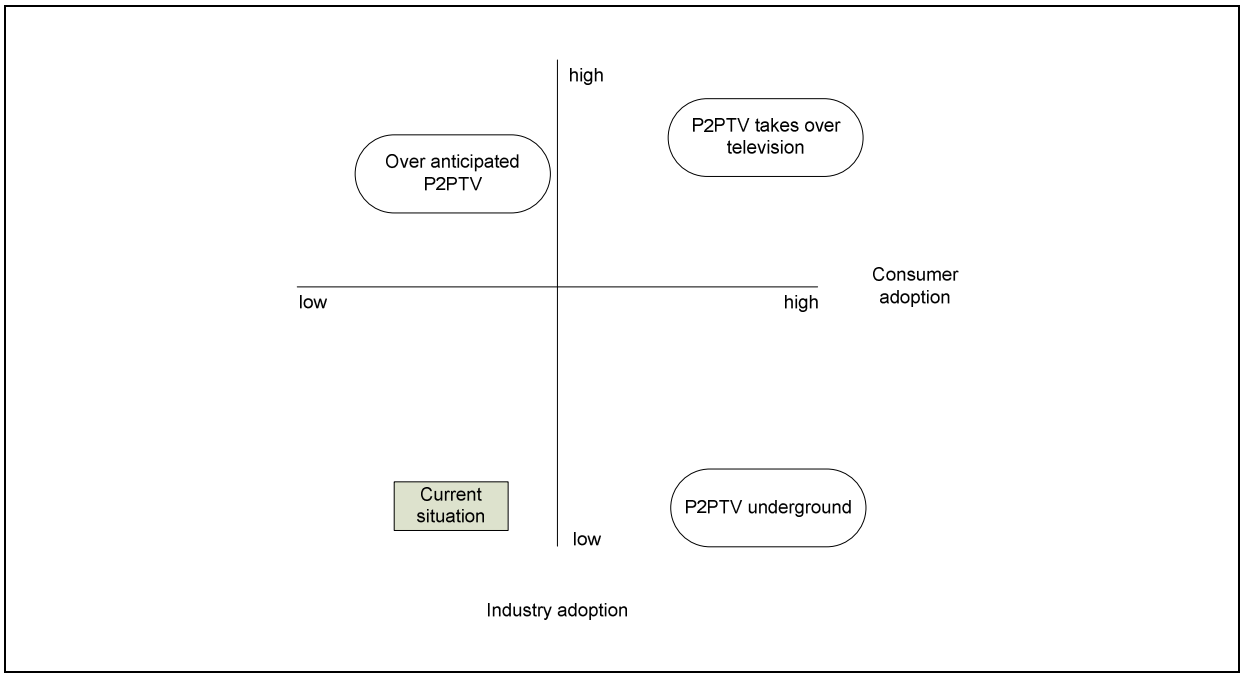


Figure 16: The what-if scenario logic pictured in a coordinate system

No what-if scenario will be formed in which the future develops itself so that both the consumer attitude as well as the industry attitude is negative, as this would mean that the P2PTV will not be used in any manner and therefore will have no impact on the television industry. The current situation indicates that at present the industry adoption is low. The consumer adoption at present is also still low, but the availability of a variety of content through existing P2PTV software applications indicate that the adoption is not nil. We have also pictured the current situation in the figure above.

P2PTV broadcasts can be watched on the PC computer screen, but with hardware advancements could be watched on the television set using a STB or build into the Internet TV. This is why the device manufacturers we discussed in Chapter 3 also come in to play in the what-if scenarios that we will be describing. In the different what-if scenarios we will be using the fact that P2PTV as distribution method can be viewed on multiple devices which too can influence the adoption. Lemstra et al. give an interesting view on this by stating that from the viewpoint of the content provider, in their case for mobile TV, the mobile network is 'just another distribution channel' (Lemstra et al., 2009). The same could partly be said for P2PTV, as this is just another distribution channel for the content, except that it's dependant on the internet for its functioning. We do however see P2PTV as a distribution channel separately from internet, even though it is dependent on the internet. Lemstra et al. introduce a value network for content provision in their research. We have elaborated on this by adding P2PTV and focussing it on the television industry. This gave us a steppingstone to picture and identify the distribution channels used to get the content to the consumer/viewer and which devices are used during the developments that we describe in the different what-if scenarios. The value network extended with P2PTV is shown in Figure 17. Even though this value network shows more detail on the different parties within the roles of actors we use throughout our research than the value chain we have described earlier, the roles stay the same. There are still the content generators, content aggregators, access networks and the viewer. The

device manufacturer is incorporated in this value network as well, so it can describe which devices could be used for the portrayal of the received content. In our research we do not see the device manufacturer as a part of the value chain, as they are not part of the circular flow of money and goods we have described (as the device is a onetime purchase), but the value network by Lemstra et al. does offer us a nice map that can serve as a handle in the coming analysis.

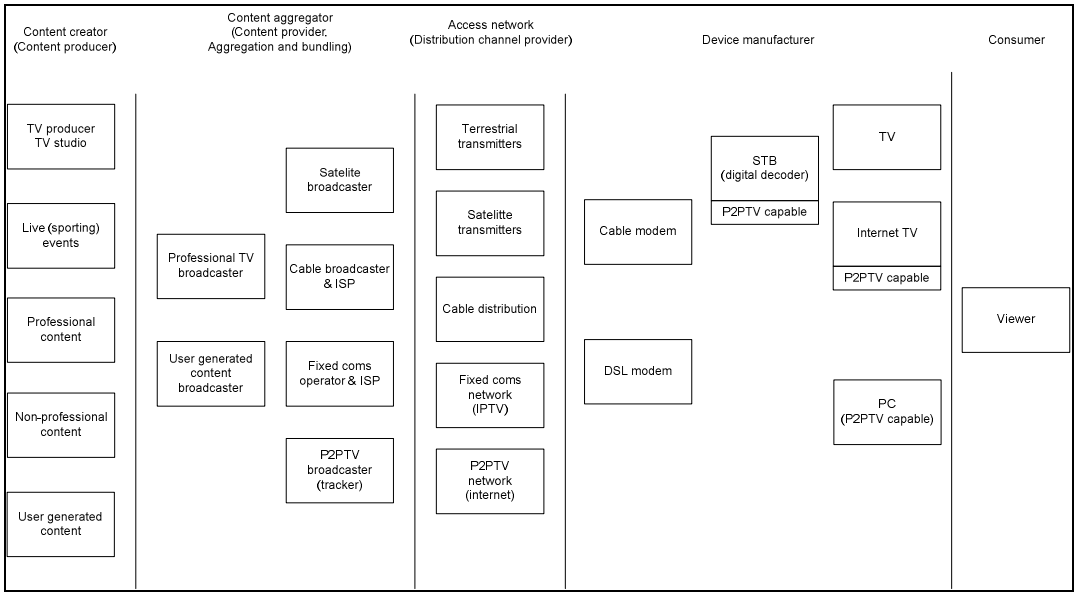


Figure 17: Value network of television content provision extended with P2PTV - Adapted from (Lemstra et al., 2009)

We will be using the map of the value network to address *specifically within every what-if scenario how and on what device* the content is possibly provided to the consumer according to the developments of that what-if scenario. In the map we can identify the different possible paths that the content follows from production to the viewer watching the content on a certain device. Per what-if scenario a figure will presented showing the value network in which the different possible paths that are used to get content from the creator to the viewer are colored gray and the ones that are not (or no longer) used are left blank.

In each what-if scenario we will sketch an idea on how the P2PTV technology is used by consumers and specific actors within the industry and how this affects the television business. During this the risks and opportunities for the key actors can be identified. If a certain risk or opportunity is exposed in multiple what-if scenarios, the likelihood of that risk or opportunity coming into play in the future is larger.

4.2.6 Characterization of the risks and opportunities

Like we encountered numerous times throughout this research, the risks and opportunities that can come from the use of P2PTV in the television industry can originate from different sources, i.e. changes in the roles of the key players in the value chain, the technical properties of the P2PTV technology and changes in the revenue models of the key supplying actors. In order to create a risk framework that adequately shows the distinction between the origin of the risks and opportunities and their influence on other changes, we need a way to characterize the different risks and opportunities.

In order to characterize the risks and opportunities that we will be identifying during our scenario based analysis of risks and opportunities, we will be characterizing them in different business domains. For this we were inspired by the STOF business model framework. The STOF model is a framework describing the four components of a business model. It was designed in 2003 (Faber et al., 2003) and has proven to be successful in the design of business models in many fields of business (Bouwman et al., 2008).

The STOF model consists of four domains; the Service domain, the Technology domain, the Organizational domain and the Financial domain (see Figure 18). Each of these domains handles with different aspects of the business model. These domains interact with each other and are affected by market dynamics, technological developments and regulation. The domains describe the following:

- The Service domain describes the value proposition of a company for specific customers in a particular market segment.
- The Technical domain handles about which technologies are used and how.
- The Organizational domain describes the value network that is needed for the delivery of the service offered in the business.
- The Financial domain describes all financial matters within the business, like revenue models, costs and pricing schemes.

These domains correspond adequately to the origins of the risks and opportunities that we will be identifying through the scenario based analysis of risks and opportunities where we see risks and opportunities coming from changes that P2PTV can implicate on key actors, in terms of changes in actor roles (organizational), changes in revenue models (financial) and the services offered to the consumer (service), by the different technical implications of the use of P2PTV (technical). That is why we will be using the four domains of the STOF model to characterize the risks and opportunities we will be identifying. We will be identifying within which business domain (service-, technical-, organization or financial domain) the risk or opportunity presents itself, i.e. in which business domain the source of the risk lies. As we characterize the risks and opportunities in this way we can also identify what influence this risk or opportunity has on other domains and which risks and opportunities this imposes within that domain. This should make for a clear characterization of the risks and opportunities we are identifying.

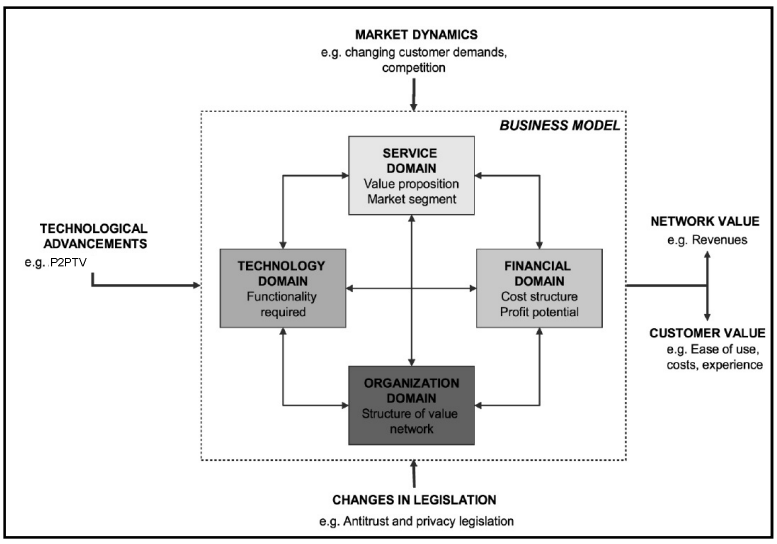


Figure 18: The STOF business model framework

4.3 Summary and risk framework design

In this chapter we addressed the definitions of risks and opportunities and the method of scenario based analysis of risks and opportunities. We have seen that every risk or opportunity has a certain impact for an actor and has a certain likelihood of coming in to play when the events would happen in one of the what-if scenarios. We will need to incorporate this in our risk framework.

We also explored the different possible future developments and identified two dimensions on which these future developments are dependent. From this we have created a what-if scenario logic that gives u a starting point for creating three different what-if scenarios that will be used for the scenario based analysis of risks and opportunities. We will also need to incorporate the three different what-if scenarios in the framework.

Also we have chosen a way to characterize every risk and opportunity by describing in which of the four business domains we discussed the risk or opportunity originates. This too must be incorporated in the framework.

In Figure 19 we give a schematic overview of the elements that we have identified that need to be incorporated in the risk framework we are designing. The gray blocks represent the risks and opportunities for the four key actors (horizontally) as we described at the end of the previous chapter, but extended with the possibility to address the impact and likelihood in the darker areas to the right of this. We will be describing three different what-if scenarios, so the risks and opportunities need to be presented per what-if scenario, which are represented by the three yellow elements in this schematic overview. Additionally, the four green elements in the schematic overview represent the four domains we have described for characterization of the risks and opportunities.

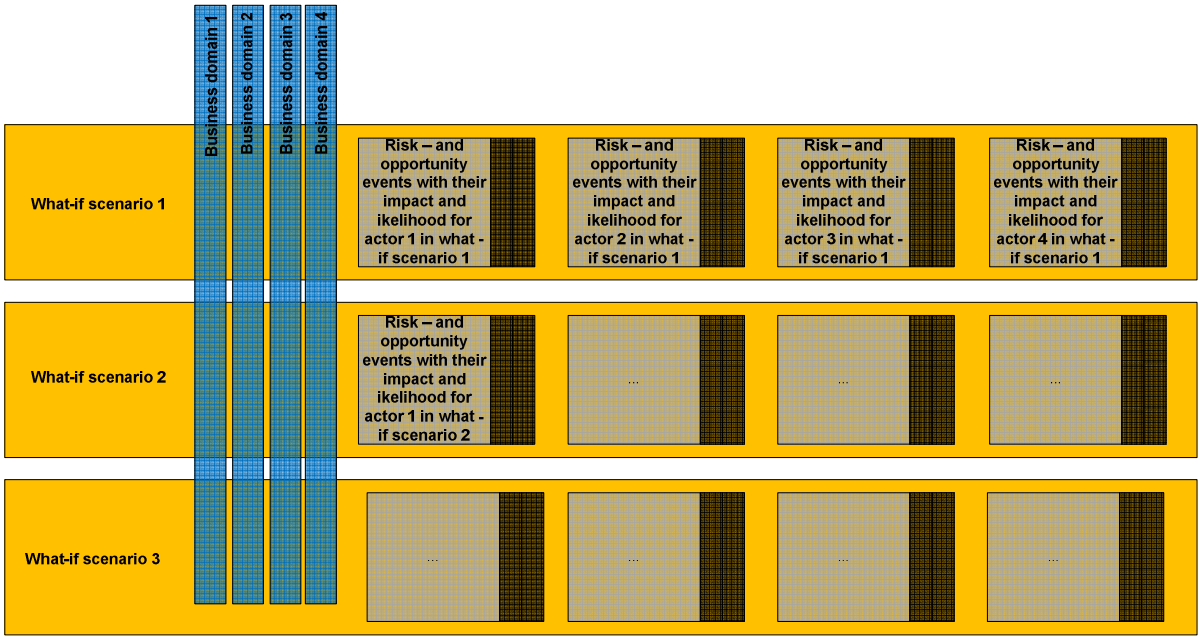


Figure 19: Schematic overview of elements in the risk framework

The actual design of the framework that will be filled with the risks and opportunities that will be identified in the scenario based analysis of risks and opportunities will be presented in the next chapter.

5 Risk framework design

Later on we will be identifying the risks and opportunities of P2PTV for the television industry. These risks and opportunities will be presented in the framework to fulfil the objective of this research, which is to design a risk framework that can be used for decision support for the actors within the television industry on the future developments of P2PTV. In this chapter we will describe how we have designed the framework, present the results of our design efforts and explain how it can be used by describing its functioning. The result of this chapter is an empty setup of the risk framework. In chapter 6 we will perform the scenario based analysis of risks and opportunities which provides the contents for the risk framework and that will result in the completed risk framework. In the Chapter 7 we will validate the framework with parties from actors from within the television industry as to whether the framework coincides with their views and opinions on P2PTV and its possible future risks after we have filled the framework with the findings of the scenario based analysis of risks and opportunities. It would have been preferred to have input from these parties during the framework design and in earlier stages of the research, but due to time constraints and the little availability of these parties it was chosen to first design the framework and afterwards validate it. The design of the framework was however supervised by two professionals from within the TMT department of Deloitte ERS.

5.1 Design

In order to design this framework we will be using the skills that are taught within the SEPAM course of the Delft University of Technology on model design. We combine these skills with an example of a framework that is used within the professional risk management environment of Deloitte ERS; the Risk Intelligence Map (RIM). The RIM is a very comprehensive hierarchical map showing the most common risks for enterprises divided per business unit. This map is not a strict or complete representation of all risks, but is used to spur thoughts and discussion on the subject of risk management. The RIM is not to be published outside of Deloitte's professional environment, but for exemplary reasons we have included an edited portion of the map in Appendix A – Edited portion of the Risk Intelligence Map (RIM).

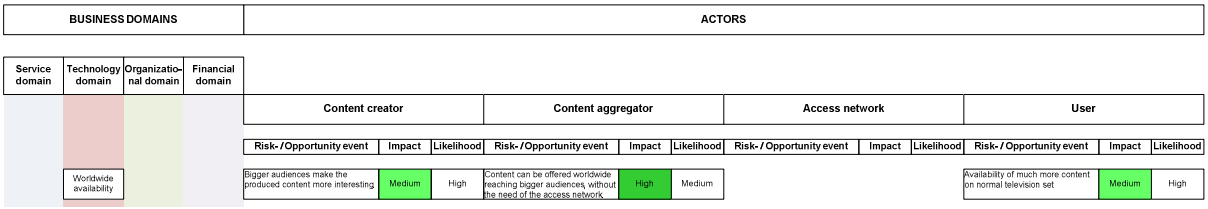
We will be using the hierarchical setup of the RIM, but instead of dividing the risks per business unit we will divide the risks and opportunities per actor as we will also do in our scenario based analysis of risks and opportunities by describing the risk- or opportunity events. We will also incorporate the impact and likelihood of the risk- or opportunity event within that what-if scenario (see the following figure).

Content creator			Content aggregator			Access network			User		
Risk- / Opportunity event	Impact	Likelihood	Risk- / Opportunity event	Impact	Likelihood	Risk- / Opportunity event	Impact	Likelihood	Risk- / Opportunity event	Impact	Likelihood

We extend the map with the characterization of the different risks and opportunities to the business domains that we have described to address in which they originate. That way the origin of the risk is viewable and the influence of the risk or opportunity has on other domains exposing risks or opportunities leading from them can be pictured within the model (see the following figure).

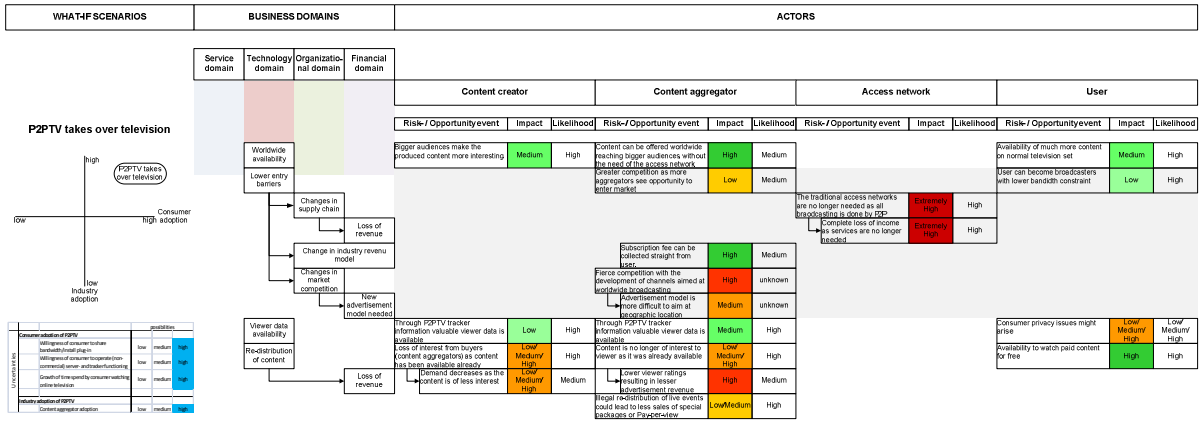
BUSINESS DOMAINS				ACTORS											
Service domain	Technology domain	Organizatio-nal domain	Financial domain	Content creator			Content aggregator			Access network			User		
				Risk- / Opportunity event	Impact	Likelihood	Risk- / Opportunity event	Impact	Likelihood	Risk- / Opportunity event	Impact	Likelihood	Risk- / Opportunity event	Impact	Likelihood

In our scenario based analysis of risks and opportunities we will encounter that the same change or possibility in one business domain can have risks or opportunities for multiple actors. Some changes even represent a risk for one or more parties, but an opportunity for others. This is why we have used the characterization by domains to be able to group a certain change or possibility in such a manner that we can represent it in our framework. Now as we examine the risks and opportunities in the form of presenting the risk- and opportunity events we will identify in the scenario based analysis of risks and opportunities we can identify from which domain a risk or opportunity originates and we can map the risks and opportunities that this has for each key actor into our risk framework (see the following figure).



From the partial picture above taken from the framework you can see a change in the Technology Domain called worldwide availability. On the same row per actor the risk or opportunity for every actor column on which this change has one. The height of the impact and likelihood is appointed with low/medium/high as this came forth from the risk analysis. The impact is colored from light red to dark red according to the height of the impact in case of a risk. It is colored from light green to dark green in case of an opportunity. In one special case, the impact is considered as *extremely high*, therefore colored completely dark red.

The risks and opportunities finally must also be mapped per what-if scenario. For that a final column is introduced on the most left side of the framework. In this column the three what-if scenario are presented according to their position within the dimensions-axis and with the description of the what-if scenarios according to the possible developments of the variables that make up the what-if scenario, dividing the framework horizontally in three different pieces divided by a black horizontal line (see the following figure).



The final result of the risk framework is included in this thesis as a foldable poster as Appendix C – Risk framework.

A final note that must be made is that when the P2PTV technology is being used for content distribution, no specific changes are made within the Service domain. As the Service domain

describes the value proposition of a company for specific customers in a particular market segment, we can say that the value of the industry is still to provide viewers with content for their information and entertainment needs. We have therefore provided one large description of the altered value proposition per what-if scenario.

5.2 Functioning and usability

First we will explain how to read the framework and then discuss its use for the key actors within the television industry that are facing decisions on P2PTV.

As we have discussed in the design section, the risk framework is a map consisting of multiple columns. The most left column, named *What-if scenarios*, describes the three what-if scenarios that we have created for the purposes of this research and divides the framework horizontally into three separate parts. The column next to that, named *Business domains*, consists of four columns representing the domains that we have used for the characterization of the risks and opportunities. The most right column, named *Actors*, is divided in four columns representing the key actors within the television industry; content creators, content aggregators, access networks and the users (or consumer or viewer).

The risks and opportunities that could expose themselves within the different what-if scenarios are placed within the rows on the level of the what-if scenario it was identified in. For every row a change within one of the domains is placed in the appropriate column within the Domains column. The risk or opportunity this change has on the different actors is then described per actor, along with its impact and likelihood, within the designated column(s) within the Actors column. The impact is colored from light red (low impact) to dark red (high impact) according to the height of the impact in case of a risk. It is colored from light green (low impact) to dark green (high impact) in case of an opportunity. This gives the user of the framework a more visual and one look overview of the proportion between risks and opportunities.

So how can this framework be used for decision support? The answer to this is that the framework can be used in several different ways;

1) The first possible use for the framework is for the actors to be more prepared towards the developments that P2PTV might have on the industry. When and if P2PTV will be adopted by the industry or the consumer, the different actors are able to use the map to examine which risks and opportunities the developments following from that can have for them. They can look up which what-if scenario resembles the true developments and from their look within their own column as actor to identify which risks and opportunities will come in to play, their possible impact and likelihood and the domain from which the risks originate. This information can be used to support decision making and form a strategy in their risk management activities. This heads up will supply them with the ability to research the risks in more detail and try to find the appropriate strategy on how to deal with these risks. For opportunities this gives the actor the chance to exploit them to the fullest. They will also have insight in how the same or other risks and opportunities affect the other actors, which can be helpful in the formation of business strategy and the formation of alliances within the value network.

2) Alternatively the framework can be used by actors within the industry to assess whether or not they favor future developments in the direction that one of the what-if scenarios represents. If an actor oversees the different risks and opportunities that the future represents, he can research and decide if the opportunities outweigh the risks, he can examine how certain risks that are in that what-if scenario can be mitigated and how the opportunities can be maximally exploited. And with this information decide to try and steer the future towards the situation that is described in that what-if scenario, if he has the ability to do this. This is of course a big prerequisite as in all value networks many actors are connected and usually do not have the ability to single handedly steer the industry towards a certain future. However with the information they can obtain through the use of the risk framework, they can be more conscious about what future is favorable in their eyes.
3) Besides these uses for actors already involved in the television industry, the framework may be of interest to new entrants in the television industry. In the Netherlands for instance several parties recently have battled to get airtime on one of the three channels maintained by the public broadcasting network NPO (Nederlandse Publieke Omroep). For this they are required to obtain a certain number of members. With the arrival of and by using P2PTV all these parties could at least have the possibility to broadcast their content online at low costs. If these broadcast then can be received only on computer systems or also through Internet TV's with P2PTV capabilities, depends on the future developments of P2PTV and the television industry we have come across in this research. These possible new entrants could make use of this framework in identifying pitfalls for the set-up of their channel and possible even try to influence the industry towards favorable future developments for reaching their goals.

The risk framework could be useful for others besides the uses we have mentioned here and that are less connected to the television industry. But as this research was performed with the intention to focus on the television industry and because of the interests of Deloitte ERS that have supervised this research we will not identify more uses then these.

We now have a design for the risk framework. The scenario based analysis of risks and opportunities that will be performed in the next chapter will provide us with the contents for the risk framework, i.e. the risks and opportunities in the form of risk- or opportunity events for the key actors in different possible futures.

6 Scenario based analysis of risks and opportunities

In this chapter the different what-if scenarios will be presented based on the what-if scenario logic and assumptions we discussed in Chapter 4. The three possible futures that that we have presented according to the two specified dimensions (Consumer adoption and Industry adoption) will be used as a steppingstone to create the what-if scenarios. From this exploration of the possible futures of P2PTV for the television industry we will be identifying the different risks and opportunities for the key actors in the industry. This is what this scenario based analysis of risks and opportunities aims to do.

We will be describing the possible change of roles of the key actors in the different what-if scenarios. We will also take a closer look at the ways P2PTV can be used for the creation of revenue and how this would be achieved within the what-if scenarios that we will be describing. We will try to identify what revenue models are or could be in place in the value creation from content delivery.

Because this research is not aimed at finding the most suitable possible business model for the exploitation of the P2PTV technique, but on identifying the risks and opportunities of the technique on the television industry in order to create a risk framework, we will not go too much into depth on the creation and validation of existing and future business models. We will take the existing revenue models and elaborate on the changes that would occur in these revenue models within the different what-if scenarios in order to be able to use these findings in the risk framework we are working towards.

We will for each what-if scenario start by describing why and how the future of P2PTV in the television industry takes shape and then address the changes in roles for the key actors and the changes in revenue models for the key supplying actors.

Because the listing of all risks and opportunities doesn't make for a pleasant reading experience, in the result paragraph of this chapter we refer to *Appendix B - Identification and characterization of risks and opportunities* for a full listing of all risks and opportunities for the key actors in the different what-if scenario.

6.1 What-if scenario: P2PTV takes over television

			possibilities		
Dimensions	**Consumer adoption of P2PTV**				
		Willingness of consumer to share bandwidth/install plug-in	low	medium	high
		Willingness of consumer to operate (non-commercial) server- and tracker functioning	low	medium	high
		Growth of time spend by consumer watching online television	low	medium	high
	Industry adoption of P2PTV				
		Content aggregator adoption	low	medium	high

Let's keep in mind one of the assumptions that we have made on future developments, i.e. that the standard consumer broadband speeds (with western civilization running upfront in this) start to grow to 100 Mbps upstream and 10 Mbps downstream. In the coming two years the first connections with this capacity are installed. By the end of the five years these connection speeds

have become standard. With such capacity the distribution of HD quality real-time video over P2PTV networks is easily possible.

In this what-if scenario we suppose a starting point with high consumer adoption, i.e. the *users* indeed do spend more time watching television online over time. *In exchange to be able to watch television content on their computer*, the users are willing to install the needed plug-in and are willing to share their bandwidth. So in this what-if scenario there is a clear demand for P2PTV. Research would be needed to determine whether there truly is demand for this at present, but in this what-if scenario we research the effects of P2PTV on the industry if there would be demand.

In light of the demand from users to watch real-time television content online (several) broadcasters*, i.e. content aggregators*, may decide that they want to use P2PTV technologies for the distribution of their content to the (growing amount of) users that watch television online, enabling their programming to become available simultaneously through the access networks that are in place now and online. In other words the industry adoption we defined earlier is initially high. Why would they do this? To offer a secondary service to their "customers", the viewers, alongside the existing distribution methods. Instead of only offering VoD systems for watching back programs, viewers could then follow the programming in real-time online. This way they might reach a larger audience with the same content, which would mean their advertisement time would become more valuable. They could also decide to use P2PTV systems for the distribution of live (sporting) events that always attract much attention, e.g. soccer games, Olympics and music events (concerts and festivals). The P2PTV technique could be used for extensive coverage with multiple channels, which is not possible on the access networks that are used now. The investments to achieve the availability of their content through P2PTV systems are relatively low as we have seen from the technical review. But several steps needs to be taken; the content will need to become available in a suitable format for distribution through a P2PTV network, servers capable of the server- and tracker function need to be installed (either in-house or outsourced through one of the organizations offering P2PTV that we described) and the internet address of the stream needs to be made public. The set-up costs as well as the distribution bandwidth needed for P2PTV distribution are low. The steps needed to introduce P2PTV would lead to a first set of risks, as mistakes could be made in the technical setup, which could to lead malfunctioning of the service, i.e. no or bad service. These mistakes could lead to dissatisfied customers.

In this what-if scenario the different content aggregators that offer their content through P2PTV systems will maintain their own portal with the internet addresses to the channels they offer online. Presumably websites will start with collecting these internet addresses to give users a complete overview, as this is already happening now with the current VoD solutions. They will also need to comply with the location restrictions placed on the aggregators laid down by regulators, which means they cannot broadcast their content outside the regions they have acquired the license for. Therefore they will need to implement measures for this in the tracker server, like IP-range filtering.

Also the fact that the consumer is willing to perform the server- and tracker function within P2PTV networks does enlarge the likelihood of the illegal re-distribution of content we described in Chapter 2. Already communities are forming that are offering the internet addresses to many broadcasts that are (illegally re-) distributed by users, e.g. www.myp2p.eu. The content could then become available outside the filtered IP-range. Users in communities have no commercial incentives for performing

the server- and tracker function, but this is often the case in these types of communities. In online communities the members thrive on pride and recognition of peers, like for instance in Open Source Software communities (Ye and Kishida, 2003).

So in the *initial two years* of this what-if scenario we suppose that the demand for the ability to watch P2PTV grows as the sophisticated consumers use and watch television online using P2PTV. Thus far little has changed in the value chain of the current television industry, as the main portion of television content distribution is still done through the access networks that are used today. But alongside the growth of P2PTV watched online the technology of devices used for the watching of television advances. Because of the high demand for P2PTV, device manufacturers might be inclined to incorporate the P2PTV technology in their newest devices. Possibly the Internet TV with P2PTV capabilities or the STB's used for digital reception that have P2PTV capabilities will be introduced, due to the demand for P2PTV from the user. Device manufacturers seem to be inclined to incorporate emerging technologies, as for instance at present there are Internet TVs available that are capable of playing the highly popular YouTube videos. The incorporation of P2PTV in hardware devices opens up the gate towards P2PTV becoming mainstream, because the standard consumer could get to easily receive P2PTV broadcasts as well.

The introduction of P2PTV may lower the entry barriers for broadcasting as we have discussed earlier. Now that P2PTV has reached the living room with P2PTV capable hardware devices, the market is open for the niche channels we too discussed earlier. But extra channels mean more competition for the existing aggregators.

The introduction of P2PTV capable hardware devices would mean that all *consumers* that are connected to the internet are now (once in possession of a P2PTV capable hardware device) capable of connecting their television set to the internet and receiving HD quality television content with more choice than before. The user experience of watching television on a P2PTV network is still a matter of research and is of course dependent on several factors, like channel switching speed (the amount time that is needed for the channel to change) and QoS. And in relation to that the benefit the consumer experiences from a greater choice of channels. *But the opportunity arises for the consumer to no longer have the need for an additional access network for the reception of television, but use the internet for all their communication services.* The term triple play has been introduced for several years now, but in these setups where all communications services (TV, telephone and internet) are provided by one single provider, the services are always divided in the sense that the consumer pays per service. In the what-if scenario we describe here the only service required by the consumer to be able to receive television and internet would be the internet service. Telephony for some time has been possible over internet as well, e.g. Skype. This would mean only internet services are needed in able to receive all the traditional telecommunication services. So they would no longer feel the need for the subscription to a specific access network now is use for television. And this would ultimately mean lower costs for the consumer. And the standard consumer is always interested in lower costs, as they are price sensitive.

Seeing the fact that the greatest part of the consumers no longer feel the need for a subscription to one of the access networks that are used today, as they are already able to receive television over the internet with P2PTV, the *content aggregator* during the last three years of this what-if scenario may no longer feel the need to offer their content through the access networks used today,

implicitly rendering these access networks no longer useful for the distribution of television content. The transition of a telecommunications service switching from one technology to another is not unthinkable. In recent history we have seen an example of this with telephony switching from circuit switching to packet switching, also rendering the existing circuit switching facilities useless.

The developments described above would pose a problem for the *access networks that are used in the current television industry*. Once they would sense a decrease in subscriptions, they might try to win back the consumer. But what are they able to offer to the consumer? They too might be inclined to offer more channels, but for that they will also need to pay more *carriage fees*, consequently leading to higher costs, which will be needed to be charged to the subscriber. Since in this what-if scenario the P2PTV technology has become easily accessible to the sophisticated and standard consumer alike, the access networks in the market today will have difficulty competing and are likely to become redundant for the delivery of television services.

If the users should decide to unsubscribe from the television services offered by the access network that are available at this time, *the content aggregator too would miss revenue from carriage fees*. They then have two options. Either to implement another type of payment system from the user directly to the content aggregator or to drop the revenue from carriage fees and turn primarily to the revenue from advertisement. At this time 80% of the generated revenue by the content aggregators comes from advertising, so quantitative research should be done whether or not a system of television content distribution completely through P2PTV would be more profitable. Otherwise a payment method is needed for the aggregators to directly receive subscription fees from the consumer. A possibility is that *users can precisely decide to which channels they want to subscribe*, creating their own package of television channels available to them.

Furthermore the issue of illegal re-distribution of content becomes more complex. Theoretically all television content worldwide could easily become available on every television set (with P2PTV capabilities) connected to the internet. However in order to receive P2PTV content on television the hardware needs to know internet addresses of the different channels. It is very likely that the communities that are formed distributing and enabling user based broadcasts will find ways to let users control the channels, i.e. the internet addresses to P2PTV broadcasts. The actors in the industry will try to have the regulator counter this kind of behaviour. For this they will be starting to lobby at regional governments in order to find appropriate measures against this behaviour. Thus far it is difficult to stop this behaviour, but if measures were found that counter illegal re-distribution, this would drastically lower the impact of the risks originating from these technical possibilities for the user.

Furthermore, the high adoption of P2PTV by the consumer also means that their activeness in the use of P2PTV grows. *Consumers will become active providers of content, broadcasting their own channels*. They are able to reach the standard consumers with their re-distributed broadcast, but also with user-generated content (UGC).

Even though the rise in interest for UGC and online video is evident (McQuivey, 2007) and the fact that user can become broadcasters themselves increasing the availability of UGC, the fact remains that for the provision of high quality, consistent content for TV broadcasting purposes the business will always be reliant on the professional *content creators* for the provision of content (Mingione, 2005). This means the content creator will always be able to create revenue from their creative

efforts. For the *content creator* in this what-if scenario little changes in the manner that revenue is created; the same processes will be used for revenue creation and their produced content will still be acquired by the content aggregators. The possibility of the content creators distributing their own content, i.e. starting their own channels is not considered for reasons we mentioned earlier. We will however address this possibility in our reflections. But the possibility of high quality digital reception of video content through P2PTV that has become possible in this what-if scenario could jeopardize the amount of revenue that comes from the sale of DVD's.

In the following figure we have represented the possible paths of the content from production to user consumption according to and by the end of five year of developments we have described in this what-if scenario. We discussed in this what-if scenario a situation in which all the distribution of real-time television content takes place through P2PTV systems. From there the content crosses the internet to be received at either TV screen or PC.

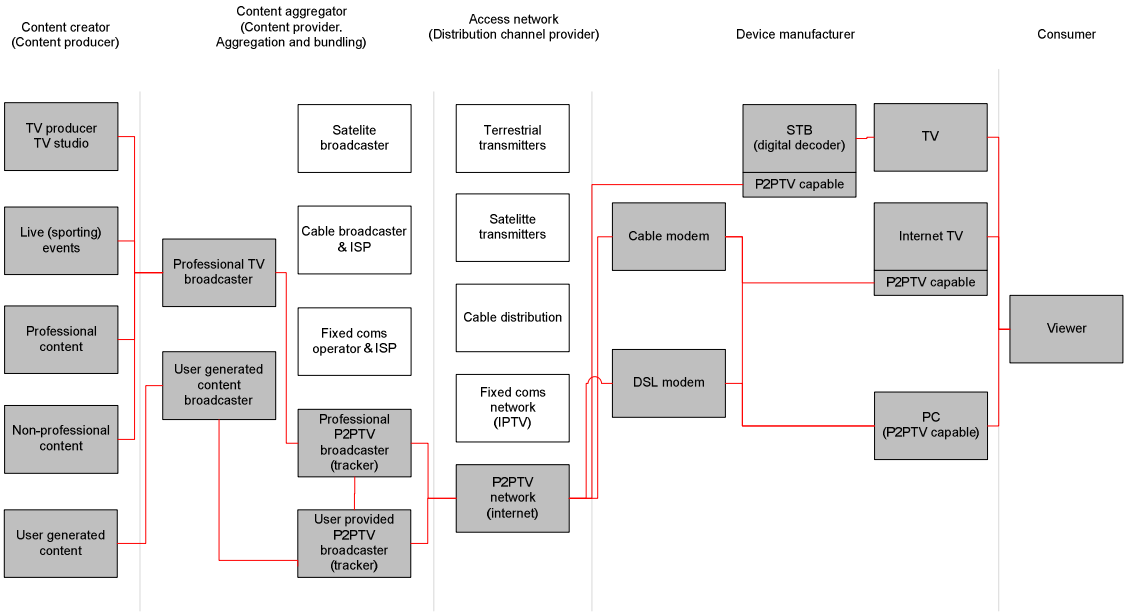


Figure 20: Value network for content provision at the end of what-if scenario "P2PTV takes over television"

6.1.1 Effects of this what-if scenario on the key actors

Now that we have described the what-if scenario "P2PTV takes over television" we can evaluate the effects the developments in this what-if scenario might have on the roles of the key actors and the revenue models of the key supplying actors.

The biggest change we can identify is the possible distribution of television content by using P2PTV networks over internet as access network, instead of through the access networks that are available at this time. Figure 21 represents the supply chain as it would become in this situation. In comparison to the value chain we presented earlier we see that the access network is no longer part of the value chain and the distribution is done by the content aggregator using P2PTV.

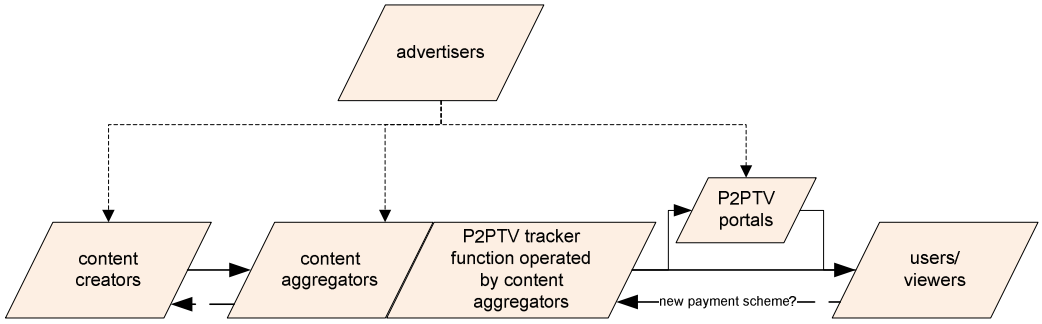


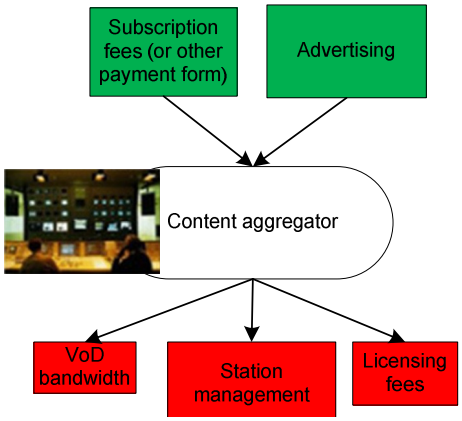
Figure 21: Value chain possible at the end of what-if scenario "P2PTV takes over television"

Content creator

The technical possibility of illegal re-distribution of content could cause financial losses for the *content creator* as a result of lesser interest for their productions. The likelihood of this is low however as the content creators assets are too important for television. Matters of copyright infringement could arise. Another risk that does appear is the risk of revenue loss due to the technical possibility of digital recording that could cause the sale of DVD's to drop. DVD sales have become a considerable portion of the total revenue, so this development could have some impact for the content creators in this what-if scenario. The role of the content creator will not change in this what-if scenario.

Content aggregator

For the *content aggregator* the revenue model would change according to Figure 22 where we can see the following changes; instead of collecting carriage fees from access networks, they may choose to receive subscription fees directly from the consumer. This makes this source of revenue relatively larger than it was, but this depends on the number of subscribers the aggregator has to its channel. Considerably more administration is needed for managing this and the station management costs go up in order to run this administration. The revenue from advertisement time can become more valuable as larger audiences may be reached. Other opportunities lie in the fact that through the distribution of internet using the P2PTV characteristic tracker server much better data is available on viewer numbers, viewing time and demography. Information that is valuable for advertisement purposes.



Revenue source	Resources	Process
Subscription fees (or other payment form)	Licensed content and station management	The licensed content is purchased and assembled into a station programming by the station management and sold to the consumers directly. The distribution to the user is done by P2PTV.
Advertising - real time	Advertisement timeslots in the programming	In the programming several timeslots have been kept open for advertsing. These timeslots are sold to advertisement agencies in which they can promote their client's products.
Advertising - VoD	Licensed content available online	If the licensed content is placed online there are several techniques for advertising when a user wants to view the content.

Figure 22: Content aggregator revenue model possible in what-if scenario "P2PTV takes over"

The content aggregator can reap most benefits from P2PTV's possibilities as we have described in this what-if scenario, but also faces the most risks. The technical possibility of worldwide distribution at relatively low costs means they can possibly reach all users with an internet connection. This causes a shift in the organizational and financial domains as the aggregator will be able to directly bill the viewer. Furthermore the availability of viewer data can enhance greater viewer targeting, meaning better advertisement income, especially with the audience growing. All this is quite likely to occur within this what-if scenario and the impact is rather big, as the amount of revenue created can drastically increase and cost are cut.

However taking distribution in own hands (or through the services of P2PTV system providers) means a number of risks. Redistribution of content is likely to occur and could lead to loss in revenue as consumers receive the content without paying. Content from special packages and Pay-per-view could be target for illegal redistribution as this is already happening now in small amounts. Another great risk lies in the collection of the "subscription fees", which is now handled by the access networks. Aggregators will need to find payment methods fit for their content distribution. Online payments have found their way on the internet and as they are starting to become standard seem the way to go here. But wrong choices in these matters could lead to missing revenue. In organizational perspective we could see a change in the competition growing as the P2PTV offers low entry barriers. And then there is the important matter of reputation loss, which could occur from several technical implications. The QoS must be upheld in order to keep customers satisfied and in order to achieve this one must rely on the technical setup.

Access network

This what-if scenario would lead to nothing but risks for the access networks that are in the market at this time, with the greatest risk of all that of becoming obsolete for the distribution of television content as the content is by the end of this what-if scenario no longer distributed through these access networks.

User

For the users or consumers of television the adaptation of P2PTV as in this what-if scenario would lead almost only to positive developments. More content becomes available, more internal

competition should lead to high quality standards and the users can become more than passive consumers. There is even the possibility of viewing paid content illegally for free if one desires to let themselves in with this.

One issue that opposes these opportunities is the risk of privacy being invaded. With tracker functions monitoring the connectivity of all viewers for the distribution, this information could also be used to track ones moves. What you (or your household) has been watching and for how long can and probably will be recorded, as this information is of value for advertisement purposes like we described earlier. The impact of this on the user depends on his attitude towards the use of this information. The user's attitude towards this influences the use of P2PTV and with that the consumer adoption. In this what-if scenario we have presumed that the user does not feel an impact of this and is thus low.

6.2 What-if scenario: Over anticipated P2PTV

			possibilities		
Dimensions	**Consumer adoption of P2PTV**				
		Willingness of consumer to share bandwidth/install plug-in	low	medium	high
		Willingness of consumer to operate (non-commercial) server- and tracker functioning	low	medium	high
		Growth of time spend by consumer watching online television	low	medium	high
	Industry adoption of P2PTV				
		Content aggregator adoption	low	medium	high

In this what-if scenario we research the developments that would occur if content aggregators were to start using P2PTV, but the demand for the offered services would be low. We suppose that (several) content aggregators have decided to anticipate on the predicted growth of the popularity of watching television online. They want to broadcast their content real-time simultaneously on the access networks that are used today and online in an attempt to reach larger audiences and P2PTV gives them the opportunity to do that with relatively low investments and low distribution costs. Therefore the initial monetary risks of the investment are negligible, but the developments in this situation may lead to other risks and opportunities.

Once content aggregators have implemented the systems necessary for P2PTV, the consumer adoption falls short of the expectation of the aggregators as the growth of time that people spend watching television online is low. Also within the group of users that does watch television online, there is resistance towards the needed software installation and the fact that they need to share their upload capacity.

Because of the low demand and usage of P2PTV in this situation device manufacturers will not be inclined to incorporate P2PTV technology in their upcoming devices, meaning that no devices that are P2PTV capable will hit the consumer market.

With the television content available through P2PTV networks from the content aggreagtors, the same characteristics are in place as in the previous what-if scenario, i.e. worldwide availability,

possibilities for illegal re-distribution, P2PTV viewer data availability and easy digital recording for the user. But with little users utilizing the offered services the implications of these characteristics are lower or non relevant. As there will be no formation of communities distributing and enabling user based broadcasts there will be little impact of the re-distribution of the televised content. And with little users viewing the broadcasts through P2PTV systems the viewer data availability is of little interest to the content aggregators.

The content aggregators might want to try to pull the consumer demand and with that the consumer adaptation, in essence pulling the developments towards what is described in the first what-if scenario. They would need to change the mindset of the consumer by heavy marketing of the benefits for the user to have access to television content online.

Essentially this what-if scenario describes a situation in which by the end of the what-if scenario the user keeps watching television offered through the access networks that are in the market today and the availability of P2PTV by the content aggregators that do offer their programming through P2PTV techniques stays a secondary service to the consumer, which is used very little.

Again we picture the possible paths of the content from production to user according to the developments we have described in this what-if scenario. In this what-if scenario we see little changes from the current situation. A professional P2PTV broadcaster is in place, but is little used as we have discussed in the what-if scenario. No P2PTV capable devices are in the market for displaying P2PTV broadcasts on a TV screen.

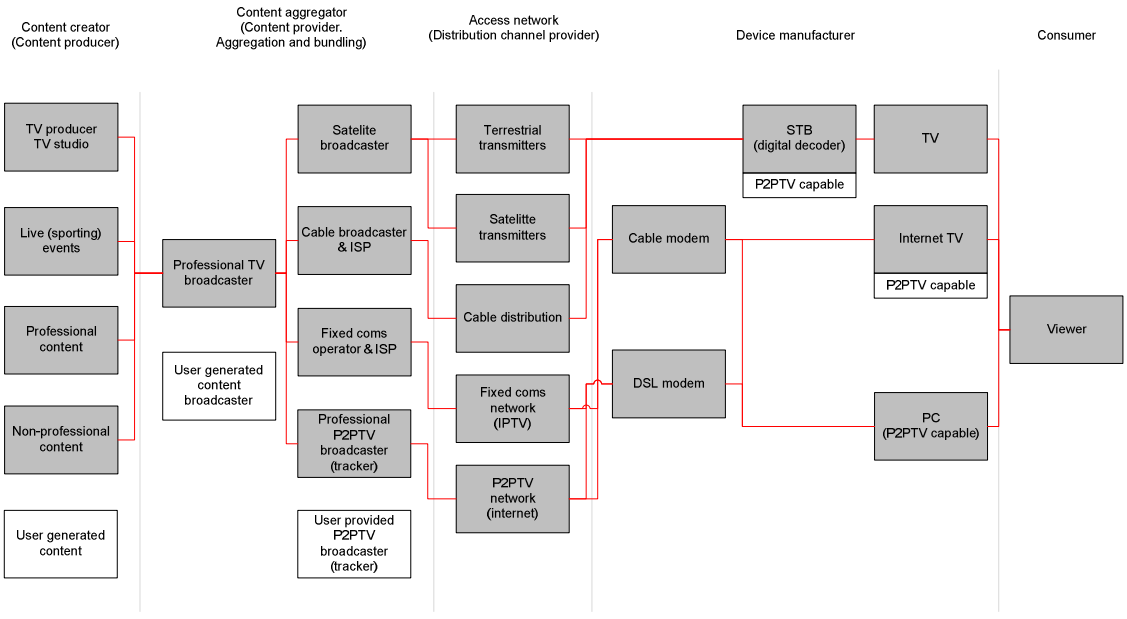


Figure 23: Value network for content provision at the end of what-if scenario "Over anticipated P2PTV"

6.2.1 Effects of this what-if scenario on the key actors

Now that we have described the what-if scenario "Over anticipated P2PTV" we can evaluate the effects the developments in this what-if scenario might have on the roles of the key actors and the revenue models of the key supplying actors.

As the consumers do not adopt the use of P2PTV for watching television, the broadcast methods stay the same. The possibility of watching television through P2PTV offered by the content aggregators does not impose high costs on them as we have seen that the costs of P2PTV are very low. Also advertising income and division will stay the same.

Content creator

This what-if scenario resembles the previous what-if scenario in most of the risks and opportunities for the content creator as real-time television content is offered through the access networks that are available at this time and the P2PTV systems simultaneously. But as little users make use of the P2PTV technology (low consumer adoption), the likelihood and impact of this leading to loss of revenue is minimal. Also the threat of shrinking DVD sales is smaller, for the same reasons.

Content aggregator

Also for the content aggregators this what-if scenario resembles much of the same risks and opportunities as the previous what-if scenario. When content aggregators have highly adopted the P2PTV technology for their broadcasting, the consumer adoption is so little that both systems simultaneously offer the content to the user. This means that bigger audiences are possible and better viewer data becomes available, but only for the part of the viewers that actually use P2PTV for watching television in their personal computers. This diminishes the impact that these opportunities can have.

The risks as well stay much the same, but with lesser impact and likelihood. The reception of carriage fees might become somewhat of an issue if the content aggregators would primarily decide to offer online television through P2PTV for free, giving users the possibility to watch their content for free if they unsubscribe from the access network they use. Since the consumer adoption is low this will not be very many users, so the impact will not be too great. Reputation loss issues also become much smaller as the dependency for television content is not focussed at their own distribution, but still mainly on the access networks used today as this is the case now, as P2PTV is seen as secondary service. Advertisement revenue will pretty much stay as they are, not threatening the revenue creation process.

Access networks

The role of the access networks does not change in this what-if scenario, as the biggest part of the users still watches television trough the access networks that are available currently.

The loss of revenue from illegally re-distributed content is low and will not impact this actor more than it does at this time.

User

As the consumer adoption is low, this what-if scenario entails little risks and opportunities for the user. The few users that do use the P2PTV for watching online live events or television reap some of the benefits of this service, but for the users in general the impact is low. Because of the low consumer adoption of P2PTV, very few users will change their role from passive to active user.

6.3 What-if scenario: P2PTV underground

			possibilities		
Dimensions	**Consumer adoption of P2PTV**				
		Willingness of consumer to share bandwidth/install plug-in	low	medium	high
		Willingness of consumer to operate (non-commercial) server- and tracker functioning	low	medium	high
		Growth of time spend by consumer watching online television	low	medium	high
	Industry adoption of P2PTV				
		Content aggregator adoption	low	medium	high

In this what-if scenario we research the situation that would develop when the industry, i.e. the content aggregators, do not adopt P2PTV, but in the coming five years the consumer adoption of P2PTV grows strongly.

At present we already see small communities forming of users that provide the server- and tracker functions within P2PTV networks that usually illegally re-distribute content. This is evident from portals existing like myp2p.eu, but also by the fact that in the currently available P2PTV applications many channels are already registered by the users of these applications.

As the growth of time spend by consumers watching television online grows rapidly in the coming five years, and these consumers are very willing to operate the server- and tracker functioning, we will see the number of users in P2PTV communities grows fast during that time. The users will again have no commercial incentives for joining this community. But it is in human's nature that the ability to watch content not available through the access networks that are available today or that normally needs to be paid for in exchange for sharing their upload capacity is very interesting. This will off course be mainly the sophisticated users.

With the growing number of users adopting P2PTV we can expect more and more illegal re-distribution of television content as the communities expand and more users perform the server- and tracker functioning. This would eventually lead to a situation in which pretty much all television content available worldwide through regional access networks will also be available through P2PTV systems provided by users.

In time the actors in the industry will be affected by the fact that users are able to receive content that is supposed to be paid for and miss revenue because of this. They will address this issue with the regulator, i.e. the government, in searching possibilities to stop the re-distribution of television content. As we discussed earlier it will be difficult to have the regulator filter or block P2PTV traffic as this is not necessarily used for illegal activities. They will try to find ways by which the users that perform the server- and tracker functioning of P2PTV channels that distribute illegally can be penalized, for instance with a suspension of their internet subscription with the ISP or fines.

The impact of these activities depends on the number of user that adopt P2PTV. Here is where the device used for watching the content becomes an important issue. From sophisticated users we can to some extent expect that they will occasionally watch P2PTV broadcasts on their computer screen. But for the average, standard, consumer this is out of the question. This is why many involved in the

television industry believe that the TV screen, not the computer screen, is the screen of choice and the remote control, not a keyboard and mouse, the control method of choice in order to reach most users. But just recently we see several initiatives (mainly available in Northern America) by independent set-top box (STB) providers that enable the user to download or progressively stream or do peer-to-peer file sharing in order to get the video into the home and on the TV screen. Examples are Roku and Netflix, TiVo, Vudu, AppleTV and others, which all use the internet for the provision of video to consumer's TV screens. If the adoption of P2PTV is such as we have described in this what-if scenario it would not be unthinkable for such an independent STB provider to provide a device that is suitable for P2PTV and connects to the TV screen? This might be farfetched as all content in this what-if scenario would be distributed by users, but such a development would possibly enlarge the impact of all risks and opportunities we can identify for the key actors.

In the following figure we again picture the possible paths from content creation to content consumption by the user. The paths that currently exist stay in place. But in this what-if scenario we see that the distribution of content can be done by user provided P2PTV broadcasters. This might even find its way to the TV screen using an STB with P2PTV capabilities.

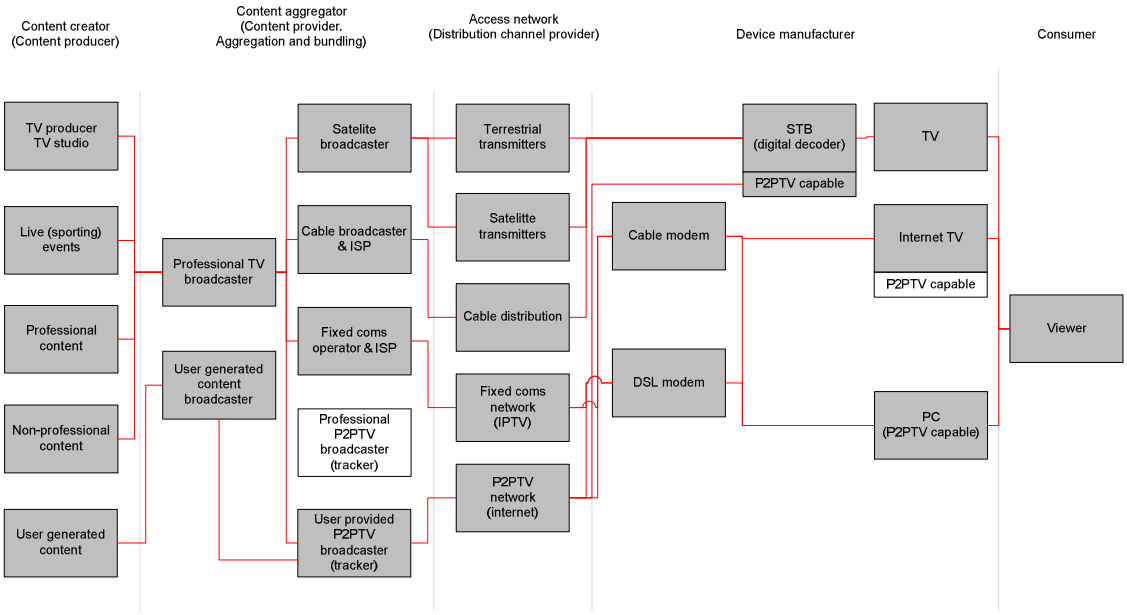


Figure 24: Value network for content provision at the end of what-if scenario "P2PTV underground"

6.3.1 Effects of this what-if scenario on the key actors

Now that we have described the what-if scenario "Over anticipated P2PTV" we can evaluate the effects the developments in this what-if scenario might have on the roles of the key actors and the revenue models of the key supplying actors.

The developments of this what-if scenario have little changes on the roles of the key actors as we discussed. We did see however that the consumer's role could change from passive to active. This activeness of the consumer can have several changes on the revenue for the key actors. These changes are not so much on the revenue models itself, but more on the amount of revenue generated.

Content creator

In the described situation in which the industry, i.e. the content aggregators, do not adopt the P2PTV technology but the consumer does, none of the key supplying actors in the television industry benefit from the opportunities that could be there if they were to use P2PTV. But several risks can be identified for the key supplying actors. For the content creator the illegal distribution of their productions might render them less valuable as the interest from aggregators for the content might drop in several regions with viewers already having had the content available to them online. But as the content aggregators will always have demand for productions, the impact of this will remain low.

We earlier discussed the growing importance of DVD sales as revenue for the content creators. The possibility of the direct recording to the computer system of high quality video content (instead of the need to download these recordings later on) could jeopardize the DVD sales and so lead to *loss of revenue from less DVD sales*. In the what-if scenario described here, with growing numbers of users in P2PTV communities, the likelihood of this risk depends mainly on the consumers' attitude towards the gadget factor of owning the official media, i.e. the factory produced DVD boxes.

Content aggregator

Earlier we established that the main portion of the revenue created by the content aggregator comes from advertisement income. The worth of the advertisement time that content aggregators have to offer to advertisement companies is based on the number of viewers and the knowledge of the demographics of the viewers. In a situation in which users are able to watch television over P2PTV systems (illegally or not) that are not set up by the industry itself (meaning the tracker function is provided by users) these numbers are more difficult to come by. This could lead to a *decrease in the worth of the advertisement time* and hence to the *decrease of revenue from advertisement time for the content aggregator*.

This re-distribution of content is especially disadvantageous for the content aggregators. Their acquired content might become less attractive to viewers as the content might already have been available online through a P2PTV system, which could lead to lower viewer ratings. It could especially hurt them as paid content in the form of special channel packages or Pay-per-View broadcast will be heavily watched for free by users online, leading to substantial loss of revenue. As we described in this what-if scenario the likelihood of the content becoming available through P2PTV systems is high and with that the likelihood of lower sales of these broadcasts is high as well.

Access networks

In this what-if scenario the access network's only concern will be the re-distribution of special paid channels and Pay-per-View broadcasts content. The ability for the consumer to watch these types of broadcasts online through P2PTV for free could lead to a decrease in subscriptions and with that loss of revenue as the access networks also receive revenue for carrying those channels. In the described what-if scenario the likelihood of the re-distribution of these types of broadcasts seems high.

User

The user could benefit from several opportunities in the what-if scenario described. First of all they can become broadcasters themselves, with the possibility of reaching all other users connected to

the internet with their own broadcasts. The re-distribution we have seen as risk for several actors is in fact an opportunity for the user to be able to watch all paid content for free. The likelihood of users watching content that is supposed to be paid for, for free, depends on the mindset of the user towards this. Also they would need to accept the fact that this content would then only be available to watch this content on a PC.

6.4 Results of the scenario based analysis of risks and opportunities

From the three what-if scenarios we have described we are able to identify the risks and opportunities for the different key actors in the three what-if scenarios. We have identified the risks and opportunities by analyzing and researching the what-if scenarios and effects the developments could have for the key actors and distinguished a large number of risks and opportunities.

During the scenario based analysis of risks and opportunities we also address from which domain the risks or opportunity originates (service-, technical-, organization- or financial domain) and their influence on issues within other domains as we discussed in the previous chapters. We will also be assessing the impact of the risks and opportunities on the key actors and likelihood of the risks and opportunities coming in to play in that specific what-if scenario. For determining the risks and opportunities in the what-if scenarios we created, we have gained insight in how risk identification on future developments is done within the professional environment of Deloitte ERS. The identification of risks and opportunities is mainly based on systematically determining the effects on the actors of every future event and every change future developments can have as a result. We have trained in systemically assessing risks and opportunities by assisting in a project that Deloitte ERS has executed for one of their clients. This does mean the findings are the result of our views on the risks and opportunities and their impacts and likelihoods. As the identification of risks and opportunities is based on personal views we will validate the results afterwards.

In the scenario based analysis of risks and opportunities we systematically list the different risk- and opportunity events for the key actors coming from every change in one of the business domains. We have determined the impact of every risk or opportunity by deciding to what extent we expect the event to negatively or positively affect the actor's ability to reach his goals. The likelihood of the risks and opportunities coming in to play in the different what-if scenarios was decided on by looking at factors we based that what-if scenario on and our expectation of the event happening according to these factors.

In order for these risks and opportunities to be usable as input for the risk framework we have listed all risks and opportunities with the domain they originate from, a brief description and their impact and likelihood described. As this resulted in a rather large list we have included this list as *Appendix B - Identification and characterization of risks and opportunities*. The appendix contains the result in which we describe every identified risk or opportunity in a standard format so that it can be used as the contents of the risk framework.

After that we have entered the different risks and opportunities in the risk framework. The result of this is a framework that is too big to present in this thesis on a single page, thus we have inserted the complete framework as a foldable poster as *Appendix C – Risk framework*.

6.5 Conclusion on the scenario based analysis of risks and opportunities

Summarizing the possible changes in both actor roles and revenue models we can clearly see the importance of the consumer adoption. In the two what-if scenario where the consumer adoption is high ("P2PTV takes over" and "P2PTV underground") we see (big) changes in the roles of the key actors, as well as in their revenue models or the amount of revenue created. Where in the what-if scenario "P2PTV takes over television" we see big changes in roles and with that in the revenue models. And in the what-if scenario "P2PTV underground" we see only the change of the consumers' role from passive to active, but this can have big impact on the revenue creation. In the what-if scenario "Over anticipated P2PTV" where the consumer adoption is low, we see that little changes would occur in the roles of the key actors and the revenue models. Table 4 summarizes these findings.

Table 4: Effects of the different what-if scenarios on actor roles and revenue (models) summarized

P2PTV takes over			BIG	changes in actor roles
consumer adoption:	high	→		
industry adoption:	high		BIG	changes in revenue (models)
Over anticipated P2PTV			NO	changes in actor roles
consumer adoption:	low	→		
industry adoption:	high		NO	changes in revenue (models)
P2PTV underground			SMALL	changes in actor roles
consumer adoption:	high	→		
industry adoption:	low		BIG	changes in revenue (models)

Overall this risk analysis clearly shows that the consumer adoption is of great interest for the *impact* of the risks and opportunities of P2PTV for the television industry. With low consumer adoption we identify little impact and likelihood of the risks, but also little to none of the advantages for the key supplying actors that we see in what-if scenarios with high consumer adoption.

High consumer adoption of the P2PTV technique, without industry adoption, shows us nothing but risks for the key supplying actors in the supply chain. With issues ranging from futile (low impact) to quite serious (high impact) especially for the content aggregators and the access networks available currently. The user only benefits from high adoption of the P2PTV technique.

7 Framework validation

The risk framework we have designed and presented in the previous chapter and that can be found in *Appendix C – Risk framework* is founded on extensive literature research and several exploratory and constructive research methods. But in order to be more positive about the correctness of the identified risks and opportunities and the underlying causal relations and thoughts we will need to validate the result of the risk framework. By performing a validation we try to establish evidence that provides a degree of assurance that the result of research, the risk framework, accomplishes its intended use. This will be done by means of an expert validation in which we discuss the results of our research with expert professionals from within the current television industry. When we have done this we can more confident about the use and effectiveness of the framework.

The expert validation is performed in two parts. At first we have validated the framework with two professionals from within the TMT department of Deloitte ERS Amstelveen. These professionals have also been supervising this research from within Deloitte and because of that are very up to date with the subject of P2PTV in the television industry, as well have great knowledge of professional risk management. Secondly we have performed a validation with an external party with proficient experience within the television and media industry. We have found Mr. Van der Kwast willing to aid in our research and validate the risk framework with his expertise from within the television and media industry. Mr. Van der Kwast has 12 years of experience in the business. Since 1996 he has worked for seven years at the RTL Media group. The RTL media group is currently broadcasting four channels on the Dutch television. After that he worked five years at the content aggregator Talpa. Two years ago he founded his own company called Operation Media B.V. Operation Media does a wide variety of assignments and has to date done a couple of big assignments for different clients, some of which within the television industry.

7.1 Framework validation: first part

During the validation with the two supervisors from Deloitte ERS we have discussed all research and backgrounds that have led up to the framework as it is. After that we discussed a great portion of the risks and opportunities and its impact and likelihood in detail. Both agreed with the risks and opportunities that we have identified and the reasoning behind them.

One point of attention they did mention was the presence of risks with high impact but low likelihood. These kinds of risks usually have major negative impact should they fire, but the likelihood of this happening being very minimal. In terms of dealing with these types of risks they remark that with the likelihood being minimal already, choices will need to be made on whether or not invests need to be made in possibly lowering the impact. Together we concurred that even with very minimal likelihood of some risks, they need to be contained within the framework as this is supposed to give a concise overview of all risks (and opportunities).

7.2 Framework validation: second part

For the validation with Mr. Van der Kwast we prepared several presentation slides containing the most important figures from our research. First of all we introduced the P2PTV technology to him, by explaining its functioning and the possibilities. After that we discussed whether our views on the functioning and the division of roles within the current television industry are correct. From there we assessed the different what-if scenarios and the dimensions that could be responsible for the different possible futures of P2PTV in the television industry. After introducing the domains we have

used for the characterization of the risks and opportunities we continued with validating the risks and opportunities from P2PTV in the different what-if scenarios and their consequences for the different actors (Kwast, April 24 2009).

For starters Mr. Van der Kwast had some, but no extensive, knowledge of the P2PTV technique. On learning of the precise functioning of P2PTV he was instantly interested in the possibilities P2PTV offers from a media perspective. Because of his experience in the current television industry he knows how revenue is created in the industry and is able to determine whether the risk framework does indeed serve as an appropriate decision support tool that can be used by actors in the industry in supporting them on decisions about the future of P2PTV within the industry.

Mr. Van der Kwast concurred with the actors we have identified in our research and the roles and resources they hold. He could find himself in the what-if scenarios as they are presented, but on a personal note he remarked that he thinks the functioning of the current television industry and the use of the current access networks is anchored in our society so much that de does not believe the introduction of television distributed over the internet, if it were using P2PTV techniques or other systems, will happen within the suggested five year time span. However he too agreed that it is not impossible and the what-if scenario “P2PTV takes over television” is needed for a complete overview of the risks and opportunities that can come from the use of P2PTV in different possible futures. The revenue models for the different actors are correct according to his insights. As being a long time employee within a content aggregator, he emphasized the importance of advertisement within the business, especially for the content aggregator.

For validating the risks and opportunities identified within this research we took Mr. Van der Kwast through our mindset within every what-if scenario, pointing out every risk and opportunity we identified. From that point we started an open discussion in which we brainstormed about the developments in the different what-if scenarios and the possible opportunities and risks. For every identified risk or opportunity we checked if it was present within the framework. No risks or opportunities that were not already present within the framework were identified in this brainstorming session.

8 Conclusions

In this research we have set out to design a risk framework, representing the risks and opportunities that P2PTV can have for the television industry, which can be used as a decision support tool. In order to design the risk framework we have formulated several research questions and presented a research approach with the main research question being; What are the risks and opportunities that the emerging P2PTV technology can impose on the key actors in the current television industry?

The P2PTV technology is and will be capable of distributing HD-quality video content over the internet making use of the user's upload capacity, at low costs and with guaranteed QoS, bringing possible opportunities, but also possible risks for the actors in the television industry. We concluded that there are four key actors in the television industry; the content creator, the content aggregator, the access network and the user. These are the key actors as the roles that these actors fulfill are at this time imperative for the processes from content production to the content consumption by the viewer. For what we call the key supplying actors (content creator, content aggregator and access network) we also researched their revenue models to identify how revenue is created in the industry at this time.

We indentify that P2PTV can influence the developments within the television industry even if the industry would not use P2PTV as a distribution method, because the consumers are able to misuse the P2PTV technology by re-distributing television content over the internet through P2PTV networks. We decided on two dimensions that determine the possible futures of P2PTV in the television industry, which are the *Consumer adoption* of P2PTV and the *Industry adoption* of P2PTV. Based on these dimension we created a what-if scenario logic for the creation of three what-if scenarios:

- P2PTV takes over television; in which we describe a future in which both the industry adoption of P2PTV and the consumer adoption of P2PTV are high.
- Over anticipated P2PTV; in which we describe a future in which the industry adoption is high, i.e. content aggregators start using P2PTV for television content distribution. But the consumer adoption turns out to be low.
- P2PTV underground; in which we describe a future in which the industry is low, i.e. content aggregators do not use P2PTV for content distribution. The technology is however highly adopted by the consumer in this what-if scenario.

Before creating the three what-if scenarios and performing a scenario based analysis of risks and opportunities we designed the risk framework based on the elements we concluded that are needed to present the risks and opportunities in a risk framework. This resulted in a framework, which will be exemplified later on this conclusion, consisting of the following elements:

- The actors; in order to describe to whom of the four key actors the risk or opportunity is addressed
- The business domains; in order to present from which business domain used for risk- and opportunity characterization the risks or opportunity originates
- The three what-if scenarios; in order to present the risks and opportunities per actor in the different possible futures
- The risks and opportunities that are identified per actor in each what-if scenario, along with the business domain it originates and its likelihood and impact.

We created the three what-if scenarios and for every one of them identified the effects the developments we describe in them have one the key actors. The performed scenario based analysis of risks and opportunities on the created what-if scenario results in a listing of the identified risks and opportunities for the key actors per what-if scenario, with the risk's or opportunity's impact and likelihood described. This listing can be found in Appendix B - Identification and characterization of risks and opportunities.

The result of the scenario based analysis of risks and opportunities forms the contents for the risk framework. The complete risk framework is presented as a foldable poster in Appendix C – Risk framework due to its size, but in this conclusion we will exemplify the way it should be read using a schematic overview of the risk framework and a small example taken from the risk framework. Figure 25 presents a schematic overview of the risk framework that shows how the needed elements are positioned.

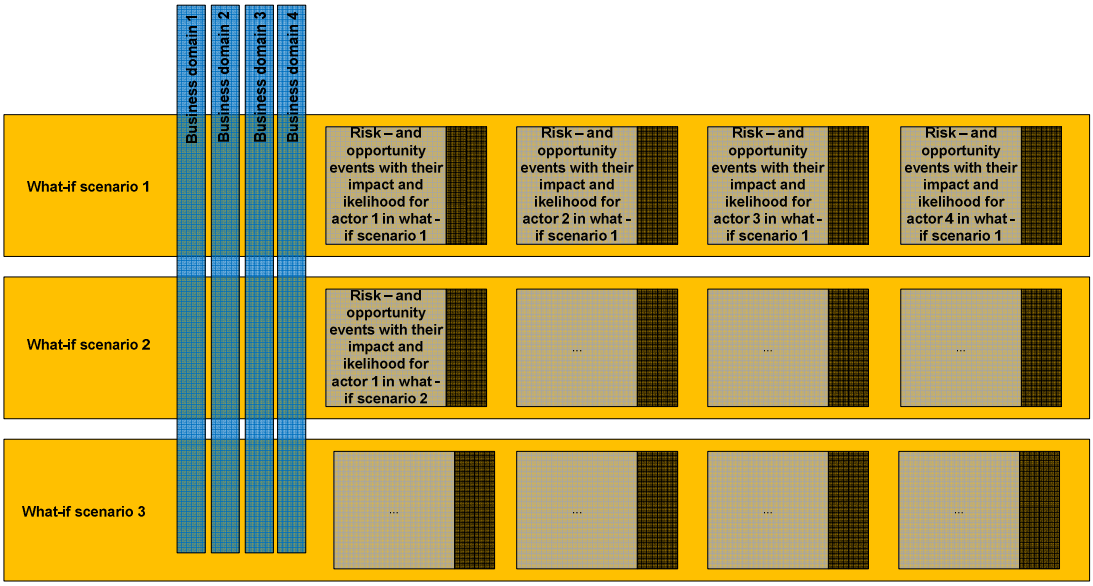


Figure 25: Schematic overview of the risk framework

In the selection taken from the risk framework pictured in Figure 26 we describe the risk- or opportunity events for two key actors coming from a change in the technology business domain named worldwide availability.

BUSINESS DOMAINS				ACTORS					
Service domain	Technology domain	Organizatio-nal domain	Financial domain	Content creator			Content aggregator		
				Risk- / Opportunity event	Impact	Likelihood	Risk- / Opportunity event	Impact	Likelihood
	Worldwide availability			Bigger audiences make the produced content more interesting.	Medium	High	Content can be offered worldwide reaching bigger audiences, without the need of the access network.	High	Medium

Figure 26: Selected portion taken from the risk framework

Worldwide availability indicates the fact that television content could be broadcasted worldwide at the same time from a single source by using P2PTV (according to the developments in one of the what-if scenarios). This change brings, amongst others, an opportunity for both the content creator

and the content aggregator. For the content creator the opportunity event is described as the event that bigger audiences can be reached by a single broadcast by the content aggregator, the produced content can become more interesting for sale. This event has medium impact and high likelihood. For the content aggregator the opportunity event is described as the possibility to offer the content worldwide and so enabling the reach of bigger audiences. The impact of this for the content aggregator is decided as high and the likelihood medium. For the full listing of the risks and opportunities and a description of and reasoning on the risk- and opportunity events, impact and likelihood, we refer to Appendix B of this thesis.

So how can this framework be used for decision support? We conclude that the framework can be used in several different ways as a decision support tool;

1) The first possible use of our framework is for the actors within the industry to be more prepared towards the effects that the developments of P2PTV might have on the industry. When and if P2PTV will be adopted by the industry or the consumer, the different actors are able to use the framework to examine which risks and opportunities these developments can have for them. They can look up which what-if scenario resembles the true developments and identify which risks and opportunities will come in to play for them or other actors, their possible impact and likelihood and the domain from which the risks originate. This information can be used to support decision making and form a strategy in their risk management activities.
2) Alternatively the framework can be used by actors within the industry to assess whether or not they favor future developments in the direction that one of the what-if scenarios represents. If an actor oversees the different risks and opportunities that the future represents, he can research and decide if the opportunities outweigh the risks, how risks that are in that what-if scenario can be mitigated and how the opportunities can be maximally exploited. And, if he has the ability to do this, with this information decide to steer the future towards the developments described in that what-if scenario.
3) Besides these uses for actors already involved in the television industry, the framework can also be of interest to new entrants. With the arrival and usage of P2PTV parties that do not have the funding or market potential of commercial channels could easily broadcast their content at low costs. The way these broadcast can be received, if this is only possible on computer systems or also through Internet TV's, depends on the future developments of P2PTV and the television industry we have come across in this research. These possible new entrants could make use of this framework in identifying pitfalls for the set-up of their channel and possibly even try to influence the industry towards favorable future developments.

An observation that we can make from this research is that P2PTV could possibly have massive impact on the television industry and on the way that television content is distributed in the future. We can conclude that the consumer adoption is of great importance to the developments of P2PTV on the television industry. The possible risk with the highest impact we identify is that for the current access networks in the future described by the what-if scenario P2PTV takes over television. In this situation there is a possibility that their services are no longer in demand for the delivery and distribution of television content, rendering their services useless for this purpose. The likelihood of

this is very debatable and difficult to predict, but nonetheless something worth for this actor of being conscious about.

It seems that if the industry does not adopt the P2PTV technology this leads only to risks. This is true, but at this time the consumer adoption is low and the impact of these risks depends on the consumer adoption. It is challenging to predict the consumer adoption of P2PTV in a situation where there is no industry adoption, but it would be wise for the television industry to keep a close eye on the developments of P2PTV among internet users in the future. Therefore this framework could be of interest to actors in the television industry even if the industry itself does not decide to adopt the P2PTV technology.

One of the assumptions we make, that ISP's do not and cannot by law limit or filter internet traffic in the near future, is one of much possible debate. This assumption relates to the government's role of the regulator, which defines the rules and regulations within the television and the telecommunications industry. The regulators role in the P2PTV debate is in our opinion limited as we assume that limiting or filtering of P2PTV traffic by ISP's is not possible by law due to privacy issues and the fact that the P2PTV technology is not necessarily used for illegal activities. But with possible growing numbers of misuse of the P2PTV for illegal activities the industry will turn to the regulator for finding ways to uphold the law and means will needed to be found to do this. The ISP's behaviour is crucial as the upload capacity of the viewers is needed for the distribution through P2PTV networks. Would the limiting or filtering of P2PTV internet traffic by ISP's become possible as countermeasure for illegal re-distribution, than the use of P2PTV is completely lost.

The future of P2PTV within the television industry is a complex and uncertain matter, but whatever the future brings, P2PTV can impose both risks and opportunities for the actors in the television industry. With the design of the risk framework we try to offer insight in these risks and opportunities for the key actors.

One final conclusion we can make is that within the value chain of the television industry one thing will never change – content will need to be created, so a content creator is needed. And there will also be someone needed to consume the content, which is the viewer. However and on what device the content reaches the viewer - be it directly, be it through ten other actors, on cell phones, or on plasma TV screens, be it by air, or through P2PTV networks – can change, but these two actors are always crucial in the television industry.

9 Reflection

9.1 Outcomes and personal expectations

The results of our research efforts is a comprehensive risk framework that contains the risks and opportunities and is validated by the supervising company Deloitte ERS and one external party in the form of an interview with Mr. Van der Kwast from Operation Media B.V. Thanks to the efforts of the graduation committee and the Deloitte supervisors a solid research approach was created and there was little need to stray from that during the course of our research.

Of course during our research we have formed our own ideas on the way future and the use of P2PTV within the television will unfold itself. Personally we expect that the adoption and use of P2PTV by consumers will grow rapidly in the coming years. This due to the fact that the knowledge of the consumer about the possibility to follow live (sporting) events or foreign television channels online and the ease of which this can be done is growing. Besides this we do not expect the television industry to pick up the P2PTV technology in the near future. This in our minds means the near future will develop towards the what-if scenario “P2PTV underground” we have defined, with several of the risks identified there firing. From that point the industry will start to take action, either mitigating the risks, adopting the P2PTV technologies or adopting in another way to these developments. We must emphasize though that this is purely our personal expectation and that this is not based on any predictive statistics as we have not gone into that in our research.

9.2 Research limitations

One aspect that in our opinion would have made for a more thorough understanding of the effects that internet technologies like P2PTV can have on the television industry was to have interviews with knowledgeable representatives of every actor up front and afterwards with the same representatives to validate the outcomes of the research. This way the information gathered through literature and other exploratory research could be supported by their knowledge. Unfortunately due to time constraints and the difficulty of finding representatives able and willing to cooperate proved not to be possible.

This means that at this point we have little knowledge on the status of how actors within the industry are aware and thinking about the P2PTV technology. Luckily the people at Deloitte have several clients within the television industry from different actor roles and have to date never had any job request relating P2PTV. This gives us a clue on the status of P2PTV within the industry, but does not rule out that they are not aware.

Another point of attention is the fact that this is a qualitative research on the risks and opportunities. Of course for any actor within the television industry it would be of great interest of knowing just how big the impact of the risks and opportunities in terms of dollars and cents and what the approximate odds of the likelihood of not only the different risks and opportunities but also the different what-if scenarios are. However as we discussed in the introduction this research was set up to be a qualitative research, rather than a quantitative. As such this is not really a research shortcoming, but more of a personal disappointment from the fact that we ourselves are curious about this.

9.3 Further research and recommendations

Following the fact that this is a qualitative study, we consider quantitative studies the main proposal for further research. The insights of this research and the resulting risk framework could well serve as a basis for more quantitative studies about the impact of P2PTV in monetary sense. With the risks and opportunities, and its underlying thoughts, causalities and reasoning presented by our research, one could start to research the amounts of revenue (from advertising, fees and so on) and costs and the possible changes of these amounts due to P2PTV in the situations we have defined in our what-if scenarios. We have identified the ability to reduce the costs of broadcasting by P2PTV. But it would be of great interest to research the amount of cost reduction in comparison to the expenses of the risks.

Another issue that this research enables is the testing of P2PTV by the actors within the television industry for their content delivery. As we described many research has been done on the technical aspects of P2PTV and have found that the technology does enable the feasible distribution of HD content with the mentioned advantages. Thus far these researches have to our knowledge not interested the industry in using P2PTV. Our research might make it clear to them why this would be a good idea to do this. Another research that would be helpful in discovering the likelihood of the created what-if scenarios would be market research into the demand of P2PTV from the consumer's viewpoint.

We recommend to all actors within the television industry to embark in the further research we mention here. This starts of course with acknowledging and understanding the possible impact that P2PTV might have, which is our very first recommendation. We thus recommend all actors within the industry to keep an eye on the developments of the consumers and the other actors within the industry to see in the direction of which what-if scenario the future is evolving.

Besides that we recommend every actor to assess at present what his thoughts and views on the risks and opportunities we have presented for them in our framework are. And from there decide whether or not they see it fit to start further research on this.

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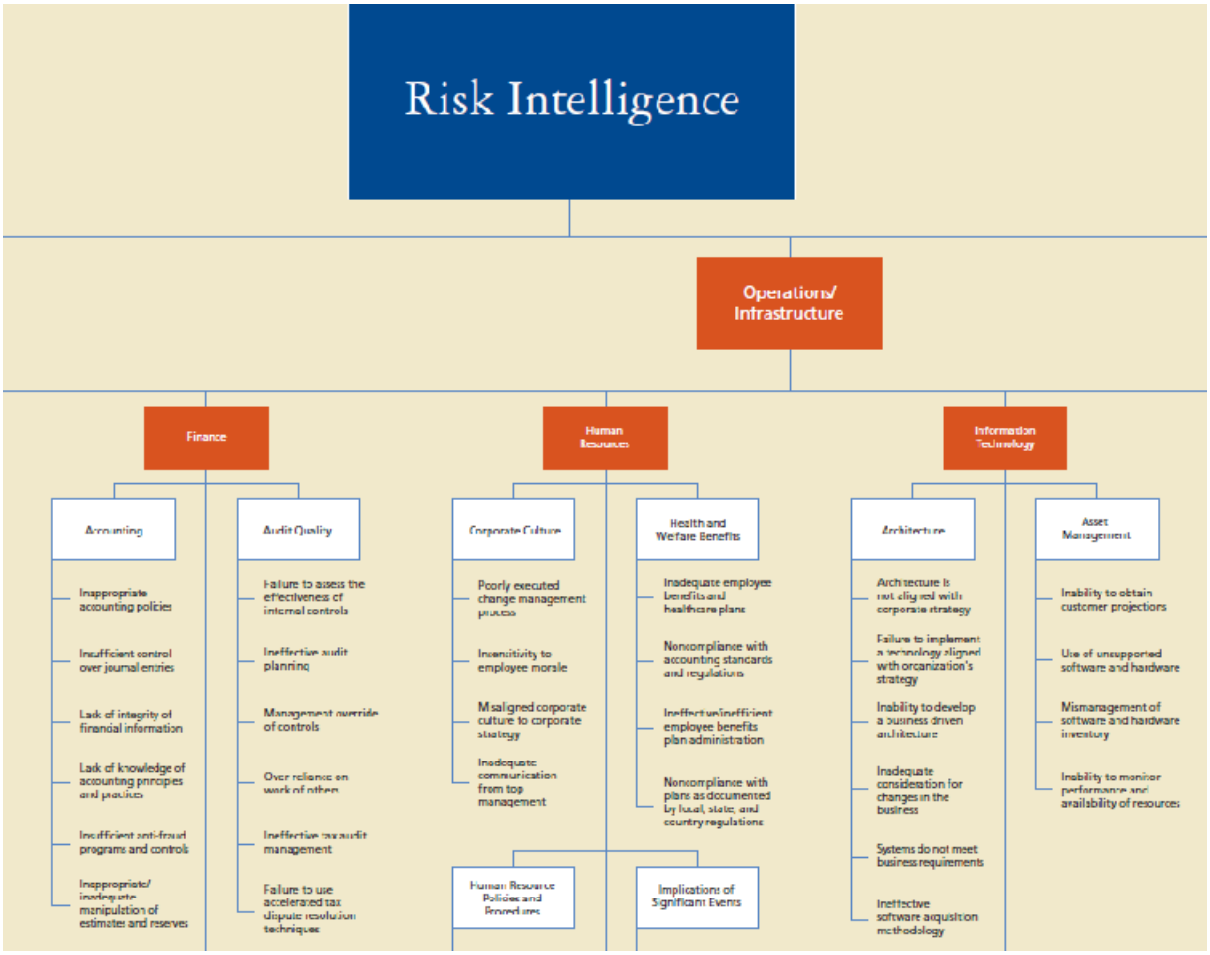
11 Appendix A – Edited portion of the Risk Intelligence Map (RIM) by Deloitte



12 Appendix B - Identification and characterization of risks and opportunities

This appendix presents the risks and opportunities we identify through the scenario based analysis of risks and opportunities for which we created the what-if scenarios in Chapter 6. For every risk and opportunity can identify we will first state in which of the four domains (service-, technical-, organizational- or financial) that we have used for characterization it originates and the name we have given to the it. Then we will briefly describe the risk or opportunity, its possible impact and why, and the likelihood of the risk or opportunity within that what-if scenario. We will present these risks in the following format:

X: risk name – risk description – impact – likelihood

The *X* represents the first letter of the domain we have used for characterization.

WHAT-IF SCENARIO: **P2PTV takes over**

ACTOR: **Content creator**

1. T: Worldwide availability – P2PTV gives content aggregators the opportunity to broadcast the content that the content creators have produced worldwide. This means bigger audiences are possible. This could make the produced content more interesting for advertising purposes – Worldwide availability is of course good for content creators business, but as they are still hired for the production of content, the impact of this opportunity is medium – As it is quite probable that larger audiences can be reached, the content becomes more interesting, so the likelihood of this happening is high.
2. T: Viewer data availability – The tracker is able to accurately record the exact number of viewers at any given time. This is most valuable for advertisement purposes – Advertisement revenue for creators commonly consists of product placement. Popularity of content, determining the value of advertisement, can be measured in other ways too, so impact is low – As all users watch TV using P2PTV this information will most likely be used
3. T: Re-distribution of content – As content could become available worldwide, content might become less interesting for the aggregators as it was already broadcasted – Depending on the number of viewers re-distributing and viewing these broadcasts the impact could range from low to high – The likelihood of illegal re-distribution is existing, but hard to determine.
4. F: Loss of revenue – As the demand decreases for content from re-distribution, this could lead to loss of revenue – The impact is dependent on the amount of re-distribution – The likelihood to is dependent on this
5. O: Copyright infringement – Unlicensed re-distribution would mean the copyrights of the produced content would be infringed – The impact of this is again dependent on the amount of re-distribution – The likelihood too is dependent on this
6. T: Digital recording – P2PTV broadcasting in HD quality would make digital recording very easy, possible leading to decreasing DVD sales – DVD sales are becoming a growing portion of the content creators revenue, the impact of this could be circumstantial – The likelihood is there too, but the gadget-factor of owning the true DVD's could compensate this
7. F: Loss of revenue – The decrease in DVD sales could lead to loss of revenue – Impact and likelihood are the same as the risk of digital recording

Actor: **Content aggregator**

8. T: Worldwide availability – For the content aggregator the fact worldwide availability means they can expand their audience. They could use multiple audio tracks and selectable subtitles for different regions if needed – This makes a big impact on the business activities as the target group expands greatly – The likelihood of this is disputable, therefore medium
9. T: Lower entry barriers – More competition possible – Impact and likelihood discussed in '11. changes in market competition'
10. O & F: Changes in industry revenue model – With the exclusion of the current access networks from the supply chain, as the technical advancements mean changes in the supply chain, the subscription fees can be collected directly from the viewers – This means higher revenue, thus can have a high impact – The likelihood is again disputable, so we define it as medium
11. O: Changes in market competition: The lower entry barriers could result in fierce competition of channels aiming at the worldwide audiences – This may impact the current aggregators greatly – The likelihood of the arrival of competition is hard to determine, but seems feasible with the amount of money circulating in the television industry
12. F: New advertisement model needed – As the competition grows and the content becomes available worldwide a new advertisement model is needed to cope with different geographic locations. Wrong choices in this area could lead to loss of revenue – As advertisement time to audiences will always be paid for the impact will contain itself to temporary losses in the decision making stages – The likelihood of this depends solely on the business administration of the aggregators
13. T: Viewer data availability – The availability of the precise viewer data that can be generated from the tracker could be positive for advertisement purposes – The advertisement model is already based on quite accurate information, but this would enhance these numbers, meaning the impact is medium – These easily acquirable accurate data will definitely be used, so likelihood high
14. T: Re-distribution of content – Acquired content could become no longer of interest to the viewer as it was available already from another aggregator, leading to lesser viewer – The impact of this could be high, but depends on many factors (viewer attachment, time differences etc.) – The likelihood of content having been available already is quite high, as everyone will be able to watch the first channel to broadcast content
15. F: Loss of revenue – As a consequence of 14, lesser viewers could lead to lesser advertisement revenue, meaning loss of revenue – Loss of revenue could be high – The likelihood again depends, for therefore medium
16. T: Re-distribution of content – For aggregators offering special packages the illegal redistribution of licensed content could cause lower sales of these packages and Pay-per-View events – They are dependent on the sale of these packages, but just as much on the advertisement revenue, which would stay the same as the same number of viewers (paying or not) are reached, therefore impact is low/medium – This is likely to happen as it is human nature not to pay for something if it is there for free too
17. F: Loss of revenue – As a consequence of 16, there could be loss of revenue – The impact depends on the scale of 16, so low/medium – The likelihood of true revenue loss is therefore medium

18. F: New pricing scheme – Mistakes in the new pricing scheme needed (see 10 and 12), that does not incorporate the risks of illegal distribution, could lead to missed revenue – This loss of revenue could have high impact – The likelihood of mistakes depends on the business strategy and could therefore range from low to high
19. O: Copyright infringement – Illegal re-distribution would be a copyright infringement on the acquired content – This impacts the business in the other points we discussed from re-distribution, but the actual infringement impact is low – The likelihood of copyright infringement with P2PTV is however high
20. O: ISP dependency – The ISP becomes a part of the distribution network, but gets paid by the consumer. The blocking or filtering of P2PTV content or system failures at the ISP could stop the P2PTV service, which means there is a dependency on their functioning – The result of blocking/filtering/failure at the ISP thus has high impact for the aggregator – The likelihood thus far seems low (with cases of traffic filtering showing that this s not legal), but is impossible to determine at this time
21. T: QoS – QoS in harder to guarantee (with ISP and consumer dependency of distribution). With reputation loss as a big corporate risk, and bad QoS possibly leading to reputation loss, the impact will be stated as medium – The likelihood of bad QoS is low, as this is a part of the technology that can be handled
22. T: Technical setup – As the distribution of all television content is dependent on the P2PTV systems set up by the content aggregator or outsourced to experts, anything malfunctioning in the technical setup would lead to great problems. Consistency is key in distribution and therefore on the technical setup – This risk firing could have high impact – The likelihood of malfunctioning of the technical systems is low as the dependency on this is obvious
23. T: User installation – For use of P2PTV with computer systems only (not for STB or Internet TV) software needs to be installed on the user's computer. If the installation doesn't proceed correctly or the functioning of the software malfunctions the reception of P2PTV could be jeopardized – As this only affects a small number of users the impact is low – The likelihood of malfunctioning software is low, as enough development will be done if P2PTV is the main distribution method of television content

Actor: **Access Network**

24. O: Changes in supply chain – The fact that in this what-if scenario P2PTV takes over the distribution makes the function of the current access networks obsolete – This would gravely impact this actor as they are cut from the supply chain. The impact is EXTREMELY HIGH – The likelihood of these changes in the supply chain within this what-if scenario is high
25. F: Loss of revenue – The fact that the current access networks are cut from the supply chain means they will not be receiving any more revenue from their traditional services – Thus the impact is EXTREMELY HIGH – The likelihood of this within this what-if scenario is high

Actor: **User**

26. T: Worldwide availability – The fact that television channels can become available worldwide means that users will have much more choice in content. For them this could results in better achieving their goal of being entertained – It therefore impacts them medium, as t

improves their choice – The likelihood of this within this what-if scenario is high, as P2PTV is fully standardized

27. T: Low entry barriers – The low entry barriers for content distribution that P2PTV entails, can change the user's mindset from passive to active. This way they can become broadcasters of their own, adding to the choice of content of other users – This impacts the user itself lowly, although it is the basic for re-distribution – The likelihood of more UGC, seeing the popularity of this and researches, with P2PTV in this what-if scenario is high
28. T: Viewer data availability – The fact that more and precise viewer data is available, might have impact on the viewer's privacy The way this exposes itself an how much this is bothersome to the users depends and can range from low to high – The likelihood of user privacy issues too depends on this
29. T: Re-distribution of content – The possibility of re-distribution of content will mean that otherwise paid for content could become available for free to the users. This is great opportunity for the viewers, with high impact – The likelihood of e-distribution in this what-if scenario is high
30. T: User installation – Software installation errors and software malfunctions could have viewers on computer systems have trouble receiving the content. This will most likely not happen too much and the impact of this is low

WHAT-IF SCENARIO: **Over anticipated P2PTV**

ACTOR: **Content creator**

31. T: Worldwide availability – Same risk as in previous what-if scenario, but this time limited to the availability of these channels to view on computer systems – This lowers the impact of this for the content creator to low – The likelihood of worldwide availability stays high, even though the P2PTV is not highly adopted by consumers
32. T: Viewer data availability - Same opportunity as in previous what-if scenario, but this time limited to those few that watch channels online – This are much smaller numbers rendering the impact for the content creator to low – The likelihood that these numbers becoming available stays high
33. T: Re-distribution of content – Same risk as in previous what-if scenario, but the impact is much lower as it is limited to those people watching television content on computer system – The likelihood of this is lower as the consumers do not adopt the P2PTV technology
34. F: Loss of revenue – Same risk of less revenue as in previous what-if scenario, but the impact is close to zero because of low consumer adoption – the likelihood of this affecting the revenue is therefore low too
35. O: Copyright infringement – Same risk as in previous what-if scenario, but the impact is much lower because of low consumer adoption of P2PTV – The likelihood of copyright infringement through re-distribution is however still present as even with low numbers of P2PTV users, this risk is still there
36. T: Digital recording – The same risk of digital recording as in the previous what-if scenario is present, but with the little consumer adoption of P2PTV the impact of this will be less. Still easy access to digital content is available, reducing the impact to medium – The likelihood of this is low, due to the low consumer adoption

37. F: Loss of revenue – Seeing the previous risk description, the impact of this risk is reduced to medium, with low likelihood as well

ACTOR: **Content aggregator**

38. T: Worldwide availability – Same risk as in previous what-if scenario, but this time limited to the availability of these channels to view on computer systems – This lowers the impact of this for the content aggregator to low – The likelihood of worldwide availability is lowered to medium, as re-distribution is less likely and better geographic prohibition can be upheld
39. T: Lower entry barriers – The fact that the industry has adopted P2PTV could lead to more channels aimed at the provision of content online – With low consumer adoption the impact of this will be low – As the consumer adoption is obviously low, the likelihood of emerging P2PTV channels is low
40. T: Viewer data availability - Same opportunity as in previous what-if scenario, but this time limited to those few that watch channels online – This are much smaller numbers rendering the impact for the content aggregator to low – The likelihood that these numbers becoming available stays high
41. T: Re-distribution of content – Same risk as in previous what-if scenario, but the impact is much lower as it is limited to those people watching television content on computer system – The likelihood of this is lower as the consumers do not adopt the P2PTV technology
42. F: Loss of revenue – Same risk of less revenue as in previous what-if scenario, but the impact is close to zero because of low consumer adoption – the likelihood of this affecting the revenue is therefore low too
43. T: Re-distribution of content – The aggregators of special packages and Pay-per-view content could be affected by illegal redistribution of their content. This will most likely be one of the few things that the little users that have adopted P2PTV will be watching online. The impact is however lower than in the previous what-if scenario, described as low to medium – The likelihood too is lowered to medium as the consumer adoption is low
44. F: Loss of revenue – For these aggregators offering these kinds of services in this what-if scenario this would not lead to big losses in revenue, lowering the impact too to low to medium – The likelihood is as described before low
45. O: Copyright infringement – As in the previous what-if scenario re-distribution could lead to copyright infringement, but with low consumer adoption the impact is lowered to low and the likelihood decreases to medium
46. O: ISP dependency – As the content aggregator uses P2PTV for their online content distribution they become dependent on the ISP's for this. The impact of this is just medium as denial of service by the ISP would mean no online content would be available – The likelihood is however low, as with low consumer adoption the ISP will not be influenced much by the little P2PTV viewers
47. T: QoS – Same risk as in previous what-if scenario, but in this what-if scenario there is no full dependency on P2PTV for content distribution, as the viewers mainly watch television the traditional way – The impact of bad QoS is therefore low – The likelihood likewise, as described in previous what-if scenario
48. T: Technical setup – Same risk as in previous what-if scenario, but because of the non dependency on P2PTV the impact lowers to low/medium – The likelihood remains low

49. T: User installation – Same risk as in previous what-if scenario, but with smaller numbers of P2PTV viewers due to low consumer adoption, the impact of this risk also is lowered to low – The likelihood remains low

ACTOR: **Access network**

50. T: Re-distribution of content – In this what-if scenario the risk for the access network comes from re-distribution. In the form of the fact that content for special packages and Pay-per-view could broadcasted through P2PTV could easily re-distributed – The impact however will be low/medium as little consumers have adopted P2PTV and watch these broadcasts this way – The likelihood of re-distribution will remain medium
51. F: Loss of revenue – The little viewers that do watch re-distributed content from these types of content will not be paying for this. This could lead to some loss of revenue – But with low consumer adoption the impact will become more than low/medium – The likelihood too is medium

ACTOR: **User**

52. T: Worldwide availability – Same opportunity as in previous what-if scenario, as the content is available online, possible worldwide – But with only the possibility to watch content on computer systems, the impact is low – The likelihood however is high as the industry has adopted P2PTV for online content distribution
53. T: Low entry barriers – Same opportunity as in previous what-if scenario, but with little consumer adoption, not many users will become broadcasters for the few other P2PTV users – This means the impact of the opportunity is low for the user – The likelihood too will be low
54. T: Viewer data availability – As in the previous what-if scenario privacy issues might arise, but as P2PTV in this what-if scenario is only little used and only for viewing content on computer systems, the impact of these issues is low – The likelihood that this little information there becomes available leads to privacy issues is low
55. T: Re-distribution of content – As in the previous what-if scenario re-distribution cause that paid and foreign content becomes available to them online through P2PTV – For the few viewers having adopted P2PTV the impact is high as they will have access to this content that is already being distributed through P2PTV – The likelihood however is low, as little viewers are willing to function as tracker
56. T: User installation – Same risk as in previous what-if scenario, but due to little consumer adoption and P2PTV only for online content viewing, the impact and likelihood of this risk are low

WHAT-IF SCENARIO: **P2PTV underground**

ACTOR: **Content creator**

57. T: Re-distribution of content – In this re-distribution of content is done in the way this is done now; a user capturing content on a pc system and re-distributing online. With the consumer highly adopting to this, much content will become available online and therefore available before airing by the local aggregators. This might make the content from content

creators of less for some of the buyers, the content aggregators – As aggregators will still have professional content needs the impact of this risk is low – The likelihood of this is however high as described here

58. F: Loss of revenue – Following the previous risk, the demand and the value of the content creator's content decreases, which may lead to loss of revenue – Because of reasoning from the previous risk, the impact of this risk is low – The likelihood of this leading to substantial financial losses is medium, as this is definitely possible in this what-if scenario, but aggregators will still need content
59. O: Copyright infringement – The fact that most content will become available online will quite certainly lead to infringement of the copyright of the content creator's productions – The impact of this is low for the functioning of the content creator – The likelihood is high
60. T: Digital recording – With high consumer P2PTV adoption and much content available online is this manner, the risk of digital recording of content which could lead to lower DVD sales of this content is considerable – DVD sales are becoming a growing portion of the content creators revenue, the impact of this could be circumstantial, but a great portion of the users will also want to have the originals. Therefore medium impact – The likelihood of digital recording is medium
61. F: Loss of revenue – Lower DVD sales lead to loss of revenue – As this is a substantial portion of the revenue generated by content creators the impact is medium – Likelihood medium as well

ACTOR: **Content aggregator**

62. T: Re-distribution of content – Content might become of less interest to the viewer as most of it has already been available online through P2PTV systems – As many users have adopted P2PTV they will probably be inclined to also still watch regular television, therefore the impact will be low to medium – The likelihood of lesser interest from the viewer is however high
63. F: Loss of revenue – Loss of interest for the content offered could lead to lower ratings. Lower ratings in turn could lead to lesser income from advertisement sales – Seeing the fact that regular television will prevail is this what-if scenario, the impact is low to medium – The likelihood of advertisement time becoming less valuable is medium
64. T: Re-distribution of content – Especially in cases where the content consist of live events or Pay-per-view content, the risk of re-distribution is considerable as these types of content are otherwise not available through normal distribution channels – The impact for these kinds of content is therefore bigger and is high – The likelihood of this happening in this what-if scenario are high
65. F: Loss of revenue – With these kinds of content the purchase prices are usually quite high. Therefore missing revenue from this content becoming available online for free is a risk – The impact of this on the revenue is high – The likelihood of loss of revenue is therefore medium
66. O: Copyright infringement – The fact that most content will become available online will quite certainly lead to infringement of the licenses the content aggregator has acquired – The impact of this is low for the aggregator – The likelihood is high

ACTOR: **Access network**

67. T: Re-distribution of content – This what-if scenario only poses a risk for the access networks in the illegal re-distribution of special packages and live events. This is one of the types of content that is of interest for the P2PTV users to become available for free online. The access network receive income for hosting these packages and the sale of these could become smaller as we discussed for the content aggregator – The impact is therefore high – The likelihood is high as well
68. F: Loss of revenue – Smaller sales of special packages and Pay-per-view will affect the revenue for the access networks as well – The likelihood of loss of revenue is therefore high – The likelihood of actual financial losses is medium

ACTOR: **User**

69. T: Low bandwidth needed for online broadcasting – For the user P2PTV systems means a opportunity to become online broadcasters with very little costs – The fact that it becomes available to them to go from passive to active has a high impact – The likelihood that users will become broadcasters is high
70. T: Re-distribution of content – Foreign and paid content can become available online for free – This opportunity has high impact on the user as much more content s available – The likelihood of this content becoming available through P2PTV re-distribution is high
71. T: ISP dependency – The availability of these opportunities depends on the ISP not to filter or block P2PTV traffic – Seeing the dependency on the ISP the impact is high – The likelihood is impossible to assign. So far all efforts by ISP's to block/filter any content have been condemned, but future developments might change this
72. T: User installation – Software installation errors and software malfunctions could have viewers on computer systems have trouble receiving the content. This will most likely not happen too much and the impact of this is low

13 Appendix C – Risk framework

(Risk framework op 2xA3 inplakken)