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Semester: 4th

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Project Period: Autumn 2012

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Copies: 3
Pages: 184
Finished: 10-01-2013

Abstract:

The main goal of this project is to investigate a viable business model for Hybrid Broadband Broadcast Television (HbbTV) and how this standard can be widely adopted in the Danish market. HbbTV is a broadcast driven standard that combines broadcasting services with the possibilities provided by the connected TV in a transparent and fluid way for the viewers, leading to more interactivity with broadcasting contents.
Investigating adoption and market opportunities for new technology requires analysis of different issues: drivers and barriers of the technology, factors that contribute to the rate of adoption, different issues with regulation and digital right management (DRM), technology penetration rate, user behaviour and initial market condition. Our project defines all these concerns.
Investigating a viable business model for new technology would require an analysis of different interrelated components of business model. Furthurmore our project describes different components of business model for HbbTV, which are Service design, Organization design, Technology design and Finance design.

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1. Introduction

Information and Communication technology ICT has taken an unexpected role in our society. ICT is now used almost everywhere and has a great effect on innovative products. The convergence of different technologies helps offering new services on the same platform and thus opening new markets for new players.

With the advancement in technology and converging services trends, televisions are switching from simple one end device to multifunctional devices. Nowadays Smart TVs can be used; not only for watching news, but also to access different services such as video on demand, catch up services, weather forecast, sports, social networks and many other different services through the apps available by the different manufacturers.

Connected TV and Hybrid TV are two new concepts of television that are starting a new era where our interaction with television is going to change. While the Connected TV concept provides TV sets with the ability to connect to Internet - opening for the different services provided by broadband networks, Hybrid TV tries to combine broadcasting services with the possibilities provided by the connected TV in a transparent and fluid way for the viewers, leading to more interactivity with broadcasting contents.

This opens for new opportunities for broadcasters to provide a rich and interactive content, and also for the viewer who will benefit from a significantly different user experience - as result of the convergence of the broadcast and broadband technologies

1.1 Motivation and background

The topic that we will be working within this thesis is business model and market opportunities for HbbTV in Denmark.

This project will be done in cooperation with YouSee A/S, a subsidiary company of the Tele-Denmark Communications (TDC) and is now considered as Denmark's largest distributor of TV and Internet solutions on the cable network. YouSee is working on hybrid TV and thus would like to investigate different issues like stakeholder relationship (commercial benefits and potential threats), factors that contribute to the rate of adaption, international trends that impact the Danish market and viable business model that would satisfy all the relevant players.

As students from the business development track, we will investigate a viable

business model for HbbTV and also analyze if HbbTV will have business opportunities in the Danish market. Investigating market opportunities for new services require analysis of drivers and barriers for adaption of technology, factors that contribute to the rate of adaption, different standardization, regulation and digital right management issues. Investigating a viable business model for new technology would require an analysis of different interrelated components of business model, which are service design, organization design, technology design and finance design. These issues will be discussed and analysed in the thesis.

1.2 Problem formulation

The main questions for the problem formulation will be:

- How can HbbTV gain widespread adoption in the Danish market?
- What could be the viable Business Model for HbbTV application?

The supported questions for the main questions will be:

- Who are the primary players in deciding whether or not HbbTV becomes a widespread standard in Danish market (i.e. broadcasters, rights holders, distributors, device manufacturers etc.) and how can each player help or hinder the adoption of HbbTV?
- What commercial benefits (or in the case of DR, what "ideological benefits") could HbbTV provide each of these players and which potential threats does HbbTV pose to each of these players?
- What international trends impact the Danish market?
- What is the effect of DRM on HbbTV?
- How the EU regulation will impact the Danish market?
- What are the drivers and barriers for HbbTV?
- What are the opportunities and the challenges of convergence?
- What factors contribute to the adoption HbbTV?

1.3 Methodology

Our project is based on analysis of the viability and potential of different technologies. To successfully handle this project qualitative research method is used where information is gathered through both primary and secondary research.

The data collected is used through the different analysis, which is shown in table below:

Data	Data Form	Aim	Utilized
Primary Data	Interviews from different stakeholders,	To gain knowledge about the value chain, HbbTV potential, barriers and other issues related to HbbTV.	Analyze the HbbTV potential in the Danish market, stakeholders collaboration, as well highlight the barriers.
	Data gathered from online surveys and face-to-face surveys.	To study the users behaviour concerning usage of the Internet and the TV.	Analyze the user behaviour concerning usage of the Interent and the TV.
Secondary Data	White papers, journals, articles, Internet.	To gain broader knowledge about the HbbTV technology, HbbTV market and value chain.	Analyze the HbbTV on the macro and micro levels.

Table 1: Data Collection

As part of the methodologies, the following steps are predicted:

1. Subject area and Problem definition
2. Initial studies through the use of various resources (gathering information)
3. Devise study literature framework (Main areas, directions that we will be working with)
4. Collect data and prepare case studies (Collection of data through the use of various resources like books, websites, articles, relevant international journals, reviewing literatures from the Classes)
5. Interviews with some stakeholders in the Danish market.
6. Data analysis
7. Making a conclusion

1.3.1 *Primary Data*

Various methods of primary research have been used to collect data for this thesis, which are: personal interviews including face – to – face interviews, email correspondence, online surveys, and user test for the pilot project.

1.3.1.1 Personal interviews

Personal interviews with different stakeholders were conducted in order to gather different data and interviews were Semi-structured. Semi-structured interviews are qualitative method of inquiry that consists prepared questions with the opportunity for the interviewers to explore particular theme or subject further. The advantage of the semi-structured interview is that interviewer will have the opportunity to speak freely within their expertise, thus providing valuable and detail information about the subject. The interview are carried out as as a personal interview and through email correspondence through question and answer.

Date and Type	Person and Title	Subject
22nd august 2012,personal interview.	Jakob Sørensen, on demand chef of YouSee A/S.	To discuss project problem formulation and YouSee's interest in HbbTV.
18th September 2012, personal interview	Allan Hammershøj, Research assistance and technical project coordinator (Department of electronic system in AAU Copenhagen)	To discuss about DRM in market perspective and how they will affect the market.
18th September 2012, personal interview	Janick Kirk Sorenson, assistance professor at CMI.	To collect information about personalization and how personalization will help in adoption of HbbTV.
28th September 2012, personal interview	Claus Pedersen Blicher, Project leader in DR media	To discuss about DR's trial version of HbbTV and their future plan for actual version, collaboration between the different stakeholders, strategies that will help faster adoption of HbbTV, HbbTV market and future.
5th October 2012, email correspondence	Martin Engen, Sales manager at Samsung Electronics	To discuss the HbbTV adoption in the Danish market and the role of

		Samsung as a manufacture in the adoption of the new technology in Denmark.
25th October 2012, personal interview	Torben Rasmussen, Senior product manager at TDC DSL.	Discussion of TDC DSL plan for HbbTV, future of HbbTV in the Danish market, barriers for the adoption, collaboration between the different stakeholders and other issues related to HbbTV.
7th November 2012, personal interview	Lars Kierkegaard, Business manager at Teracom A/S	Future of HbbTV in the Danish market and barriers for HbbTV.
6th December 2012, email correspondence	Mads Danscher, IPTV manager for Viasat	Regarding Viasat future plan for HbbTV.
17th December 2012, email correspondence	Christian Johansen, Konsulent, DR Jura, Politik and Strategies	Regarding agreement between DR, Stofa and YouSee
20th December 2012, email correspondence	Stig Møller Christensen, Director of sales Pay-TV at TV2.	To discuss TV2 plan for HbbTV, collaboration between the different stakeholders, future of HbbTV in the Danish market, barriers for the adoption, collaboration between the different and other issues related to HbbTV

Table 2: Primary Data Sources

The interviews were carried out as personal interviews and through question and answer session. All the respondents has been asked about their opinions regarding future of HbbTV, its market potential and barriers, company's plan about HbbTV and stakeholders collaboration.

1.3.1.2 Online surveys

Another method of conduting primary research is to have people filled out surveys. We used online surveys among users to study the users behaviour concerning usage of the Internet and the TV. The decision of asking users about their habits/ behavior when watching TV would not only give information about their behavior, but will also help understand what services the users might prefer. Different mediums were used for the

online surveys such as facebook, sict.moodle.aau.dk and email and we got response from 63 people in 14 days.

1.3.1.3 Field surveys

We also conducted face to face surveys with potential users at the Elgiganten store to know what user consider while buying TV, their knowledge on HbbTV and if they are willing to pay for a small subscription fee. We spent 3 days talking to salesman at Elgiganten and interviewed around 12 customers.

1.3.1.4 User test for the pilot project

Data is also collected via interviewing with user in the user test session. The data collected via users are their willingness to fill out the surveys for recommendation for using service which will personalize their electronic program guide (EPG) and if the users are their willingness to accept advertisement according to their their interest.

We interviewed one user and spent around 2 and half hour in the user test session.

1.3.2 Secondary Data

Secondary data collection is the method of collecting data from different resources such as books, Internet, white papers, journals etc. The secondary data includes both qualitative and quantative data. Internet portals have provided access to official news media, scientific materials and relevant home pages. The secondary data is used in the projet to gain broader knowledge about the HbbTV in terms of service, technology, market and regulation and to make a viable business model.

2. Overview of HbbTV

2.1 What is HbbTV?

HbbTV stands for "Hybrid Broadcast Broadband Television ". HbbTV is a new pan-European initiative that combines broadcasting service and broadband services in a transparent and fluid way for the viewers, leading to more interactivity with broadcasting content. . It also allows access to internet-only services for consumers using set-top boxes and/or connected TVs. In other words, broadcast without Hbb is defined as a downlink service where TV viewers only watch the content which is broadcasted, whereas with Hbb, the broadcast service is expanded with an Internet uplink channel. This opens op for an interactive experience and a range of new services, which is not possible in a traditional broadcast context.

Hybrid devices are not a new concept. There have been many attempts by TV manufacturers to illustrate an integrated browser and content from the Internet to the TV screen for many years. However, due to the advancement in the technology, hybrid devices have been able to reach a wider market and gain user acceptance.

HbbTV is the collaboration of two projects, the French H4TV project and the German HTML profil project in 2009. The first HbbTV-compatible set-top-box was launched in the German market in December 2009.

HbbTV Consortium is the organization for HbbTV that aims to provide an alternative to proprietary technologies and deliver an open platform for broadcasters and defines HbbTV as *"a new industry standard providing an open and business neutral technology platform that seamlessly combines TV services delivered via broadcast with services delivered via broadband and also enables access to Internet only services for consumers using connected TVs and set-top boxes"*. The European Broadcasting Union (EBU) defines HbbTV as *"a device or services that uses two networks (broadcast and broadband) for data and application delivery"* [1]. Furthermore, EBU considers a Hybrid TV as a device where it is possible to "... combine *the functionalities of both broadcast and broadband tuners..." to offer a seamless experience to the* consumer.

Figure below illustrates an example of service where data is delivered using both broadband and broadcast networks.

Figure 1: Integration of services delivered with broadband and broadcast network [2]

HbbTV has thus enhanced the reach of content to television, thus by enabling consumer to access both broadcast digital content and Internet multimedia content on their flat screen TV, via a single device.

Unlike IPTV, which is controlled by telcos, the telcos or the broadband operators do not control HbbTV. The broadcasters themselves control the services and the content of the HbbTV. In other words when combining the broadcast and the broadband worlds, it is somehow similar to the OTT (over the top). A good example of the OTT is Netflix where the broadband operators have no control on Netflix content, and the user accesses the Netflix services over the top. However the difference between the OTT and the HbbTV is that the broadcasters own the infrastructure [See Appendix 6]. Allan Hammershøj explains in the comparison between OTT and HbbTV that, "*When we talk about the broadcasters, they own the infrastructures in a way at least you can say the broadcasters network, for example in Denmark it is gatekeeper that is owning the DTT but you can say it is a broadcasters, it is an infrastructure completely controlled by the providers meaning that for example if DR send on specific frequency which is maintained by the gatekeeper and received by the terminal and you cannot use other services that is defined by the gatekeeper. There are some obligations towards the Danish government in the broadcast world; you need to have this kind of channels actual before being the gatekeeper.*"

2.2 What kind of interactive services does HbbTV offer?

By adopting HbbTV, consumer will be able to access different interactive services and multimedia content from providers such as online providers, broadcasters and CE

manufacturers. Some of the services delivered through HbbTV includes video on demand (VoD), catch-up TV, personalization, games and social media, interactive advertising, voting as well as programme related services such as digital text and Electronic Program Guide (EPG: favourite programms based on meta data highlights). More about EPG can be seen in Services [Chapter 7]

These services can be further categorized into two applications defined by the standards: [3]

1. Broadcast independent application: This application cannot be declared in the broadcast stream and is available only via broadband channel. Independent online providers and CE manufacturers can provide those applications. Video on demand (VOD), cache up TV, games, social networking and photo streaming are some of the examples of broadcast independent application.

2. Broadcast related application: The broadcaster controls the content presented by this category of applications. The content provided by those applications may change to be adapted to the broadcast content. Example of broadcast related application include services suh as digital teletext, electronic program guide and Red Button applications such as interactive advertising, voting, quiz, sport scoring.

2.3 HbbTV System Overview

The figure below illustrates a system overview of a hybrid terminal with DVB-S (satellite) as the example of the broadcast connection. Note that HbbTV can also operate on other broadcasting technologies such as DVB-T (Terrestrial) and DVB-C (cable).

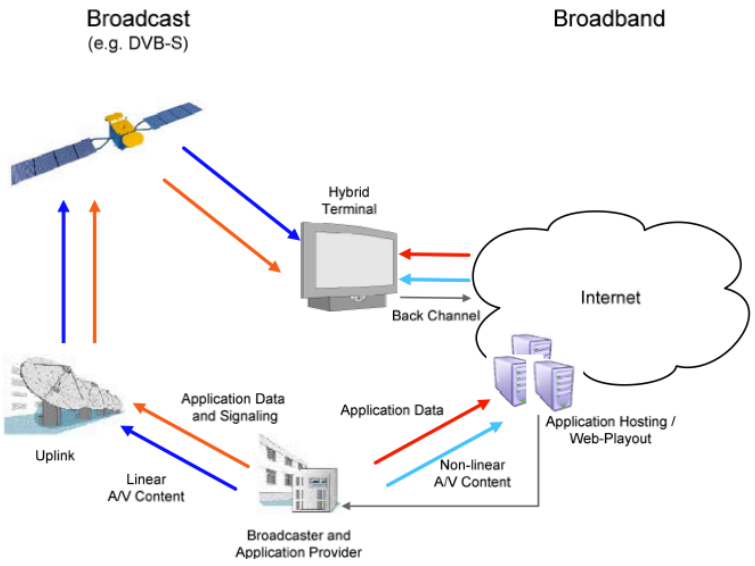


Figure 2: System Overview [4]

A hybrid terminal has the potential to be connected to two networks in parallel. It can be connected to a broadcast DVB network on the one side, through which a hybrid terminal receives standard broadcast Audio/Video (i.e. linear A/V content), application signaling information and application. So the connection to the broadcast network admits the terminal to receive the broadcast related application even though the terminal is not connected to the broadband network.

On the other side, the hybrid terminal can be connected to the Internet via a broadband network, which allows bi-directional communication with the application provider. The hybrid terminal receives the broadband related application and non-linear A/V content (e.g. A/V content streaming on demand) via the broadband network.

2.4 HbbTV Consortium

HbbTV Consortium is the organization for HbbTV that aims to provide an alternative to proprietary technologies and deliver an open platform for broadcasters. HbbTV is specifically designed for the Hybrid TV by the HbbTV consortium and published by ETSI as ETSI TS 102 796 V1.1.1 in June 2010 [5].

The members of HbbTV consortium consist both television broadcasters and CE manufacturers. The HbbTV steering group members are: EBU (European Broadcasting Union), France Television, Abertis Telecom, Institue fur Rundfunktechnik GmbH, Abertis Telecom, ANT Software Limited, Digital TV Labs, OpenTV Inc, Opera, Koninklijke Phillips Electronics N.V Inc, RTL Group, Samsung,

SES ASTRA S.A, Sony Corporation and Television Francaise 1-TF1. The consortium membership is open for new members.

HbbTV works on existing standards, as there are already developed solutions for the existing standard and this will help to reduce the costs of developing applications and reduce time to the market. Some significant reference documents used in HbbTV are:

- CEA-2014 - Web-based Protocol and Framework for Remote User Interface and the Internet (Web4CE), also known as CE-HTML.
- Open IPTV Application Environment of the Open IPTV Forum
- TS 102 809 (DVB) Signaling and carriage of interactive applications and services in Hybrid Broadcast Broadband environments

The founding members of the HbbTV consortium develop the specifications to create a joint standard for hybrid services. The technical specifications are developed by the joint effort of the following bodies.

- Joint Technical Committee (JTC)
- Broadcast of the European Broadcasting Union (EBU)
- Comité Européen de Normalisation ELECtrotechnique (CENELEC)
- European Telecommunications Standards Institute (ETSI).

Different specifications on HbbTV are HbbTV 1.1 HbbTV 1.5 and HbbTV 2.0, however HbbTV 2.0 is in early stage of development, these diiferent versions of the HbbTV standard will be discussed later in the report.

2.5 HbbTV Deployments and Adoptions

Since the development of HbbTV in 2009, it is supported by wide range of players suh as network operators, broadcasters, manufacturers, middleware suppliers and other technology partners.

Almost all the European countires have approved and adopted HbbTV as a standard. However, Germany is the most matured market for HbbTV and is deployed both on satellite (e.g. Astra HD+) and Free-To-Air (FTA) terrestrial. 90 % of the TV market supports HbbTV in Germany and there are already more than 50 apps available for HbbTV. The major German commercial and public broadcasting groups including ZDF, ARD, RTL and Pro7Sat1 have together launched some 20 different services of

services at IFA 2010. There are wide range of HbbTV services and receivers in support of programming at ARD, ZDF and Bavaria's Bayerische Rundfunk. Some of the HbbTV services available via ZDF are news, teletext, Cache up TV, Video on Demand (VoD), voting, sports, interactive advertising, personalization, social networking and weather. Services offered by KabelKiosk, Eutelsat's German subsidiary, includes VoD and catch-up TV. An outstanding example of the potential of HbbTV appeared at the Summer Olympics (London 2012), with the integration of six live streams in an Olympic App on HbbTV Offered by ARD and ZDF.

France has been one of the leaders in the development of the HbbTV standard. The French public broadcaster, France Television, has deployed an HbbTV-based video-on-demand (VOD) service. The HbbTV services available are news, sports, weather, catch-up TV and social media. GlobeCast (a subsidiary of France Telecom) and France 24 (an international news and current affair television channel) have launched exploratory HbbTV services and have recently announced that they will expand their exploratory Hybrid Broadband Broadcast Television (HbbTV) service to the Middle East in the fall of 2012 with the support of Orange and Arabsat.

In UK, the UK's Digital Television Group (DTG) has recently made its HbbTV-based connected TV specification openly accessible to the industry**.** The D-Book 7 Part B version 2 is designed to build on HbbTV to align the UK with pan-European standards and includes additional features to meet the requirements of UK service providers. The Digital Television Group will suggest UK requirements to HbbTV for addition in HbbTV version 2.

In Switzerland, Radio Télévision Suisse (RTS), Swiss public broadcasting will be the first SRG affiliate to test an HbbTV service before the end of 2012, with the other affiliates following in 2013. The services that RTS plans to include are applications such as a VOD service, multimedia Teletext with news and sports, and dedicated offerings for people with disabilities.

In Poland, TVP (Telewizja Polska) has recently completed trials of the HbbTV standard in partnership with TV technology companies Icareus and Alticast. Important services offered by TVP as a trial were Euro 2012 soccer tournament and Euro 2012 football championship, where the app was being used by at least 5000 people a day [6] and had an average of 12,000 users per game. TVP is planning to add more services such as weather, news, programs like breakfast program this autumn and original language signs and signs for blind or deaf people.

In Scandinavia, the NorDig standard organization has dropped MHP and selected HbbTV 1.1. . DR, the Danish public service broadcaster running a pilot of its catch-up service on HbbTV with great success. The launched application consists of 6 services, which are news, highlights, previews, mostly viewed, last chance and had you see.

The interest in HbbTV is also seen outside Europe in countries such as Vietnam, Malaysia, Japan, China and USA, who are conducting trials.

In a short time, HbbTV has been supported by wide range of players and deployed in many countries. As HbbTV opens plenty of scope for broadcasters, pay TV operators and app vendors, technology will go global soon in the future. The success of HbbTV will depend on the viable business model. The success of HbbTV can be put down to three factors:[6] foundation on existing standards that are being implemented anyway as part of OTT and IPTV deployments; its flexibility; and support from industry groups, especially the European Broadcast Union (EBU), whose influence broaden outside the continent. "*Denmark is too small to push into anything, the Danish broadcasters organizations in regards to Samsung, Sony, Phillips or whoever, is not really important. They really do not care about us. We are too small to influence them in the marker for them to make specific attraction for Denmark. That is why we as a unified European Broadcasting (EBU) union try to make this standard within the Internet based TV services. So we will not be able to influence the different chips going into the TV, it is only European Broadcasting Union whose influence extends beyond the continent. Lots of broadcasters organization having many millions of users, two hundred million users or so will be able to influence. (*Interview with Claus Pedersen, see Appendix 2*).*

There are a number of stakeholders involved in the HbbTV (broadcasters, device manufacturers, content providers, etc.) and they are working together to develop a common solution which supports merged linkage between the Internet and TV. Moreover, it is necessary to agree on common, open and harmonized standard to enable success of the hybrid services between different stakeholders. Hence, along with changes in the technology, there is also a change in value chain system.

2.6 Summary

HbbTV combines broadcasting services with the possibilities provided by the connected TV in a transparent and fluid way for the viewers, leading to more interactivity with broadcasting contents. HbbTV is a standard which is favored by the

broadcasters as they do not loose control over the content and the broadcasters themselves control the services and the content.

Within 3 years of development, HbbTV has gained wide range of support from many different players and has sparked a wave of interest in many global regions. Currently widespread through continental Europe, and under trial in a number of other major countries outside Europe, it looks like HbbTV is going to be winning TV platform. HbbTV version 1.5 has improved and supported many features to a version 1.0 and possible features for version 2.0 looks even more promising. HbbTV's widespread deployment and the world's interest in the HbbTV industry will depend on the continued standard development work, planned or currently work in progress and the viable business model.

3. Technology

3.1 Standards role in the market

A standard is a norm (implicit or explicit) followed by more than one person or more than once by one person [7]. Standarization defines some of the characteristics of the processes and products, which should be followed to make them suitable for use, likely succeed in the market, understable to the consumer and consistent with offers from other producers.

Developments in information and communication technologies have demonstrated the huge economic importance of standards for compatibility and interfaces. According to the World Trade Organization (WTO), the standardization has following effects in the market [7]:

- Standards allow for exchange between anonymous economic agents.
- Standards facilitate compatibility between products.
- Standard facilitate technological diffusion.
- Standards solve coordination problems in case of network externalities.
- Standards solve important market failures derived from imperfect information and negative externalities.

According to Swann, standardization has the following purpose and benefits [8]:

- Compatibility standard help to expand the market opportunities because they help to increase network effects.
- Standardization defines some of the characteristics of processes and products, which should be followed to make them suitable for use, likely to succeed in the market, understandable to the customer and consistent with offering from other producers.
- Standardization contributes to economic growth.
- Standardization helps to build focus, cohesion and critical mass in the formative stages of a market.
- Standardization helps to a market against Greshams's Law (Bad money drives out good if their exchange rate is set by law).
- Standardization increases competition.
- Standardization reduces transaction costs between different producers and between producers and customers.

- Standardization of measurements allows innovative producers and consumers.
- Standardization reduces risk as perceived by producers and by consumers.
- Standardization codifies and diffuses state of the art technology and best practice.
- Standardization captures trends in customer demand.
- Companies that use standards perform better.
- Standardization can increase trade.
- Open standards are desirable to enable a competitive process of innovation – led growth.

3.2 MHEG and MHP Standards

Before going into the depths with HbbTV, it will be worth knowing how its predecessors MHEG and MHP work.

MHEG and MHP lay a foundation for HbbTV. Therefore there are similarities between these standards. But what differentiates HbbTV from its predecessors is that it puts the broadcasters in control so only they are able to relate broadband services to the broadcast program. The broadband content in HbbTV is differentiated by broadcast related and broadcast independent applications. This relation is achieved through AIT (Application Information Table).

In the Television domain, the most interesting technological development is the interactivity. The interactivity is developed from the user only being able to zap between channels and Tele-text to broadband content with rich graphics. **Interactivity** and **application signalling** are the important components of all the above three technologies, where each of them is implemented differently, which is described individually for each technology in the following.

3.2.1 MHEG

MHEG stands for the Multimedia Hypermedia Information Coding Expert Group and is an ISO standard published in 1997. The purpose of the standard was to define a method of storage, exchange and display of multimedia presentations [9]. MHEG was not dedicated to TV, but rather a more general platform that can be used in e.g. CD-ROM-based encyclopedia and interactive books.

Even if the standard consists of eight parts – MHEG-1 to MHEG-8. Only the fifth part – MHEG-5 – is widely used in the interactive TV domain. MHEG-6, MHEG-7 and MHEG-8 are considered as extensions to MHEG-5.

3.2.1.1 MHEG-5 Application signalling and Interactivity

Application Signalling

MHEG-5 applications and related data are loaded from the data carousel of the broadcast stream. To be able to run these applications, the receiver must know about their existence as well as how to manage them, this mechanism is referred to as Application Signalling. MHEG-5 leaves application signalling to specific profiles to specify it. The ETSI profile uses the PMT of the MPEG-2 TS and a Service Gateway object, acquired from the file system delivered by an object carousel, to implement it [10].

Interactivity

MHEG-5 Interaction Channel (MHEG-IC) enables connected TV to interact to broadcast services via an IP connection [11]. MHEG-IC is also adopted in the ETSI standard. MHEG-IC supports the standard protocols normally used to deliver the web content as TCP-IP and HTTP; and makes use of a special "web browser" to present HTML applications.

3.2.2 MHP

MHP, or the Multimedia Home Platform, is the collective name for a compatible set of middleware specifications [12] developed by the MHP group, a sub group of DVB, between 1997 and 2000.

The MHP standard defined these profiles:

1. Enhanced Broadcasting profile (Profile 1): The simplest version of an MHP environment supports this profile. It is aimed for STBs without a return channel in a low-cost area. In this case, applications may only be downloaded from the broadcast stream – the MPEG-2 TS. [13]
2. Interactive Broadcasting profile (Profile 2): Same as Profile 1 but includes support for a standardized return channel that allows an interaction between the audience and the broadcast.

3. Internet Access Profile (Profile 3): In this profile, Profile 2 is extended with support for Internet applications making it possible to combine Internet-based services such as email and web content, with the broadcast world.
4. IPTV profile (Profile 4): This profile integrates support for DVB-IPTV into MHP.

3.2.2.1 MHP Interactivity and Application signalling

MHP supports many communication protocols; some are TV specific as DVB-SI, DSM-CC and MPEG-2-TS, while others are network protocols such as IP, TCP, UDP and HTTP. The main way to get broadcast-related applications remains the DSM-CC object carousel, as the return channel is not mandatory for all MHP profiles. In absence of a return channel only light interactive applications and services can be carried in the broadcast stream e.g. teletext and EPG. Depending on the supported MHP profile, services may range from simple interactivity (as voting in a live program) via the return channel (Profile 2) to online games (Profile 3) and catch-up TV and VOD (Profile 4).

GEM (Globally Executable MHP) is a subset of MHP standard specifications that can be implemented in environments which do not necessarily use DVB standards for broadcast signaling as OCAP [14] in U.S and ARIB [15] in Japan This makes it also possible for the GEM platform to bring interactivity to applications that do not require broadcast signaling as for Blu-ray discs [16].

3.2.3 HbbTV

HbbTV (Hybrid Broadcast and Broadband TV) is specifically designed for the Hybrid TV by the HbbTV consortium and published by ETSI as ETSI TS 102 796 V1.1.1 in June 2010 [17]. The technical specifications are developed by the joint effort of the following bodies.

- Joint Technical Committee (JTC)
- Broadcast of the European Broadcasting Union (EBU)
- Comité Européen de Normalisation ELECtrotechnique (CENELEC)
- European Telecommunications Standards Institute (ETSI).

HbbTV is not a totally new standard i.e. it is not started from scratch but references parts of already available standards and specifications and adapts the necessary parts

of these standards. In the following are some significant reference documents used in HbbTV are listed:

- CEA-2014 - Web-based Protocol and Framework for Remote User Interface and the Internet (Web4CE), also known as CE-HTML.
- Open IPTV Application Environment of the Open IPTV Forum
- TS 102 809 (DVB) Signalling and carriage of interactive applications and services in Hybrid Broadcast Broadband environments

3.2.3.1 Status of HbbTV

In the following subschapter, we will analyse the different HbbTV verions.

3.2.3.1.1 HbbTV 1.0

HbbTV 1.0 was published as an ETSI standard in June 2010 as ETSI TS 102 796 v1.1.1. HbbTV 1.1 is the first specification of HbbTV and it defines specification on media formats, content and service protection, DAE (Declarative Application Environment) and definition of the application languages (XHTML, CSS and JavaScript including Ajax).

Since HbbTV 1.1 is an initial specification, it has many limitations. The main limitations of the HbbTV 1.1 are that the following items are not supported:

- Flash
- CSS3.
- HTML5.
- MPEG-DASH.
- Other format than MPEG-4.
- State of the art DRM.

Furthermore, only a limited number of font families are supported. The supported fonts do not appear very clearly on the TV screen.

3.2.3.1.2 HbbTV 1.5

HbbTV 1.5 specification was released on the 4th April 2012 and is the latest specification on HbbTV.

The figure below shows the main improvement of HbbTV 1.5 over HbbTV 1.0.

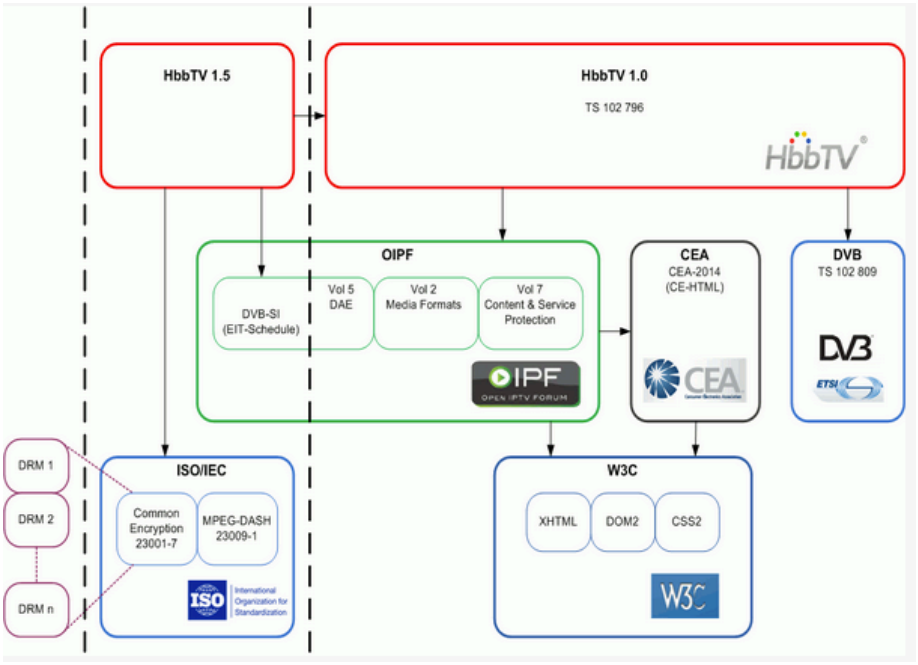


Figure 3: HbbTV 1.5 Specification Overview [18]

HbbTV 1.5 adds support for HTTP adaptive streaming based on MPEG-DASH (ISO/IEC 23009-1), improving the perceived quality of video presentation on slow or busy Internet connections. In addition, it admits content providers to protect DASH delivered content with multiple DRM technologies based on the MPEG CENC specification (ISO/IEC 23001-7), so it is DRM compatible. Moreover, HbbTV 1.5 adds access to broadcast TV schedule information (DVB-SI EIT-Schedule) that enables operators to create full 7-day electronic program guides (EPG).

3.2.3.1.3 HbbTV 2.0

HbbTV specification group has already started to work on HbbTV 2.0 and is in the early stage of development. The decisions are not made yet, but some new topics are identified. Examples of possible feature for HbbTV 2.0 are:[19]

- Second Screen (iPad, Galaxy Tab)
- Synchronizing streams delivered by broadcast and broadband
- Advanced graphics
- Downloadable fonts
- Better integration of DRM also known as "DRM frameworks"
- More access to DVB to DVB-SI EIT
- Push VOD via broadcast including protected content

- Selections from HTML5 and other next generation web technologies
- Widgets

3.2.3.2 Signalling interactive application and services

This component of the TS 102 809 is necessary for HbbTV because it helps the receiver to identify the applications associated with a service and find the location from which to retrieve them, the source of the broadcast data required by the broadcast-related application and how the signalling enables the broadcast to manage the lifecycle of applications. This is achieved by the following properties of applications:

Application metadata

Applications may have the following metadata associated with them.

Item	Description
Type	Identifies the platform needed to run or present the application.
Identifier	Identifies the application.
Control code	Defines the lifecycle state of the application.
Profile	Defines the minimum profile of terminal needed for this application
Visibility	Identifies whether the application is visible to the user or to other applications via an application listing API (where such an API is supported).
Priority	Defines the priority of the application relative to other signaled applications.
Icons	Identifies the location of icons for this application.
Graphics constraints	Identifies any constraints on this application with respect to changes in graphics configuration or presented video.
Storage information:	Defines whether an application should be stored, and which application files should be stored.

Table 3: Application metadata

Application type

A type is associated with each application, which is used by the terminal to discard unsupported applications.

In MPEG-2 encoding the application types are 15 bit numbers. The receivers use the type identifier to filter out signalling for unsupported application types and discard them. Application types are, for historical reason, registered with MHP_APPLICATION_TYPE_ID.

Application Identification

The item identifier in Table 4 is for the application identification. Each application is associated with an identifier. The application identifier consists of two parts, the organization_id and the application_id.

organization_id:

This field is a globally unique value that identifies the responsible organization for the application. This field is also used for authentication when X.509 certification is used.

application_id:

This field is allocated by the organization, which is registered with the organization_id field and is used to uniquely identify the application. [ETSI TS 102 809 Technical specification]

3.2.3.3 AIT in HbbTV

The application control code is signalled through the application_control_code field in the AIT (Application Information Table). The AIT provides full information on the data broadcast and lists all broadcast related applications, the application_type, application_identifier, application_control_code and AIT version_number.

Figure 4: AIT Table

The version_number is incremented by 1 whenever a change in the information carried within the sub_table occurs.

For each application in the AIT a descriptor loop gives all relevant parameters like organization_id, application_id and application_control_code etc.

3.2.3.4 Adaptive Streaming

Adaptive streaming is a technology that enables high-quality audio-video streams over the Internet dynamically. In the past, most of the video streaming technologies used streaming protocol such as RTP, RTSP. Today, adaptive streaming of major players is mostly based on HTTP such as Apple HTTP live streaming (HLS), Google WebM, Microsoft smooth streaming, Adobe's HTTP dynamic streaming, MPEG-DASH etc. Using HTTP has some benefits: It makes it easier to get the stream through most firewalls of client machines and it has caching functionality that reduces loads on web services and increases performance.

The HbbTV 1.5 specification was released on the 4th April 2012, which supports for HTTP adaptive streaming based on the recently published MPEG-DASH specification (Feb 2011). It also enables content providers to protect DASH delivered

content with potentially multiple DRM technologies based on the MPEG CENC specification [20].

MPEG-DASH

The first DASH (Dynamic Adaptive Streaming over HTTP) draft specification was published in February 2011. As the name says, it's a standard for adaptive streaming over HTTP which has the potential to replace exiting proprietary technologies (HLS, Adobe Dynamic Streaming and Microsoft Smooth Steaming) [21].

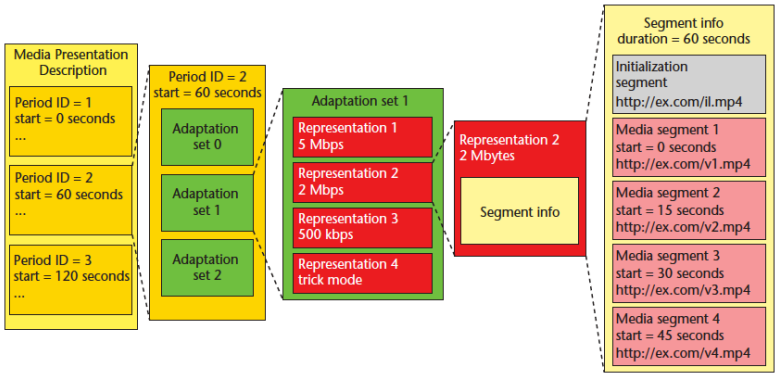


Figure 5: DASH Media presentation model [22]

DASH consists of two components: Media Presentation and Media Presentation Description. The actual AV streams are called Media Presentation. It is a collection of structured AV content that includes periods, adaptation sets, representation, and segments. It consists of one or multiple periods, where each period has a starting time and duration and consists of one or multiple adaptation sets. An adaptation set contains the information about one or more media components and its various encoded alternatives, e.g. different bit rates of the video component of the same multimedia content or audio component. Each adaptive set can use one or multiple DRM scheme as long as the client recognizes at least one. It uses the Common Encryption Scheme (CENC), which defines a signalling of a common encryption scheme of media content. [23]

Each adaptation set contains multiple representations e.g. 640x480@500kbps, 640x480@250kbps.

Also, each representation is divided into media segments, which are the media stream chunks in temporal sequence. Each segment has a URI.

The Media presentation Description (MPD) is an XML document that describes a manifest of the available content, its various alternatives, their URL address, and

other characteristics and segments, which contain the actual multimedia bit streams in the form of chunks, in single or multiple files.

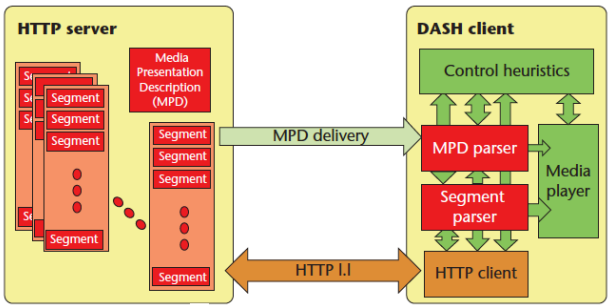


Figure 6: Streaming scenario between HTTP server and a DASH client [20]

The client requires MPD to play the content. The MPD can be delivered to the client by using HTTP or email or any transport media. The client analyses the MPD about the program timing, media types, resolutions, minimum and maximum bandwidth, encoded alternatives, required DRM etc. Using this content's characteristics, the client chooses the appropriate encoded alternative and starts streaming by fetching the segments using HTTP GET request.

3.3 Standards Deployment and Future outlook

3.3.1 MHP

MHP is widely adopted in Europe and other countries as a standard for interactive digital TV. Initial deployments of MHP were in broadcast markets, terrestrially (DVB-T) by MTV3 in Finland and over satellite (DVB-S) by Skylife in Korea. Since then, the uptake of broadband has meant that many recent MHP deployments have been in hybrid broadcast/broadband networks, where the broadcast network is using the broadband network for complementary information, applications and, recently, video.

Until 2010, the largest deployment of MHP was in Italy (DVB-T), Korea (DVB-S), Belgium (DVB-C) and Poland (DVB-S2/DVB-C). Italy is a matured market for MHP. More than 11 million MHP devices have been sold in Italy since the MHP has been adopted as a standard [24]. Other key markets where MHP has trials or small deployment include Austria (DVB-T/DVB-C), Spain (DVB-T), Norway (DVB-T), Saudi Arabia (DVB-T), Switzerland (DVB-C), Australia and Taiwan (DVB-T) [25].

The first MHP services were launched on the DVB-T platform in Finland in 2002. Even though Finland was the first country to implement MHP, the service was shut down at the end of 2007, as it never reached a critical mass. The main reasons for the lack of success in the Finland were [26]:

- Broadcasting of the application can be really expensive as more than 50% of the Finish households use the terrestrial networks.
- Broadcasters and manufacturers have to pay license fees to MHP.
- Negative publicity of MHP by Finish media.
- There were only few MHP set top boxes available. The big manufactures were not interested to develop MHP set top boxes just for the Finland because Finland is a small market. MHP/GEM implementation depends on market's needs: The fact that it is not mandatory to implement the full set of profiles specified by the standard left it at the mercy of the STB makers. This makes broadcasters depend on the manufacturers' strategy for each market.

Germany also selected MHP, but it failed because there was no market for the interactive TV in the country then. Malaysia initially choosed MHP to provide interactive digital TV, but it failed and they instead selected MHEG-5. The main reason for choosing MHEG-5 is because the broadcasters and manufacturers had to pay middleware license fee if they use MHP technology, but no license fee is being imposed for the broadcasters using MHEG-5.

The price for MHP receiver's prices has fallen greatly in recent years, in Italy; the price of MHP set-top box is only 70 Euro [25]. As of April 2010, around 14.5 million MHP compatible receivers had been deployed in networks using DVB-T, DVB-S, DVB-C and DVB-T2 [25]. The total MHP devices deployed as of November 2011 has reached more than 16 million and shown in the table below [24].

Countries	Type	Devices
Italy	DTT and DTH Tivu	11,000,000
Austria	DTT and cable	185,000
Belgium	PayTV on cable (Telnet)	1,300,000
Finland	DTT	150,000
Germany	DTH	100,000
Hungary	HelloHD	
Norway	PayTV and FTA on terrestrial.	30,000

Poland	Satellite (ITI)	954,000
Poland	Cable (MMP)	106,000
Poland	Cable (Vectra)	100,000
South Korea	PayTV on satellite	2,400,000
Spain	FTA and pay-TV on DTT	
Switzerland	Naxoo	210,000
Taiwan	Cable:TFN, Kbro, CNS, TBC	40,000
Total MHP Device		**16,725,000**

Table 4: Table: MHP devices deployed

3.3.2 MHEG-5

MHEG-5 is a mature technology and is deployed in multiple countries. It has been widely deployed in the United Kingdom e.g. Freeview (DTT), Freesat (DTH), TopUpTV (DTT pay- TV operator) and in other countries such as Australia: Freeview (DTT), New Zealand: Freeview (DTH & DTT including HD), Hong Kong: TVB (DTT), Germany (TechniSat) and Ireland: (DTT). It is also specified in South Africa: (DTT) and India: Digicable (cable pay-TV operator) and is at the trial stage in other countries such as Thailand and Malaysia. MHEG-5 has been deployed in millions of receivers worldwide and number continues to rise.

MHEG-5 is most mature market in UK. MHEG-5 was first implemented in the UK DTT launch of OnDigital (now Freeview) to provide interactive services for digital television with over 30 million receivers sold into the market since the launch back in 2002 [27]. MHEG-5 is included in all the digital terrestrial television consumer equipment sold in the UK. Using MHEG-5, Freeview offered multiple interactive services to the consumers like digital teletext, interactive advertising, multiscreen video selection and red button enhanced TV services. The reason that MHEG-5 is succeeding in the UK is due to following reasons [27]:

- Consumers have built interactivity into their daily TV usage patterns.
- MHEG-5 is widely supported and low cost open standard. Boxes can be bought for 25 pounds (around 50 dollar), so the technology is cost-efficient.
- MHEG-5 can be adapted to the market's needs.

MHEG-5 has been extended by profiles to adapt market needs. One of the most popular profiles is the UK profile, which is also used in other countries such as New Zealand and South Africa.

The deployment of MHEG-5 in New Zealand has proven to be a great success too. FreeView NZ was the first free-to-air digital TV platform outside the UK to deploy MHEG-5 as its interactive. From 2011, it is mandatory for all the TV's over 32-inch and PVR to include HD MHEG and MHEG IC [28]. Thus, Freeview New Zealand took its lead from the popular Freeview UK platform in its brand positioning, business structure and a number of key technology decisions.

In Hong Kong, the leading broadcasters Television Video Broadcast (TVB), deployed MHEG-5 in 2008 to launch interactive television service and the technology is deployed on its digital terrestrial Television channels. In Germany, TechniSat, the market leader in Germany for digital receivers, has launched the first MHEG-5 application in 2009 to provide interactive services to the consumers. In Australia, FreeView, the leading public broadcaster in Australia has selected MPEG-5 as its interactive service for the Television in 2009 and has proved to be a major success.

MHEG-5 also has been chosen as an interactive TV middleware in South Africa in 2009. The SABC, South Africa's Public Broadcaster, has adopted MHEG-5 profile for South Africa to meet unique needs to the market and is proven to be a great success. The success of MHEG-5 in South Africa is because it is a cost effective with lower royalties than other middleware solutions and it is not proprietary to any vendor, an open standard and uses less memory [29].

3.3.3 HbbTV

Within three years of innovation, almost all the European countires has approved and adopted HbbTV as a standard and the interest is also seen in other countires. Germany and France is the most matured market for HbbTV. HbbTV has already been deployed in Poland, Spain, Netherlands and Scandinavia countries. Austria and Switzerland has planned to roll out the HbbTV service in the beginning of 2013. The details on HbbTV deployment can be found in section 2.5.

3.3.4 *Future outlook of the standards*

Today, there are different standards available for interactive hybrid TV platform. Different countries are using different approaches; such as MHEG-5 in UK, BVB MHP in Italy and HbbTV in Germany. HbbTV was introduced as a standard for hybrid broadcast/broadband and is the latest of the interactive TV standards.

When several standards are available for interactive TV services, it can be a barrier for the adoption of technology. The reason is that devices will not interoperable across standards and thus limit the adoption of the new technology by the consumers. This is especially the case in the broadcast TV market, where a viewer uses one device (a TV set or an STB) to receive different channels that may be using different Hybrid TV standards.

In the future, there might be standards wars between different interactive TV standards, like battle between Betamax and VHS in early 1980's, where VHS came out to be the successful standard. The market may face towards one of the standards which is adopted by all markets and resulting in a "*winner takes all*" outcomes where a single standard emerges victorious, while the other disappear [30]. Another possibility could also be the case where another standard might take over the existing standards. It is also possible that all of these standards can be widely adopted which results in a fragmented market and limiting the adoption of new technology.

3.4 Broadband development

Hybrid broadcast broadband technology relies on the broadband to convey broadcast-related content via IP. The broadband connection is also used as return channel to provide enhanced interactive services. That is, without broadband access the Hybrid TV will be limited to local interactivity and lightweight applications that only use the data carousel. So a closer look into broadband development is important.

3.4.1 *What is a broadband?*

Broadband definition has evolved from being at least 128 kbps, in data download rate, in 2005 to higher than 4 Mbps in 2011 in some countries [31]. The EU Commission considers a broadband is a connection that allows a minimum of

144 kbps in download stream, while in Denmark, the lowest marketed data rate is 2 Mbps [32]. In relation with Hybrid TV, the full experience depends heavily on the downstream data rate: while lightweight interactivity (Voting, shopping etc.) may be satisfied with data rates down to the minimum, more than 10 Mbps required for heavy content as VOD to get a decent quality and smoothness [33].

The main issue here is that depending on the broadband technology, the real download stream may be far from what it has been marketed for!

3.4.2 Broadband technology and data rates

Since Hybrid TV is actually only implemented on fixed TV devices and STBs, only fixed broadband technology is studied in the following.

The main fixed broadband technologies deployed in Europe are xDSL, Cable or Fiber-based. These different technologies allow for different capacity, range and whether the capacity is shared or not. The following table compares these different technologies:

Technology	Spectrum Usage	Capacity Shared?	Capacity	Max Range	Advantages	Limitations
Cable	7 – 860 MHz (Typically 7- 550 MHz) 6 MHz per channel	Yes (By up to 1000)	40 Mbps per channel, upgrade path to 50 Mbps proposed Typical bandwidth per user 0.5 – 3 Mbps	Amplifiers are installed to extend range. This is cost effective typically up to 100 km.	Uses existing cable TV network	Limited bandwidth per channel, bandwidth is shared by many users, asymmetric - very low upstream data rates
DSL-based (ADSL, VDSL …)	Up to 2.2 MHz	No	12 – 52 Mbps @ 0.3 km 7.5 - 8.4 Mbps @ 2.7 km 1.5 Mbps @ 5.4 km	Max: 5.4 km	Uses existing POTS	Limited bandwidth, which is distance sensitive.
Fiber	THz	PON:	Up to 1	20 km	Relatively	Requires

	Yes P2P: No	Gbps per channel per fiber.	unlimited bandwidth	new fiber access network overlay

Table 5: Comparison between main fixed broadband technologies (adapted from *[33]*)

These comparison show that the most promising technology is fiber since it allows high bandwidth. For low-density population areas, cable can provide acceptable capacity, but does not guarantee fixed stream since the effective capacity depends on the network use as it can be shared with up to 1000 subscribers. In the low-end, DSL technologies allows for acceptable capacity, but only for short ranges (lower than 300 m).

3.4.3 Development trends

The figure below shows that while the fixed broadband penetration reaches more than 27,7 % [34] of households in average in many countries, the broadband technology used in Europe is mainly DSL-based.

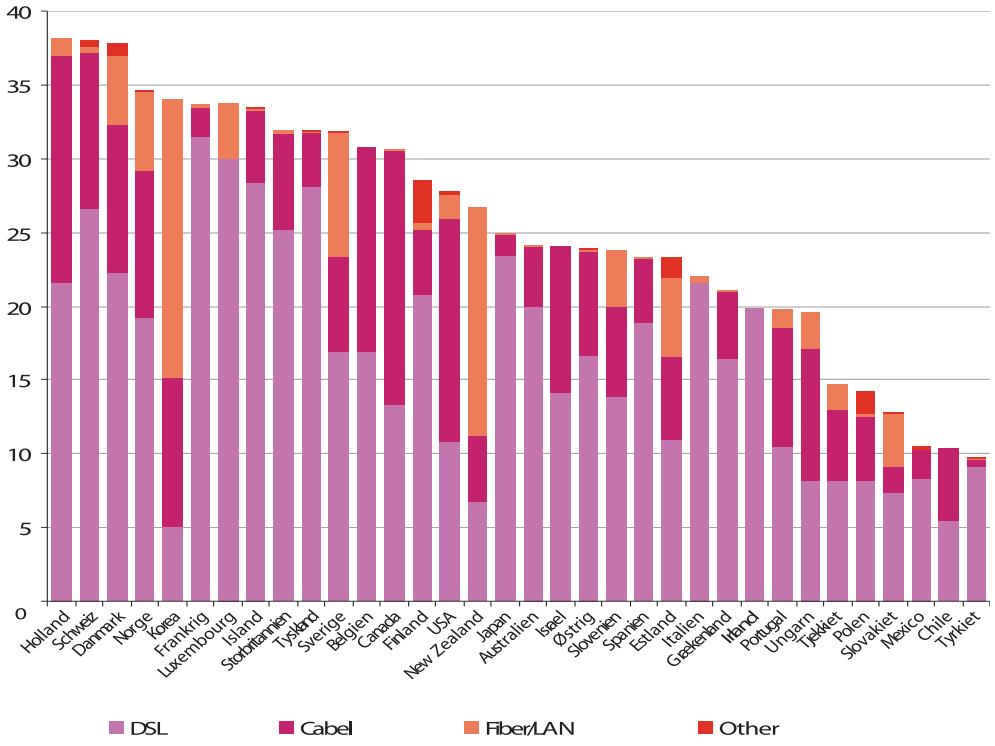


Figure 7: Penetration of fixed broadband connection in OECD, end 2010 (min. 256 kbit/s) [32]

However, the marketed capacity is generally growing, as it is the case for Denmark, according to [32], where more than 50 % of broadband subscribers, to connections that is marketed as between 10 and 50 Mbps in the first half 2011, while in the second half 2010, they were less than 50 %.

Denmark has a broadband coverage close to 100%. The penetration of the fixed broadband was 39,3% as of 2012 according to [34]

3.4.4 *Impact on HBB*

Broadband capacity may be a real issue for the expansion of Hybrid TV since it will directly impact the quality of services that the broadcaster could convey through the broadband, especially, heavy services such as VOD. However, the fast growth in marketed broadband capacity and the adoption of adaptive technologies (adaptive streaming for VOD for example) may help out in the near future.

3.5 Summary

Three standards (MHP, MHEG-5 and HbbTV), that allow Hybrid TV realisation, have been presented in this chapter. MHP was initiated as a standard to introduce new value added and interactivity to the broadcast digital TV, but MHEG was introduced to a more general platform that can be used in CD-ROM-based encyclopedia and interactive books. The HbbTV was introduced as a standard for hybrid broadcast/broadband and is the latest interactive TV standards. MHEG and MHP lay a foundation for HbbTV therefore it has some similarities between them. But what differentiates HbbTV from its predecessors is that it puts the broadcasters in control so only they are able to relate broadband services to the broadcast program. The broadband contents in HbbTV are differentiated by broadcast related and broadcast independent applications.

As different standards are available for interactive hybrid TV platform and different countries are using different approaches, in future, it might cause standard wars between different standards or all of these standards can be widely adopted, but this will fragment the market and limit the adoption of new technology.

Broadband capacity is very important for the development of HbbTV and this will be one of the big drivers in the adoption of HbbTV in the Danish market as Denmark is leading country in the development of broadband and has an ambitious goal that all the Danish citzen should have access to will be 100 Mbits in 2020.

4. DRM (Digital Rights Management)

In this chapter DRM will be analysed. The value chain will be defined, and the different technologies will be analysed in order to identify which is the most suitable DRM technology that we can suggest for HbbTV since there is only room in the standard for one DRM.

4.1 Digital Rights Management

DRM is a technology that enables content providers to distribute, promote and sell digital contents in a secure way. It is a subset of Enterprise Content and Collaboration Management (ECCM) [35]. The role of DRM is very critical in this matter since the Internet poses the most serious threat for the viability and profitability for the content providers because it is the most powerful distribution engine for the digital content.

DRM is a collection of techniques for restricting the free transfer and free use of the digital content. It controls the rights depending on user ID, Position and responsibilities. It was invented to reduce the redistribution or copying of the audio video files and not least prevent piracy.

Many online stores with adopted DRM techniques have different schemes to limit, for example, the number of devices on which the content can be played, and in the case of VOD for example, the number of times it can be viewed.

4.2 Why do we need DRM?

Encryption is a part of the protection process, but encryption is not enough because it has limitations [36]. It does not prevent from copying of the content, because copying a file means moving a set of binary numbers (zeros and ones) from one digital device to another. Hence, an encrypted file can be easily copied in the same way as the unencrypted file, and it can be sent by email or distributed using peer – to – peer networks. The encryption protection is not to prevent copying, it is to prevent having access to the content. This is exactly the main idea of DRM.Note that the copying and sharing of the encrypted file have no value without the access key to the content of the file. *"DRM compared to security is having more functionality inside regarding securing*

the content for the content owners, distributors, etc. not to the end user where the user have nothing to do with the DRM because its procedure is annoying for them" [Appendix-6].

4.3 DRM Technologies

In the market today there are many different technologies based on the concept of attaching the content to be distributed with usage rights. The content providers should be able to implement different business models based on the usage rights such as pay-per-view, on Demand, subscription etc. The usage rights define the extent the content can be used, for example:

- Can the content be transferred to someone else,
- How many times should it be possible to access the content,
- How many devices can the content be implemented on for the same user

Pentini et. al. define in their paper Digital Rights Management as: *"market opportunities for a clearinghouse"*

The key factors regarding the adoption of encryption technologies:

- Scalability
- Interoperability / Support
- Compatibility
- Integration
- Ease of access to technology

Many different DRM brands are in the market, but there is no clear standard that have been widely accepted. As for the business model, DRM varies from a simple license fee to outsourcing of the whole solution. The major two brands are Apple's proprietary FairPlay and Microsoft's PlayReady; those two are commercial, but there are other open sources such as Open Mobile Alliance (OMA DRM) and OpenIPMP.

Some of the popular DRM brands and the technologies behind them will be analysed in the following sub-chapter to find out which brand is mostly suitable for the HbbTV application.

4.3.1 *Apple FairPlay DRM*

Fairplay DRM is an Apple Inc. proprietary DRM technique, which is built onto QuikTime multimedia software and it only works with Apple's products and iTunes. It allows the assets or content to be authorized for a maximum of five PC's, Tablet's or mobile devices, but on an unlimited amount of iPods.

FairPlay digitally encrypts Advanced Audio Coding (AAC) files and prevent from using those files on an unauthorized environment [37] and it limits the usage of the content to the Microsoft Windows and Macintosh Operating Systems i.e. the content cannot be played on other operating systems such as Linux [38].

The file format of Moving Pictures Experts Group (MPEG-4) choice is QuickTime. This standard covers the entire media task and inherits the QuickTime's stability, extensibility and scalability.

The encryption scheme used by FairPlay is the AES algorithm, where the AAC data is encrypted with the AES key. This key is encrypted with the user key that is stored on the iTunes database, while the user key is encrypted with the system key. This encryption occurs while transferring from the server to the client.

4.3.2 *Microsoft's PlayReady DRM*

Playready DRM is Microsoft's proprietary. It was released in 2008 and the Silverlight supports the content restricted with it. It is compatible with Windows Media DRM [39]. It works on many devices including the portable devices but not the Apple iPods. It can be used to play both the audio and the video. Its content licensing terms vary from provider to provider.

PlayReady is designed to enable consumer entertainment scenarios such as protection of many content types, make it easy to transfer content on many devices belonging to the same user [40].

Finally, PlayReady is an independent platform and can be ported on any device even if the portable device doesn't use the Microsoft technology. But the PlayReady PC supports only some of Microsoft products such as Windows Vista SP1 [41]. It supports many formats such as AAC, H.264 and MPEG-4 [42].

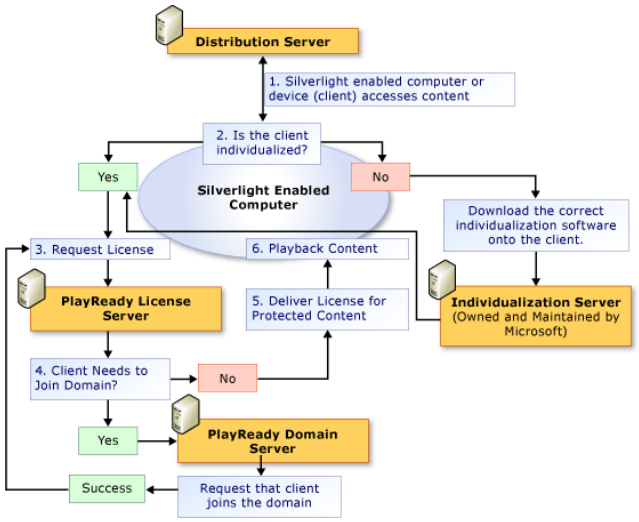


Figure 8: Microsoft PlayReady DRM [42]

The encryption scheme used by PlayReady is the AES [43] where the Silverlight application initiates the connection by sending a request to the distribution server. The client will receive an encrypted content. To decrypt the content, the user will receive a key from the license server. When the license server receives the request from the PlayReady for authentication, it will issue a license with the usage rights and restrictions, and then the client will be able to decrypt the content [44].

4.3.3 *The open source OpenIPMP DRM*

The OpenIPMP stands for Open Intellectual Property Management and Protection. It is an open source DRM for MPEG-4 and MPEG-2 [45]. It aims to provide development group interoperable DRM software that can be easily transferred to any platform such as Linux, Mac, windows and embedded platforms [46]. The interoperable solution that OpenIPMP provide adheres to many open standards including OMA (Open Mobile Alliance), MPEG-2 and MPEG-4. The Open IPMP includes J2EE (Java 2 Enterprise Edition) for issuing the licences and handling restrictions. The client SDK is intended for the integration with MPEG encoder and decoder, in other words the player.

The integration interface includes a pluggable key management, a crypto system interface and a client server protocol that uses web services such as SOAP.

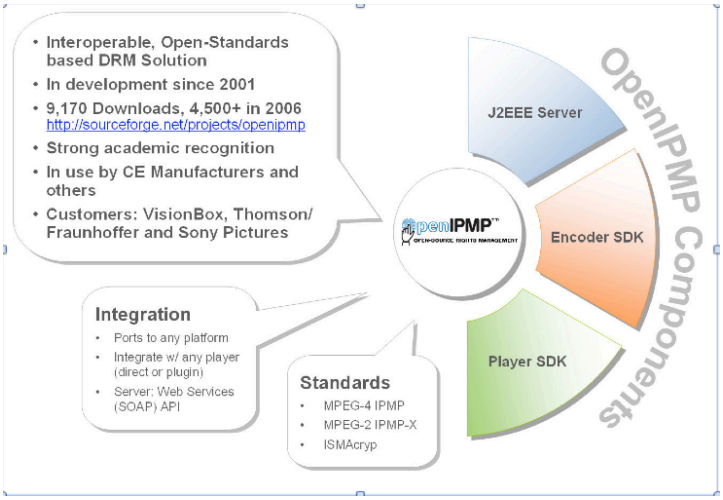


Figure 9: OpenIPMP DRM [47]

To secure the content and rights in a networked environment, the OpenIPMP uses the PKI (Public Key Infrastructure) with the encryption and the digital services. As for the certificates, OpenIPMP uses the X.509 certificate that forms the basis for digital identity on the Internet to implement licenses. To protect the licenses and other sensitive data that are intended for a particular user, the Open IPMP uses asymmetric encryption (RSA keys), while for the encryption of the media assets, it uses the symmetric encryption (Advanced Encryption Standard (AES) and Blowfish). The symmetric keys are used to encrypt media assets whereas each digital certificate ensures each OpenIPMP transaction is certified cryptographically.

To verify the integrity of the critical systems objects such as licenses and content identifiers, OpenIPMP uses the digital signature. Whereas for the critical transaction such as license acquisition and content registration, the Secure Sockets Layer (SSL) is used to ensure that information cannot be corrupted during transit.

4.3.4 *Widevine DRM*

Widevine is a commercial solution for the DRM, which provides solutions for the digital entertainment on any digital media devices. Brian Baker founded Widevine in 1999 and it became a global provider for cable, Internet video services, etc. and in 2010 Google acquired it.

Widevine is widely used on Set-Top- Boxes (STB) [48] and hundreds of service providers use its multiplatform DRM and video optimization for the security of audio and video.

It does support the Apple Mac and the Microsoft Windows platforms but not Linux [49] and as well as it supports many different devices. It is deployed on millions of devices including televisions.

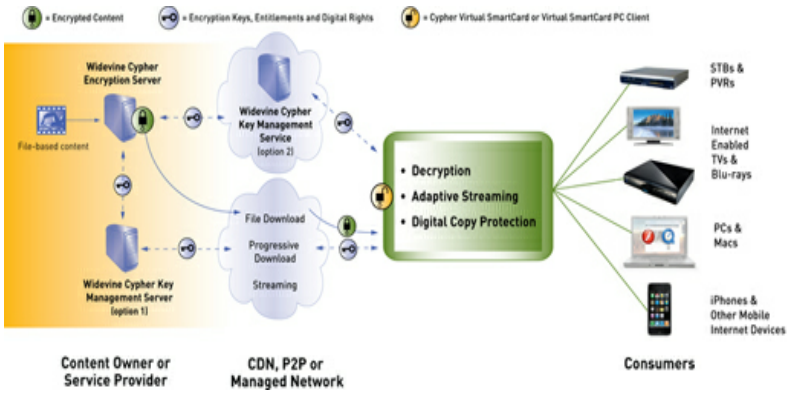


Figure 10: Widevine Architecture [50]

Since there are hundreds of the software tools that are available on the internet for the record of content and enable piracy, Widevine has added an additional level of protection to prevent those tools from piracy known as stream recorders and screen scarpers [49]. It works as follows:

- The content (video) is encrypted, stored and then distributed to the user
- The user uses a media player or the browser to watch the video
- During playback, the encrypted content is now decrypted and is now vulnerable for piracy
- The digital copy protection will detect this attack and produce a number of customizable responses from silent monitoring to revocation of viewing rights.

4.3.5 *Marlin DRM*

Sony, Philips, Panasonic, Samsung and Intertrust are the founders of Marlin DRM. In 2006 they launched an open standard community called Marlin Developer Community (MDC), and identified the trust management organisation [51]. The Marlin Trust Management Organisation (MTMO) is a neutral trust management-licensing organisation identified by the founders of Marlin. Since Marlin is an open standard, it relies on shared input from many interested parties to create an acceptable standard by all participants.

OMA is a complementary technology standard for Marlin DRM [51]. Marlin has applications in broadband, broadcast and IPTV market whereas OMA relates to the mobile market.

Other standard development organisations such as, OIPF (Open IPTV Forum) and Digital Entertainment Content Ecosystem (DECE) have adopted marlin specifications.

Many of the major studios such as, Warner Bros., Colombia Pictures and Walt Disney support Marlin DRM to protect their content for electronic sell of their digital assets, rental and subscription.

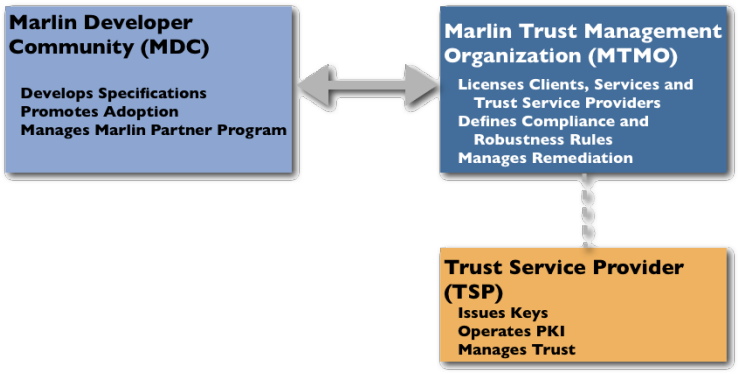


Figure 11: Functions and Roles of MDC and MTMO [52]

Main Specifications [53] of the Marlin DRM are listed below:

- Marlin Dynamic Media Zones Specifications provide support for the media content with specific attributes representing restrictions that the media player application must follow when replaying the content.
- *Marlin Core System Specification—Defines the basic components and protocols that form the basis of most Marlin implementations.*
- *Marlin Broadband Delivery System Specification—Defines additional capabilities that are unique to clients that can take advantage of an interactive IP-based communications channel. Among other items, includes protocols for obtaining licenses and reporting usage data for subscription-based services.*
- *OMArlin Specification—Specifies how to enable interoperable download, streaming, sharing and consumption of content between OMA and Marlin DRM systems.*
- *Marlin IPTV End-point Service Specification—Defines support for "end point" devices, such as TVs with IP capabilities.*

As for the media file format that the Marlin support:

- For Broadcast: MPEG2 TS PS
- For Mobile: a modified OMA DCF format

- For Broadband: any codec that can be transported in MP4 ISO

The Marlin BB [54] (broadband) was adopted by the OIPF as the essential content protection mechanism of the end-to-end specifications. It specifies the technologies for building DRM and copy protection into the end users devices and services.

In February 2012 Intertrust [55] announced its new version of Wasabi Marlin Client SDK that supports MPEG DASH. This new version is a complete Software Development Kit (SDK) for the development of the media applications based on Marlin DRM standard. It can be deployed on desktops (PC and Mac), Mobile (iOS and Android) and embedded systems with support for MPEG- DASH and common encryption on all platforms (Set-Top-Boxes and Connected TV). Gilles Boccon-Gibod, SVP, Technology and Chief Architect at Intertrust explained how the market of the connected TV and STB is highly fragmented and how each manufacturer is developing its own platform, then he said: "*With the release of the MPEG-DASH specification, there is now a common adaptive streaming technology for content publishers and broadcasters. The HbbTV 1.5 specification includes support for MPEG-DASH and a DRM. In France, the HD Forum, an industry group of broadcasters and CE manufacturers, have taken steps towards reducing the market fragmentation by developing a common platform built on the HbbTV 1.5 specification with support for Marlin DRM.*"

4.4 Advantages and Disadvantages of DRM

Since the DRM is the technique that describes the restriction of the free use or transfer of the digital content, many has argued that DRM as Digital rights management is misnomer [56], they reinterpret DRM to stand for Digital Restriction Management. The DRM technology has existed for a while now. One of its forms is one used by DVD's CSS (Content Scramble System) [57], which is the data encryption and authentication method to prevent illegal copying of DVD's [58]. Even though the DRM technologies will be there for many years to come because many within the media industry believes that DRM is the only way to save there business models, DRM still has its advantages and disadvantages which will be discussed in the following subchapters.

4.4.1 What are the advantages of DRM?

- DRM aims to protect the copyright content holder's property rights from piracy attempts.
- Does not generally use other forms of copy protection such as "serial keys" and "keyfiles" [59]
- DRM allows for secure transaction where the customer only pays what they consume. This type of transaction is called micropayment scheme [57], it cannot charge users differently, but it can do price discrimination by charging per use.
- DRM allows for secure content delivery for the consumer
- Since consumers are generally not willing to pay the higher price, DRM allows them to pay the 'per-use' fee and the content will be inaccessible when they are done using it.
- Allows for content providers to monitor sales of their products more efficiently
- Cuts down on the amount of piracy for a given piece of software

4.4.2 What are the disadvantages of DRM?

- Because of the strict control of content, DRM may strangle new technological innovations. Example DRM doesn't support HbbTV yet.
- DRM is very restrictive to the consumer in usage
- Is heavily reliant on licenses which could expire, leaving the consumer with software they paid for that no longer works
- It is fairly ineffective in stopping software piracy, because even if it will take a lot of time and money, someone will figure out eventually how to circumvent the protection.
- Since the majority of users would prefer to have access to the fee free content, therefore DRM is not popular with the majority of consumers.
- DRM has a numerous compatibility issues
- Even though micropayment is considered as an advantage, it can also be a disadvantage, because it might not be readily available since systems used by credit card companies are too expensive to charge users for fractions of cents [57] and new systems with cheaper billing will be eventually installed.

4.5 DRM Revenue opportunities

In general, for any new business model to succeed, it needs to add more value and provide more value than the people can get elsewhere. In other words any business must be based on providing additional value.

Today, in the era where there is witnessed a rapid propagation for the use of the Internet, easy access to the internet makes it easy for the unauthorised people to gain access to the digital information and illegally circulate the content. This situation calls for an urgent solution to prevent piracy and hence revenue loss for the companies and also losss of credibility. Digital Rights Managements (DRM) comes in here as the solution to insure protection of data and content against piracy. In the Digital Rights Managements market (DRM), there have been witnessed an erosion in the growth by 15.9% in the period between 2007-2009 [60]. Because of the numerous corporate failures in merging application markets such as banking and financial services, and media entertainment, this pressed the opportunities in the DRM market in 2010 where the DRM market made a smart recovery.

According to the study made by the Global Industry Analyst, Inc., the growing concern among content providers, government agencies, consumers, etc. and the need to restrict the digital piracy, data theft and unauthorised use of valuable digital content will make the revenues for the DRM global market reach $2.5 billion by the year 2017, where the United States will continue to be the largest regional market for the DRM, the Asia- Pacific will represent the fastest growing market for the DRM at the Compound Annual Growth Rate (CAGR)[1] by 19% this growth will be seen especially on the payTV services. The media and entertainment DRM will represent a growing in this segment at a CAGR of about 15.3%[60] in China and India.

4.6 DRM Value Chain

Even though DRM is to protect and manage the rights of content providers, such as distributors, artists, publishers, etc. but it is not only dedicated to entertainment content. It also has a big interest by other industries such as it is used within the

[1] CAGR: Compound Annual Growth Rate: The year-over-year growth rate of an investment over a specified period of time.

industry to protect their financial and business digital information. Governments need DRM to protect the exchange of secure documents within the internal portal as well as for education. So in other words, everyone within the value chain is concerned about the security and management of their digital content. The figure below shows the Digital Management Rights value chain:

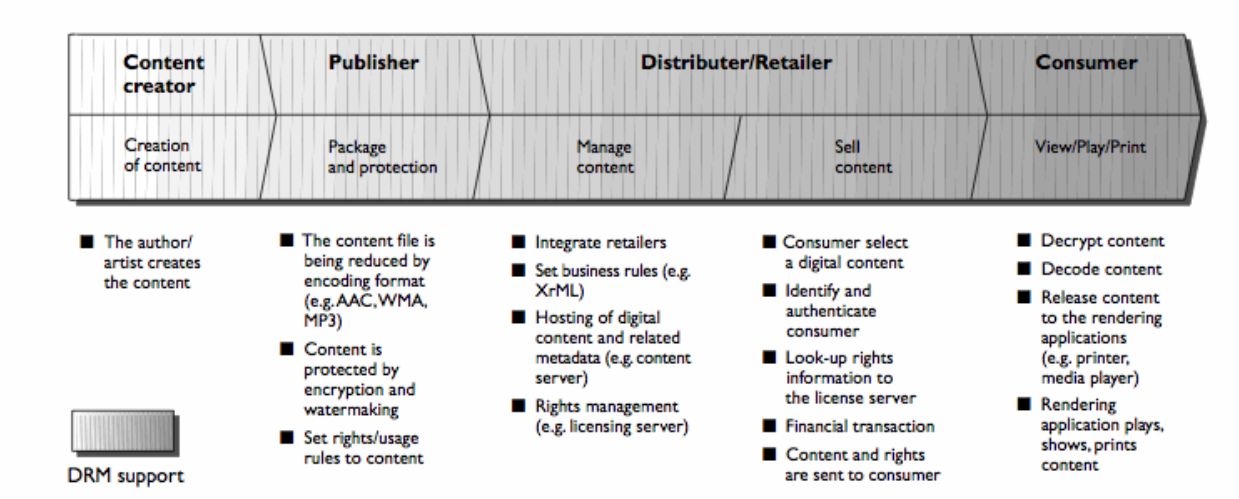


Figure 12:Digital Right Management Value Chain [61]

An example to explain the figure above is as follows:

- The content creator such as an author creates the content.
- The digital content will be compressed by the encoding format such as PDF or MP3; then it will be protected by encryption, and then watermark and the usage rules will be set to the content.
- The distributor will integrate the retailers, set the business rules, use the content servers to host the digital content and the related metadata, use the license servers for the rights management. So that when the customer selects the digital content, the server will identify and authenticate the customer, then the content server will search for and find the information rights in the license server, then the financial transaction will occur and the digital content will be sent to the customer.
- Since the content is encrypted the first thing to do in the customer side is to decrypt the content and decode it and then release it to the rendering applications. The rendering application will show the content such as play MP3 format music.

The process of the Digital Management Rights is as follows [62]:

- Compression: for an easy and rapid transmission of the content, where the content creator chooses the compression format, such as for the music the *de facto* format is the MP3.
- Encoding: for the protection and definition of the parameters that are in use, where the again the content creator chooses the encryption technology. And the role of this technology is to protect the content from unauthorised copying of the content.
- Transaction: for tracking the usage and the delivery of the payment for the parties involved in the transaction, where the content creator gives the authority to the distributor to sell the content according to the encoding.
- Player: for playing or reading the delivered purchased content by the consumer who purchased the content from the distributors.

In terms of HbbTV, different stakeholders have different approaches for the DRM in their business models. In UK for example, because the third party content owners are seeking to ensure that reception equipment will implement copy protections and because those requirements are not mandatory, they asked BBC to take steps to ensure that reception equipment will implement the specific content management arrangements. So the respond to this request from BBC was the proposition to encode the TV listing metadata that accompanies all digital TV channels with a simple compression algorithm. BBC will keep this algorithm and the manufacturers will have to sign a private agreement in order to receive a copy of it. The agreement requires the manufacturers to implement a pervasive DRM in the equipment they build [63].

In the Danish market and in terms of HbbTV, DR control the data by only making the content available that has the correct right associated with it, in other words, if for example, they do not make a Disney movie available in the system, then it does not matter whether there is a digital right available or not within HbbTV, because the content is not available. There is a difference between DR and NRK in Norway, STV in Sweden or BBC in UK where they build the DRM within their content whereas DR makes some programs available for 14 days and then they remove it, so that it is a catalogue of content where they push or pull the content to make sure that they live to the DRM system. They buy content with specific rights associated to it, those rights are different from content to the other, because sometimes they know that they want this specific content for a long period of time and buy rights associated to it, and their content is limited to the geographical area [Appendix 2]. YouSee think that DRM is a tricky thing, because they receive lists of DRM's supported by the content providers

such as movie studios and TV broadcasters and these lists there are different DRM's that are supported by them and YouSee have to find which DRM is common one between the different companies providing content, and these lists changes a lot, and nowadays there is a big hype about the ultraviolet which is not a DRM, but a group of DRMs that are consolidated to the certain principle. YouSee spent a lot of time analysing which streaming format to go with which DRM, and they decided to use VCAS DRM by Verimatrix, which is in fact a DRM that uses Marlin DRM for the MultiRights [Appendix 7].

Globally, there is a trend towards supporting the Marlin DRM where in September 7, 2012 [64] announced Intertrust Technologies Corporation an integrated solution that unifies HbbTV and Marlin DRM technologies into a single, easy to adopt technology. There are as well different countries pushing Marlin to be the standard DRM in the HbbTV standard, even though according to the Specifications of the HbbTV seen in the HbbTV section that there will be a support for different DRMs at the time, the countries are supporting Marlin are: Japan, UK, Italy and France [64]. Marlin DRM is also supported by different device manufacturers: Panasonic, Samsung, Philips and Sony where those companies together with Intertrust joined to develop Marlin DRM specifications in 2005 [65]. Nowadays Marlin DRM is the underlying DRM for the PlayStation Network by Sony and in SyncTV video sharing service in the United States.

4.7 Summary

After analysing the different DRM systems, we could see that some are made for a special type of products, such as the Apple's FairPlay DRM that is only compatible with the Apple A/S products and others need a specific Plugin such as the Microsoft's PlayReady DRM needs the Silverlight plugin, whereas for Widevine is almost the same case as the Apple's, but the difference is that Widevine DRM is compatible with the android OS. OpenIPM is not updated since 2006. Verimatrix's VCAS DRM can be considered a good hatch for the VOD and Pay-TV because it is specified in protecting this type of services, but in order to do that it uses Marlin DRM for the MultiRights option. Therefore we conclude that Marlin DRM is the best option for the HbbTV, because it also supports MPEG-DASH that is supported by HbbTV 1.5. Many Countries are willing to standardize the Marlin DRM along with HbbTV starting from Spain and France.

5. Convergence

Convergence is generally understood to mean the capability of different network platforms carry similar kinds of services, or the coming together of consumer devices such as television, telephone and personal computer [66]. Different authors define Convergence in different way. However, the most important and popular definition is by technology author and media author [67]. The technology author defines convergence as: "*Convergence identifies a general pattern in the evolutionary process, namely the tendency to bring entities together, for example the coming together of classical telecommunications, the internet, information technology and broadcasting, the ability to offer multiple services on a single network or the ability to offer the same service via more than one medium.*" The media author defines convergence as: "*The flow of content across multiple media platforms, the cooperation between multiple media industries, and the migratory behaviour of media audiences who will go almost anywhere in search of the kinds of entertainment experiences they want.*"

Convergence is not only about technology; it is also about new services and about new methods of doing business and of cooperating with society. With the convergence, there are new services and new business models, which are likely to increase the overall information market and its potential for innovation. Examples of new products and services being delivered via convergence include:

- Hybrid Broadband and Broadcast TV (HbbTV) where there is integration with broadband and broadcasters.
- Voice over the Internet (VOIP).
- Data services over digital broadcasting platforms.
- Online services combined with television via systems such as Web-TV.
- Webcasting of news, sports, concerts and of other audiovisual services.
- E-mail, data and World Wide Web access over mobile phone networks.

There are 8 forms of convergence which are explained in the section below [67]

1. Network Convergence

In network convergence, different network technology segments serve the same network architecture. For example, the IP multimedia subsystem (IMS) acting as a common core network for fixed and mobile telecommunications networks.

2. Service delivery Convergence

Different services traditionally delivered on particular carriers are merged on a common IP carrier as illustrated by the growing use of Voice over IP (VoIP) technology for voice transmission on data networks.

3. **Services Convergence**

Services and applications that derive from different industry segments combine into richer experiences independent of the basic supporting technologies. Convergence of the Internet radio and broadcast radio is very good example of service convergence.

4. **Terminal Convergence**

A terminal network refers to the integration into fewer devices [personal digital assistants (PDAs), smart phones, etc.] with numerous features that used to be offered on separate specific devices only (word processors, MP3 players, cameras and electronic games).

5. **Content Convergence**

In Content convergence, transmedia consumption combines experiences from Internet, telephony, gaming, television and so on.

6. **User culture Convergence**

In user culture convergence, subdivisions of customers in the different media sectors combine into true multimedia groups that increasingly affect the mainstream information and entertainment cultures.

7. **Business Convergence**

Business convergence denotes the multitude of new partnerships, associations and achievements across the old industry, for example, information technology (IT), entertainment and telecommunications that generate new organizational structures, new business models and new strategic relationships.

8. **Digital Convergence**

Digital convergence is convergence of the 3C, which are communications, computing and consumer electronics.

Even though many different kinds of convergence exists, our main focus for this project are convergence in terms of technology, convergence in terms of service, convergence in terms market and convergence in terms of regulation.

5.1 Convergence in terms of Services

The general understanding of convergence in terms of services is that generally the same content can be reached from different types of technical platforms. A good example is the delivery of the TV content by broadcasters on different distribution platforms, e.g. through the Internet accessed via the telecom network (such as DR NU) or via a digital terrestrial broadcast network using Digital Video Broadcast (DVB) services. In other words, since service providers are providing content to more than one sector, this implies that the service convergence is cross – sectional [71]. To do so this does not mean that content providers are to change their root sectors, instead the new activities will be in the new sectors.

In a study made by Eddie Townsend [68], he explains that cloud computing is the central of the development of the converged services. Because with the different factors introducing the 'cloud' that allows the effective sharing of the data and information across users and services, and enables the technology that complete the convergence of the transport of the internet and the intelligence of the advanced web and the ability to share and draw value from the data that support the multiple business models that forms the future Internet.

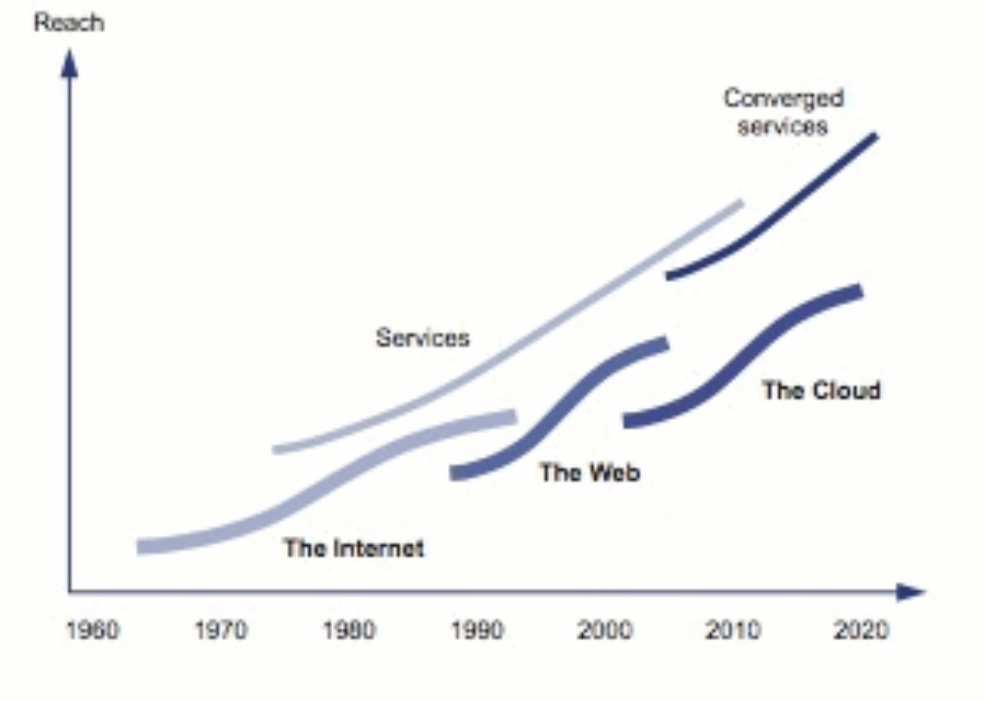


Figure 13:Converged Services to create the future Internet [68]

The future Internet's most important characteristic is convergence because it means to break down the sector silos. This means that data used by professional users in the future Internet can be shared by users according to the user's permission for multiple purposes. In other words, data from health centers can only be used now by health professionals, the same for example data from energy be used by energy companies only, whereas in the future those data can be gathered for the same user according to the users permission to access the data. This means that data from one silo sector can be repurposed for a different use in another sector. This will create an ecosystem that will be scalable across all services.

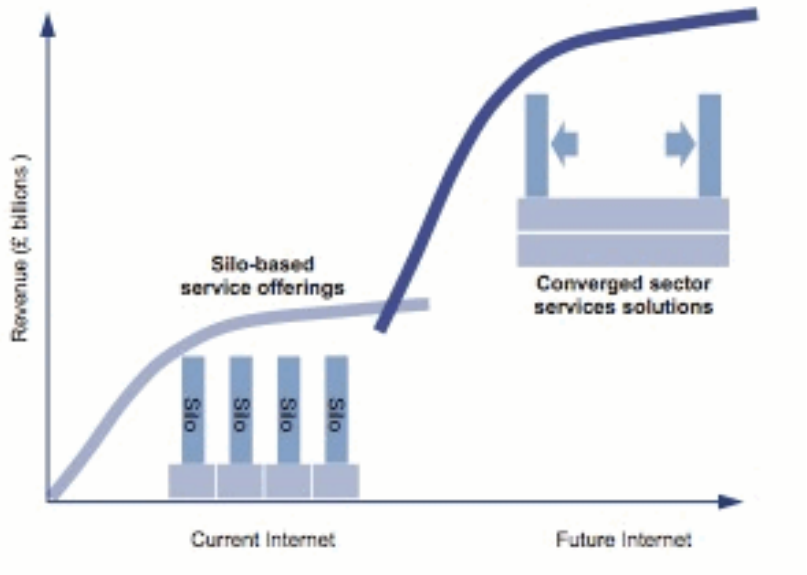


Figure 14: Increased revenue from provision of integrated services [68]

An analysis made by major international companies that supply the ICT solutions show that offerings of integrated multi-sector solutions would greatly extend their revenues.

5.2 Convergence in terms of Technology

Typically the term converged technologies define the combination of the telecommunications, information technologies and media, where those sectors are normally operated independently from one another and are now growing together.

The combination of voice, data and video can help on gaining revenues where there is a saving of business money when upgrading or making changes, reduce the long

distance charges and local access, reduce the network management costs and overall costs required to keep the current technology in position.

According to Stelios Papadakis [69], technological convergence has both functional and technical sides:

- Technical side: refers to the ability of any infrastructure to transport any type of data
- Functional side: refers to the ability to integrate the functions of computation, entertainment and voice in one device that can execute a multiplicity of tasks.

The developments in the entertainment medium made the entertainment devices more attractive to the consumers to use and easier to handle. In the past those entertainment mediums used to be played on specific devices, such as videos used to be displayed on a television through a specific device for the video player, music came through a compact disc player. The result of technological convergence is in:

- New devices that not only interact with the media that they are primarily designed to handle, but also with a number of other formats [70],
- New platforms such as the HbbTV
- New services such as VoIP.

Because of convergence, video game developers, such as PlayStation by Sony, create gaming consoles primarily for playing games, but in addition they design them to play music, videos, and connect to the Internet e.g Nintendo Wii, which also offers access to Netflix VoD service. The same with the media player such as the iPods which are capable to not only play videos and music, but also stream data over the Internet and view websites. Multiple devices were used in the past for the same functionality that single entertainment device can provide. Computers nowadays with Internet access provide greater functionality than media devices, because Internet is widespread example for technological convergence where virtually it gather almost all entertainment technologies from e-books, videos, music, games and so on.

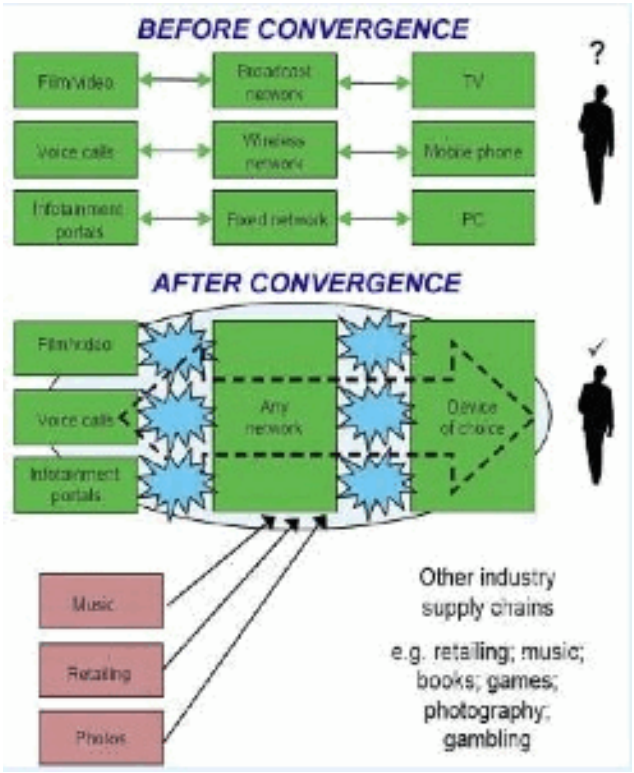


Figure 15: ICT industry before and after technological convergence [69]

The multi-technologies that companies introduce are usually at slightly lower standard than those on independent devices [70], this different quality is reduced and dedicated devices may become obsolete after a year or two. However, technological convergence gives the consumers the satisfaction of having devices with multiple functionalities all in one, because this type of devices will make them save on cost and size and getting a better quality out of those them.

5.3 Convergence in terms of Market

The reshaping of the ICT sector through a series of associations and mergers have resulted in more globalised ICT and media industries and have created new relations between various layers in the value chain and across industries.

Another important aspect in many alliances and mergers is the vertical integration [71] between different levels in the value chain and across industries. The combination of the technical, financial and strategic trends is what shapes convergence. Those financial and strategic trends can be independent of the convergence of the underlying technologies.

Before the convergence there were no links or very weak ones between companies over a wide range of industries. With convergence, this old financial strategy has fallen out of fashion and been replaced by a trend towards concentration and core competences. The new strategy, involvement in other sectors, should only take place and be possible if there is an advantage through cross – sectorial activities.

Today, development of the ICT and media industries is been shaped by convergence in challenging ways for the existing institutional arrangements. The major market trends can be described as follows [71]:

- Company and market structures are formed by convergence and other factors including the financial considerations and corporate strategies.
- Mergers and alliances have taken place between actors within the same market segment. Even though those mergers and alliances may rather be attributed to internationalisation than convergence, but yet a large number of cross – sectional and vertical mergers[2] have taken place.
- Vertical integration has mainly taken place between content production and distribution. There is a new trend towards the integration of the service production and the manufacturers, such as the manufacturing of smart TVs, which include applications.
- In order to complement their own business, many companies have set – up new activities in other sectors. Even though content providers try to keep their main activities within one sector, they are becoming a multi – channel content providers, such as newspapers and broadcasters. And the telecom companies in order to insure content to their networks, they are going into the content provision and this includes the broadcasting.
- In the different layers of the value chain, convergence takes different shapes. Such as:
    - In distribution, convergence is most prominent between the telecom and the broadcasting sectors.
    - In content production, convergence is included in IT, telecom, broadcasting and other mass media sectors
    - In equipment production, convergence is included in IT and telecom sectors.
- The media sectors and the ICT sector are emerging, smart mobiles are a good example, but in this project the HbbTV is a better example.

[2] Merger between two or three companies producing different goods or services for one product.

5.4 Convergence in terms of Regulation

Before different sectors were regulated separately and because of the changes of the market and convergence, the regulatory body, also change in terms of both legislation aspect and also in the organizational aspect.

The services provided and the various routes in the media sector are becoming interchangeable through the various transmission platforms indicating that the content can be distributed across different infrastructures. And with the digitalised technical development, new routes have emerged and the role of the infrastructure and content providers is changing because there are new infrastructures available, the content is being developed according to the types of the media and media providers needs to adapt to the new options and seek the opportunities [72]. The new opportunities bring new legal challenges and responsibilities and new compliance obligations, some of these challenges are listed below [73]:

- Privacy: when the users access the services through the Smart TV, they provide personal data as well behavioural data. The behavioural monitoring technology that is been used in collecting data using cookies have been subject to much debate, regulatory scrutiny and legislative activity in the past few years. Compliance in the current climate involves a balance between obtaining necessary, appropriate and informed consents while not compromising the user-experience and platform functionality and it should not be an obstacle for smart TV business. The compliance obligations relate to all aspects of personal data includes:
  - Processing and storage
  - Transfers including to outsourced service providers
  - Rights which users have in relation to data about them
  - Accuracy and security
  - How long data can be kept
  - What data can be used for
- Content: the presentation of media services in many jurisdictions is regulated, even if the content is delivered over the Internet, such as the On Demand service is regulated under the EU Audiovisual Media Services Directive. This means that regulated service providers need to observe a range of requirements that govern, such as advertisement.
- Consumers: taking the consumer protection law, specific e-commerce and distance – selling as a whole, this area of regulation infiltrate every aspect of the supplier-

consumer relationship, it impacts issues such as supplier limitations and exclusions of liability, taking indemnities from consumers, and other terms that imbalance the supplier-consumer relationship, while also requiring online retailers to make certain information available and under most circumstances, to give consumers the right, for a limited period after placing an order, to cancel it and obtain a refund.

- Equality: the covering of the accessibility of online platforms for users with disabilities, such as providing workable text equivalents of images and sounds.
- User – generated content: the users of Smart TV's are able to access and submit user-generated conten, and this will give a potential legal liability for both the user and the platform that host and provide access to such content that is for example criminal or infringes a third party's intellectual property rights. Eventhough there are potential defences for certain intermediaries, they have limitations:
  - They do not protect against all types of liability
  - They fall away once the intermediary becomes "involved with" the content
  - They do not necessarily protect all intermediaries

All these changes present issues for the media regulations that has an important role in helping to shape the media landscape of a country.

The modifications in the existing networks to offer new services were convergence is accelerating to combine services in the same platform are challenging the common perception about the best means to license and regulate providers in the ICT sector. According to the ICT regulation toolkit [74] the policy makers and the regulators are responding to the challenges represented according to the convergence in several ways:

- The shift towards an equal or technology neutral regulatory treatment of different information and communication infrastructure such as in the European Union where they introduced the regulation aspect of convergence through a flexible and technology neutral approach.
- Modification of the structure of regulatory authorities by providing them with the authority to regulate the telecommunication, broadcasting and information technology sectors.
- Implementation of new laws and regulations that deals with issues as intellectual property, content data protection, security, and computer piracy, to create necessary legal enabling framework to support ICT sector.

- Accommodate convergence within the existing legal and regulatory framework. This will only work in countries with no barriers to the market entry or restrictions on the type of services offering.

5.5 Convergence in terms of Green ICT

Green ICT is getting more and more important in the ICT sector as it helps the world to move to a new carbon economy. As the ICT sector is responsible for 2.5 % of total Carbon emissions at over 0.8 billion tones of CO_2 equivalent [75] and estimated to rise to about 1.4 billion tones of emission by 2020 [76], organizations are more consciously looking at new ways where they can use their ICT more efficiently and thus save money on ever growing energy costs and cutting carbon in the process. Moreover, sustainability continues to gain importance as a performance sign for organizations and their IT departments. IT organizations are increasingly focused on ITs carbon footprint, and placing more importance on developing long-term strategies to reduce their carbon footprint through more sustainable products and operations.

The European Commission has set an action plan for Energy Efficiency, with the aim of consuming 20% less energy by 2020 and with estimation to reduce its CO_2 emissions by 780 million tones and save €100 billion in fuel costs and necessary investment in energy-efficiency technologies [77]. Moreover, European Union has commitment to achieving 80-95% Green house gas emissions reductions by 2050 and the European Union has already built several strategies in order to meet those goals. HbbTV as a convergence of the technology and convergence of the devices can contribute in some way to the reduction of the energy and can contribute to meet those goals, as HbbTV will minimize the use of different devices. By adopting HbbTV, consumers will be able to view all of these advanced services on their flat screen TV, via a single device instead of a multitude of different devices. Also, millions of Set Top Boxes, which are being used, now can be replaced with a small chip inside the HbbTV set, saving considerable amount of materials needed to build Set Top Boxes.

Converged services have a great potential to lower the environmental impact and remove millions of tons of CO_2, as most of the converged services enables more energy efficient or optimized process. Dematerialization in the ICT is the process of substitution of high carbon products and activities with low carbon alternatives. Some of the popular examples of ICT enabled dematerialization services are Video

Conference, Triple Play services and cloud computing and these services all have environmental benefits, which are explained below.

5.5.1 ICT enabled dematerialization services

5.5.1.1 Video – conference

The technological convergence has lead to video conferencing service such as Skype, which has both sustainable and economic benefits. The advantages of video conferencing meeting is it avoids unnecessary travel (driving to meetings or domestic or international flights) that would avoid millions of metrics of CO_2.A recent report by the Carbon Disclosure Project (CDP) provide some interesting insights about sustainability benefits of Video Conferencing [78].

- Telepresence can avoid millions of metric tons of CO_2.
- An individual business implementing four telepresence rooms can reduce its CO_2 emissions by 2,271 metric tons over five years. These reductions are equivalent to the annual greenhouse gas emissions from over 400 passenger vehicles.
- From an economy-wide standpoint, US and UK businesses with annual revenues of more than $1 billion can cut nearly 5.5 million metric tons of CO_2 emissions by 2020 as a result of deploying a total of almost 10,000 telepresence units. These reductions are equivalent to the annual greenhouse gas emissions from over one million passenger vehicles.
- US firms can reduce CO_2 by 112,000 metric tons in 2010 to 963,000 metric tons in 2020, a total of almost 4.6 million metric tons in cumulative cuts in CO_2. These reductions are equivalent to the annual greenhouse gas emissions from almost 880,000 passenger vehicles.

More and more companies are finding benefit of video conferencing and using this technology whenever appropriate. The analysis made by The Energy Saving Trust, UK based organization, found that inter-office travel over an annual period it was account that 58% of inter-office travel was unnecessary and this saves journeys represent a total of 37,620 travel miles, 11 C/ton when converted to carbon savings.

5.5.1.2 Triple Play

Triple Play is a service convergence where several communication channels are provided using a single network. Service providers offer different services such as telephony, television, and Internet services using telephone, cable television, or fixed wireless networks.

The environmental benefit of triple play is saving on the resources needed to deploy different networks. In establishing any network, fixed-line or wireless, there is needed a significant materials and energy due to construction – digging up, erecting towers, etc. Establishing more network would require more ICT components to be produced, used and finally disposed of-which generate more energy consumption. As triple play service can use the same network to carry different services, there is saving of both materials and energy consumption. So ICT sector provides increasing amount of services to the consumers from decreasing amounts of resources.

5.5.1.3 Cloud Computing

Cloud computing is the use of computing resources (hardware and software) that are delivered as a service over a network (typically the internet). Cloud computing is another example of converged service, which has both economic and environmental benefits. The benefits of cloud computing are: achieve economies of scale, reduce spending on technology infrastructure, reduce capital and energy costs, gaining operational efficiencies and reducing time to deployment/market for applications. Thus cloud computing results smaller carbon foot print as a outcome of both enhanced infrastructure efficiency and a reduced need for IT infrastructure to support a given user base.

A report by non-profit Carbon Disclosure Project outlines cloud computing is estimated to assist large U.S. companies save $12.3 billion in energy costs and cut out 85.7 million metric tons of carbon dioxide emissions annually by 2020. A study conducted by Accenture and WSP Environment & Energy and commissioned by Microsoft, shows cloud computing's potential to operate business applications more efficiently, resulting lower environmental impact. The key drivers of emission reductions include [79]:

- Dynamic Provisioning – Over-provisioning of servers at the cloud's operational scale can be very expensive. Cloud operators can quickly match server capacity to demand shifts.

- Multi-Tenancy – Major cloud providers have the capability to serve millions of users at thousands of companies at the same time on one massive shared infrastructure.

- Server Utilization – Cloud computing can help drive energy savings by improving server utilization, which is the measurement of the portion of a server's capacity that an application actively uses.

- Datacenter Efficiency – The way facilities are physically constructed, equipped with IT and supporting infrastructure, and managed has a major impact on the energy use for a given amount of computing power.

5.6 Opportunities and Challenges of Convergence

The emerging between the market need and the availability of a solution for a market need is the result for a great business ideas and inventions and the use of sufficiently affordable and available technologies that addresses the growing market need, this is when according to Gil Namur, we reach the conversion point and a huge window of opportunity.

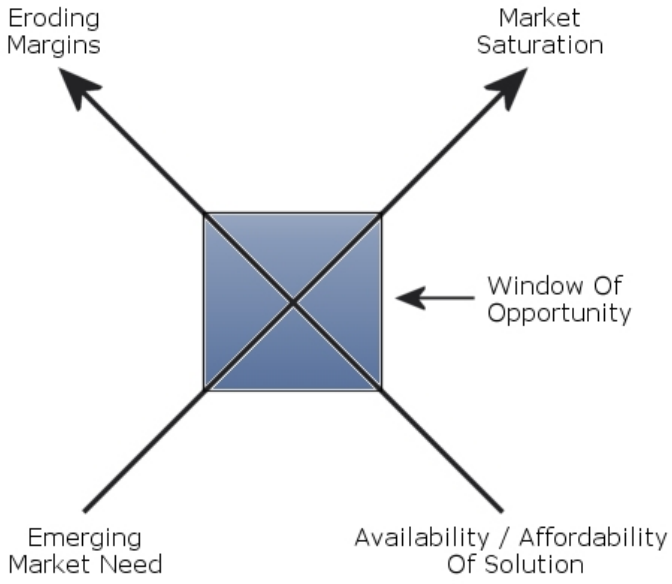


Figure 16: Window of opportunities [80]

Entrepreneurship opens the window of opportunities for new players in the market, because when the window first opens there are not many competitors, but as the market matures and become saturated the margins begins to gradually corrode. Even though the margins are strong when the window of opportunities first opens, but

eventually the technology will mature to a point where it is so low in cost and thus will be difficult to maintain a business model for it that work.

According to Stelios Papadakis, the main opportunities for the convergence are:

- **Increased market competition**: with convergence, the barriers for entering the market are lowered for new market players and this intensifies the competition which gives the consumers the ability to choose among the different providers and services according to the lower costs.
- **Emergence of new services and applications**: convergence gave the opportunity for companies to open new sales market and operate more efficiently increasing their returns from technology investments and through the new services; they achieve new business and rapid market expansion. The new applications have given consumers a new way to be entertained such as social games online (Facebook games) whereas the convergence of the voice, video and data gives the consumers a new way for communication with much lower prices than before.
- **Convenience and simplicity**: Nowadays devices such as the mobile phones gives the consumers the opportunity to enjoy the convenience of having a multi functional devices saving by that size and cost.

Convergence has raised a number of issues for the adjustment of the new environment by the different stakeholders, regulators and users. Those issues according to Papadakis are:

- **New regulatory framework**: traditionally the regulatory framework were designed in an era were there is a clear difference between the services and the infrastructure, nowadays the challenge is to give licences and regulate providers in terms of converged services over the same platform where the regulations are increasingly inadequate for the new services.
- **Bandwidth shortage and infrastructure upgrade**: the new services and applications are bandwidth intensive and thus require an existence of broadband infrastructure. Those new complex multimedia services are possible and attractive only with the broadband access. Countries with developed economics will face the challenge of having to upgrade their infrastructure or miss on the benefits of the technological convergence. So the problem of the past is still the same in today's challenges that is the financial constrains.
- **Strategic alignment by operators and service providers:** since the barriers of the market access are reduced and thus allowing new players to enter the market and provide a variety of service packages, this entrance require operators and service

providers to reassess their business models and strategies to face these new providers, upgrade their networks to integrate with their new offerings and trying to convince the consumers to pay for the new value added by the new services.

- **Privacy, security and reliability**: people nowadays are depending more on ICT networks. This encourages the cybercriminals to invent malicious ways to exploit the consumers and the devices to their benefits. This cyber attack challenges all of the users, operators and service providers to take action in order to minimize the risks of the attacks.

5.7 Convergence in Terms of the Internet and TV

When convergence comes together from two different entities such as the computer and the television, it may have a great influence on the consumers to accept the new technology. According to some studies [81],people who are not computer literate are more likely to embrace the Internet, video on demand and so on if they can access those technologies through their big screen the TV. Since TVs are familiar and easy to navigate using the remote control unlike the personal computers this tends to be more text oriented and require a lot of training for some persons and a formal education, this is why converging those two technologies gets a lot of acceptance within regular consumers.

The convergence of Computer and TV can be seen in different platforms, such as shown on the image below, WebTV, IPTV and Hybrid TV. A discussion about those different forms will be explained later to know the difference between them.

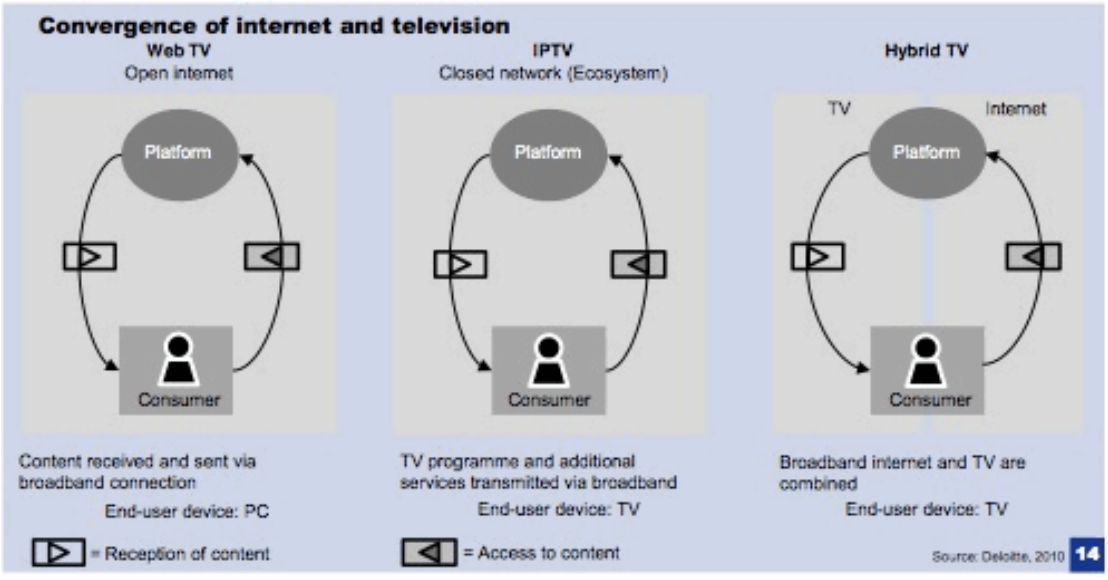


Figure 17: Convergence of Internet and Television [82]

The television is used to refer to the screen that we watch as well as what we watch on it, in other words the television is a medium and a transmission system. On the other hand, the Internet is a transmitting bit system and is different from the devices that receive those bits; the device is originally a computer. The content of the Internet is a World Wide Web contents i.e. a multimedia pages with dynamic content including audio and video. In this sense the television shows will merge into hybrid with the World Wide Web style of content. In the other words, the television and computer will be running the same browser that allows the same content to be viewed on both devices [83].

5.7.1 WebTV

Since the official launch of 'YouTube', more than 100 million users [84] have accessed to view video clips on a daily basis. This movement encouraged the content provides and programmers from the traditional television industry to use the new platform and make the content available for users via the personal computers, and this is where the era of the web videos evolved into Web TV.

Web TV is one of the first entries of the convergence of the Internet and the television, and is owned by Microsoft [84]. The Web TV is mostly free of charge and a number of producers such as Apple and Microsoft supply the hardware and the software for the reception of Web TV on both the STB's (set top boxes) and PC's [85]. Web TV as seen from the above image relies on the open Internet where the streaming of the content is streamed over the public Internet and is available to the widest audience that is possible. The key characteristics of Web TV include [86]:

- The encryption of delivered video is possible as well as the DRM, but not always implemented.
- Since the network is not fully managed by operators
  - There is no end – to – end bandwidth provision
  - QoS (Quality of Service) is limited, even though there is seen development with some services.
- The streamed channel is using unicast technologies, and in some cases the peer – to peer technologies as well.
- Customer services are online and are not that developed.

So with improved codecs and support, increase in the bandwidth distribution and peer –to – peer distribution, more power in the computers for processing the videos, then the coming few years should see a strong convergence between what purists now see as divide between Web TV and IPTV [87].

5.7.2 *Internet Protocol television (IPTV)*

Internet Protocol television (IPTV) has been widely deployed by several operators, those that propose a triple – play ADSL offer to their customers. And because it is delivered over a dedicated, operator – managed network that is used for broadcasting TV, it is fully controlled by the operators who can configure certain parameters to ensure high level of QoS (Quality of Service) such as bandwidth consumption and regularity of packet transportation.

IPTV uses the transport stream transmission technology that is based on satellite TV broadcasting and the content is delivered over the User Datagram Protocol (UDP) in datagram mode [88]. Unlike the Web TV, the IPTV is a closed Internet – based platform and can only be accessed by a monthly subscription that is paid for the telcos who invested large amounts in the establishment of the necessary technical infrastructure [85].

IPTV can be compared with the Digital Cable where operators are having full control on managing the platform over a closed network. This management of the services occurs in the same way as the regular TV platform by providing a Quality of Services (QoS), bandwidth provisioning, failover [3] paths, routing management and different Quality of Service practices [86]. 3vision have summarised some of the key technical characteristics of the IPTV platform:

- When the broadcast channels are provided over IP, they are streamed using the multicast technologies.
- Operators providing high level of video content are using the Digital Management Rights as a standard for the encryption and management of the assets.
- In order to deliver the content with minimal interruptions, the operators run a variety of QoS practices.

[3] Failover: A method of protecting computer systems from failure, in which standby equipment automatically takes over when the main system fails.

- The delivery of the content is meant for specific devices, those are the set – top – boxes (STB) but the PC's are not excluded from the delivery of the IPTV and they can operate in the same way as the STB's.
- Billing and customer services are the same methods as the traditional TV platforms.

In terms of development, IPTV have the advantage for being flexible so that it can improve and increase its TV platform especially with interactive services. But even with the many advantages that IPTV has, it still uses the same technology that other types of data use to send and receive information the Internet Protocol (IP). This means that the TV when receiving may experience a pack loss or delays.

5.7.3 Hybrid TV

The convergence of the Internet and TV have developed a lot and changed according to the needs of the different stakeholders in the market who are interested in converging new technologies and be able to present their services in a better format. The Hybrid TV focuses on the correlation of the Internet and the television as well, but this time the convergence drive was initiated by the manufacturers of the end – user devices. The intention of the TV makers is to differentiate their products from those of the competition by offering Internet capability in connection with the content. Hybrid TV is the term used to describe the combination of the receiving television and also piping the Internet into the living room, in other words changing the Internet from a lean forward to a lean back. Hybrid TVs reverse channel capability create the circumstances for the interactive offers in areas such as the product information, e-commerce and advertising; in such a way that products seen on the TV programmes can be viewed and ordered. In the case of HbbTV, when the viewer pushes the red button on the big screen, he will be able to call up a URL that leads to a website with respective information; and enable content providers to have a new source for their revenues [82], this will gradually be established when consumers need to replace their TV sets. The new offers by content provides are interesting for the media consumers since it has the combination of the Internet and the TV services integrated to form a new services. With this offer new business models will be introduced and the hybrid TV makers will become a portal providers and thus extend their value chain this will make them service providers since they will be building a lasting relationship with the customers, then they will be facing a challenge

collaborating with the different content providers as well as the aggregators to be able to create attractive offers for the users [82].

As for the online content providers, hybrid TV solution opens an opportunity to gain direct access to the living rooms and thus increase their reach as it is seen with Google and their attempt with Google TV in 2010.

Despite the failure of Google TV 1.0 in the market and the great loss for Logitech by $ 34 M, Google is still fighting for its position in the market and according to Google chairman Eric Schmidt's who claim that half of TV sets in the stores next year will have Google TV capability [89]. This shows how online content providers are seeing an opportunity to gain more access to their content from the living room. Even though there is no mature revenue models that have been taking place yet, broadcasters sees the hybrid TV as an opportunity and a risk at the same time. On one hand, the TV is upgraded to access the media world, in such a way that media consumers will be able to access directly into offers from media providers and the internet via the TV this will give the encouragement for the traditional TV. Whereas on the other hand, there will be an increase in the competition for the available online content that the media consumer will put together as desired. In order to stay in the competition, content providers needs to offer users appealing content and formats.

5.8 Summary

HbbTV focuses on the correlation of the Internet and the television where there is integration with broadband and broadcasters. The convergence of different technologies helps offering new services on the same platform, but delivering such new services leads to new regulation, new market and new business model.

Market has changed a lot with convergence where mergers and alliances have taken place between actors within the same market segment. Another important aspect is the vertical integration between different levels in the value chain and across industries. Because of the changes of the market and convergence, the regulatory body also change in terms of both legislation aspect and also in the organizational aspect.

Convergence has several opportunities such as: increased market competition, emergence of new services and applications, convenience and simplicity, however there are number of challenge such as: new regulatory framework, bandwidth

shortage and infrastructure upgrade, strategic alignment by operators and service providers, Privacy, security and reliability.

6. Market

The market is affected by the customer needs for the product and who or what is having influence on the customer, so understanding the customer's requirement of the specific market and the social surroundings that affects the costumers, will make it easier for service providers to know how to market their product and who are their target groups.

Since the concerns for the market now are about the potentials for the HbbTV, then the need is to know, "what do customers want online?"

Two studies [90] highlighted this dilemma; Zatso made one and the other was made by Pew research centre.

Zatso's study " A view of the 21st century News consumer" observed people's reading habits. The study showed that 1 out of 3 respondent replied by that they use the Internet for checking the news, whereas almost 2 out of 3 of 3500f respondents replied by checking their e-mails and that emails gets them closer to their relatives and friends. This concludes that the most popular activity online is checking emails, and then the next best is reading news.

Pew study showed that those who are connected to the Internet have a better connection to their families and friends that those who are not.

Personalisation has its benefit on reflecting people's reactions where 75% of the respondent wanted on demand news and around 2 out of 3 wanted personalised news. Over the half of the respondents made educational research.

Other than email and news, 75% goes online to search for information about purchases they want to make. 64 % visited travel agencies webpages, 54% seek data about health and medicine, 38% seek job opportunities, 47% visit government webpages, 1 out of 3 played online games, 45% uses the Internet for instant messaging such as Messenger, Skype, etc. 12% traded stocks.

According to Levinson (the inventor of "Guerrilla Marketing") the most effective online sites are those who focus on providing the user with the information they want instead of focusing on entertainment. For him, *"Straightforward data, information that invites comparison, and straight talk are going to win the day."*

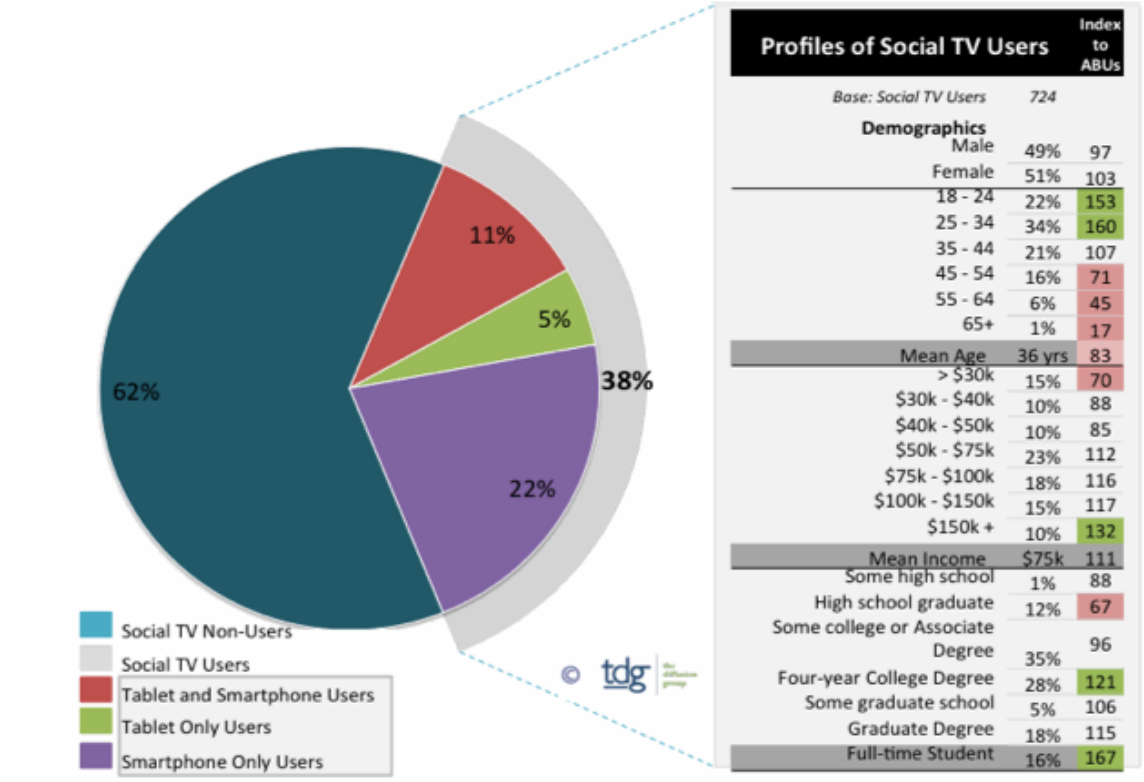


Figure 18: Social TV users [91]

The image above shows the results of the analysis made by TDG (the diffusion group) about the size of the social TV users, this group includes tablets and Smartphone users, tablets only users and smartphone only users. The result was 38% and there is a prediction that this result will increase in the coming few years. According to Jannick Kirk Sørensen, assistant professor at CMI, "*There is a researcher in the German university; she is sociologist and studies about work places. She wrote theoretical analysis of social relationship. She says that you always need a social object to share*". [See Appendix 5] So in other words the social relationships have a great affect on the market trends.

In the following subchapters the case studies from different European broadcasters will be analysed to understand why they are interested in HbbTV after that an analysis of the HbbTV potentials according to the case studies and the different stakeholders' interest in the Danish market and the expected penetration of the HbbTV in the European market and as a special case in Denmark.

6.1 Case Studies

6.1.1 United Kingdom Case Study

In the United Kingdom announced Intellect, the representative of the United Kingdom Technology, the launching of the HbbTV trial in July 2012. This launching came a week after the launching of the hybrid platform YouView, backed by the four major terrestrial broadcasters in UK including the British Broadcasting Corporation (BBC), the commercial service TV network in the United Kingdom ITV plus (Independent Television) and two Internet service providers (ISP). The aim of the launching according to Intellect is that they want a hybrid television system that would work alongside the UK's Freeview platform. William Higham [92], director at Intellect said that the harmonisation with the EU offers more choice to the UK consumers and that it brings the ability to connect and stream additional channels and applications from across Europe. He also says that moving towards TV without borders also gives a huge scale advantages for the UK's content makers and technology companies, in other words the UK's vital creative industries.

The UK's Digital Television Group (DTG) made in October 2012 the HbbTV based connected TV specifications openly available to the industry [93]. The D – Book version 2 is designed specifically on HbbTV to align the UK with the pan European standards. Even though the specifications are built upon the international standards, such as OIPF, ETSI, MPEG-DASH with extensions to carter for UK- specific features, they also include additional features to meet the requirements of the UK's service providers.

6.1.2 ZDF in Germany Case Study

Zweites Deutshes Frensehen (Second German Television) is a public service broadcaster. It was founded in 1961 by the federal treaty, and launched for the first time in 1963 where in the same year it became a member of the European Broadcasting Union (EBU). It is an independent non-profit institute. It is financed by Television licence fees and advertising revenues [94].

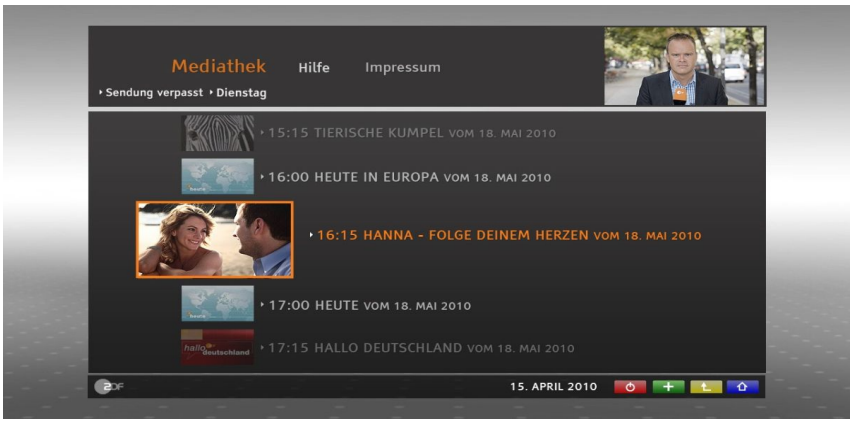


Figure 19: ZDF HbbTV Mediathek [95]

ZDF is a supporter of the HbbTV and they launched their HbbTV on DVB-T network in 2010. In October 2011 the public broadcaster ZDF reported its profits by €52.9 million and that their website attracts six million viewers a month [96]. The services used in the HbbTV application are:

1- Hilfe (Help)
2- Imperssom (Imprint)
3- Nachrichten (News)
4- Heute Journal Plus (News Plus)
5- Sendung verpasst (Catch-up TV)
6- Sendung A-Z (Program A-Z)
7- ZDF Mediathek (ZDF Media Center)

In the first half of 2011, the catch-up TV service Mediathek gained popularity with 30 millions views and the portal's mobile app that were launched on September 2011 were downloaded 390,000 times in one month.

Since the number of the ZDF users is increasing by up to 49% year on year where it reached in October 2010 close to six million [97], and in addition to its Mediathek, ZDF decided to make sports, news and weather programmes available through the HbbTV portal.

6.1.3 *France 24 Case Study*

In DR conference Peter Mølsted, Senior Consultant at Danish Broadcast Corporation, represented the HbbTV in the French market, because it is also still in the mature

stages, where the difference between the French specificities compared to the German are [105]:

- The Broadcast use of DTT network and not the satellite.
- The HbbTV receivers are the TV sets not an Integrated Receiver Decoder (IRD).
- Some HbbTV services are available via both the broadcast and the broadband.

The HbbTV service has been launched on five channels of the France Televisions and available on every HbbTV enabled TV set from 8:00 pm until 12:00 pm. The service is based on HbbTV 1.5, where broadcasers needed to increase their investment to produce it. This include:

- Contextual services
- Interactive adds
- Video – on – Demand (VoD)
- Catch-up services
- Temporary services: linked to sports or political events, such as the Olympic games and interactive service for election results.

Figure 20: "C dans l'air" France 5 hbbtv live program [105]

As for France 24 the French international news channel that offers news in three languages English, French and Arabic, it broadcasts worldwide on a 24/7 basis and can be accessed by cable, satellite, ADSL and mobile. In December 21st 2011 announced France 24 the launch date of the HbbTV [98] services in the early 2012 with cooperation of GlobeCast as a partnership and with the support of Orange and

SES where viewers can use their connected televisions to interact with France 24's linear and non – linear programming via a broadband connection and there is no use for extra devices (Set top boxes).

Less than a year after, in September 2012 announced France 24 the launching of HbbTV interactivity in the Middle East. The launching of the new interactive service happened with collaboration with Orange and Arabsat operators [99]. With the partnership between France 24 and the broadcast service provider GlobeCast, the service will enable satellite viewers to use connected TVs to interact with France 24's linear and on – demand content. For the HbbTV service provided by France 24, Globecast will provide ground services and uplink from its Paris technical operation centre, whereas, the satellite feed will be delivered via Arabsat's BADR – 4 satellite. The broadband delivery of the HbbTV service will be by using the Orange's content delivery network (CDN).

With an interview with Frank Melloul, head of strategy, development and public affairs at France 24, he said: "*France 24 is always concerned with the quality of experience of its viewers worldwide. HbbTV is one technology, which appears to be a promising way to raise the bar for these viewers. Expanding our experiment to a second region, the Middle East, means that we'll have a reliable test to measure the benefits of HbbTV on a global level*".

France 24 sees, according to their head of strategy, great potentials for the HbbTV, which encouraged them to do the launching in the emirates.

6.1.4 Danish Radio (DR) Case Study

Danish Radio (DR) [100] is the biggest Danish national broadcaster; it was founded in 1925 as a public-service organisation. It was founded in 1925 as a public service organisation. Nowadays it is considered to be Denmark's oldest and largest electronic media. In 1950 DR was on of the 23 broadcasters who founded the EBU (European Broadcast Union). DR began broadcasting in 1951. DR is funded by means of licence [101], it is set by the parliament and obliged when reaching the legal age, regardless of whether you make use of the DR's services or not. In 2007 the media license replaced the former TV license, the launch of the media license result in that everyone, who can receive DR's programs or services via TV, PC or mobile phones.

The table below shows the number of users [102] of DR.dk, and if we take into assumption that the dr.dk is the same as DR NU, we can say that there is a fairly steady evolution of 18% -19% between the 2007 – 2011 years.

TABEL 7

Brugere af DR

PCT.	2007	2008	2009	2010	**2011**
Hele DR gns. ugentlig dækning[1]	98	98	98	98	**98**
DR TV gns. ugentlig dækning[2]	83	84	87	88	**88**
DR Radio gns. ugentlig dækning[3]	80	87	86	87	**86**
dr.dk gns. ugentlig dækning[4]	18	18	19	19	**19**

[1] Danskere i alderen 15+, kilde: Megafon Cati-undersøgelse.
[2] Danskere i alderen 3+, kilde: Gallup TV Meter, Definition: set min. 5 min. inden for en uge.
[3] Danskere i alderen 12+, kilde: Gallup Radio Meter, Definition: lyttet m. 5 min. inden for en uge.
[4] Alle danskere i alderen 7+, kilde: FDIM/Gemius (Forskudte kvartaler).

Figure 21: DR users

As a result of the launching of the media license, DR income increased as seen in the table below which means that the use of the DR NU is increasing:

DKK	2008	2009	2010
Media License	2,190	2,220	2,260
Radio	320	320	320
Business license	770	780	795

Figure 22: DR's License Fees per household [103]

Along with new technologies and new services, users attitude is also changing. In the past, people were satisfied with linear TV content but now users are more demanding and want more services such as VOD, teletext, personalized services and many more. So HbbTV is an oppertunity for the broadcasters to keep the market by providing interactive services thus adding value to the user by leading more interactivity with multimedia content. Denmark is the leading country in the development of broadband with high-speed broadband connection and penetration, which is also a driver for HbbTV.

Moreover, according to Denmark's Statistics, the population of big cities such as Copenhagen will grow by 13%, whereas in the whole Denmark the growth will be expected to reach 3% [104]. These results show that there is an increase of the populations, which means an increase of the viewers for the past years, and a potential increase of viewers until the year of 2020.

The above results encouraged DR to launch the HbbTV application on DVB-T network as a pilot test in March 2012 on its DR1.

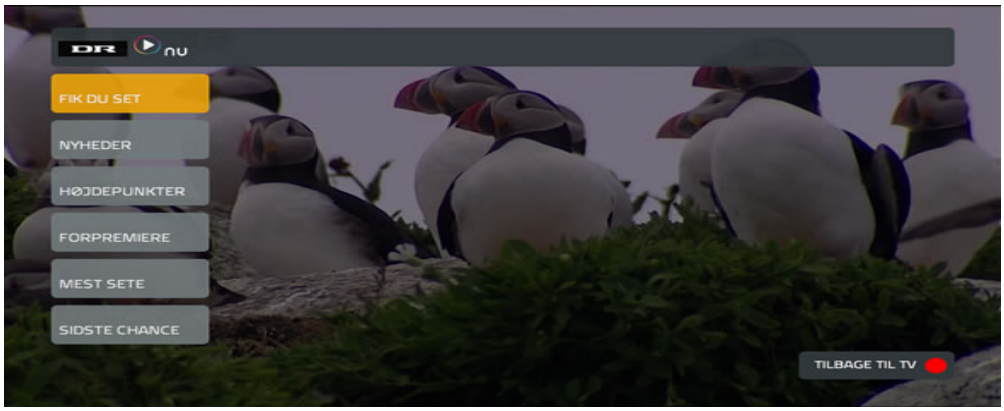


Figure 23: DR1 HbbTV application menu

DR have decided to observe the HbbTV application for errors, such as bugs that are making the system unstable, acceptance by the users, security issues and other considerations until the end of 2012 and then they will decide whether to keep the HbbTV application available for users using the HbbTV enabled devices or not.

They launched the application with 6 services listed below:

1 – News (Nyheder)

2 – Highlights (Højdepunkter)

3 – Previews (Forpremierer)

4 – Mostly viewed (Meste set)

5 – Last chance (Sidst chance)

6 - had you see (Fik du set)

The same above-mentioned services are used on DR NU the online service for DR; the only difference is that for the HbbTV application the services are available for only 7 days whereas on the web the services are available for a whole month. And since it is a test application they used the most used services available on DR NU.

According to Claus Pedersen Blicher, the project leader in DR media, the test trial was a simple test to see what is possible when combining the broadcast with over the top services. The test was a success and they are happy with the results even though the service is simple and has limitations and errors. But the satisfaction is because they prove how it should work in the real environment instead of testing the service internally. [Appendix Interview with DR]

In November 1st, 2012 announced Peter Mølsted, Senior Consultant at Danish Broadcast Corporation, at the DR conference that the results of the test trial [105]:

- The infrastructure exists
- There is few users, around 2000 users for the DR panel

The unique visitors for the HbbTV portal per month after launching the application:

March	**924**
April	9134
May	11325
June	15927
July	19261
August	19208

Table 6: visitors for the HbbTV portal per month

- Visiting the specific services of the red button showed:

Service Name	Visited
Total Page views	29221
Seneste	12938
Mest sete	4271
Highlight	3869
Premiere	3666
Sidste Chance	3124
Update	493
TVA 1830	435
TVA 2100	425

Table 7: visitors of the redbutton

- Users used the Red Button in general were counted: 1417759, where there were 18839 video views in July corresponds to approximately 1% of DR NU was via HbbTV.

6.1.5 YouSee Case Study

YouSee is subsidiary of Tele Denmark Communication (TDC); the largest telecom company in Denmark. TDC is the leading provider of entertainment and communication solution in Denmark in different segments within broadband, telephony and television. Although Denmark is the primary focus of the business,

TDC also has its services in other Nordic countries in Norway, Sweden and Finland through the business unit TDC Nordic.

TDC cable TV is a provider of broadband and Cable Television in Danish households. In order to maintain and strengthen its core competencies in Danish market, TDC cable TV changed its name to YouSee A/S in 1st October 2007. YouSee is now leading supplier of broadcast and broadband solutions for cable-TV network and is the second largest provider of broadband in Denmark. YouSee now offers different entertainment and telecommunication solution to individual households and organized customers (housing associations and antenna).

6.1.5.1 Services

Through the cable network, the main services YouSee offers are TV, broadband services and telephony. With several TV solutions available YouSee's "full package" has 35 channels, and if the customer orders a digital set-top box with their subscription, called a Selector, they are able to receive more channels. YouSee 's Internet, formerly known as Web-Speed, comes in several solutions of up to 50 Mbit downstream and 4 Mbit upstream and includes a web- space with tools to create your own homepage.

They use the DVB-C (Digital Video Broadcasting - Cable) standard for the distribution of the TV and broadband on the cable television.

The products that YouSee deliver are listed below:

- 170 TV channels
- TV channels in more than 20 languages
- 20 Radio channels from Denmark and International
- On Demand service with the ability to record, pause and rewind.
- 460,000 household of broadband
- 80,000 households of IP telephony
- 25 Danish national TV channels

6.1.5.2 Revenues

In 2011, YouSee's revenues [106] increased by 6.2% compared with 2010. The raise in the revenues occurred even though there was a strong competition in the broadband market and almost saturation in the TV market.

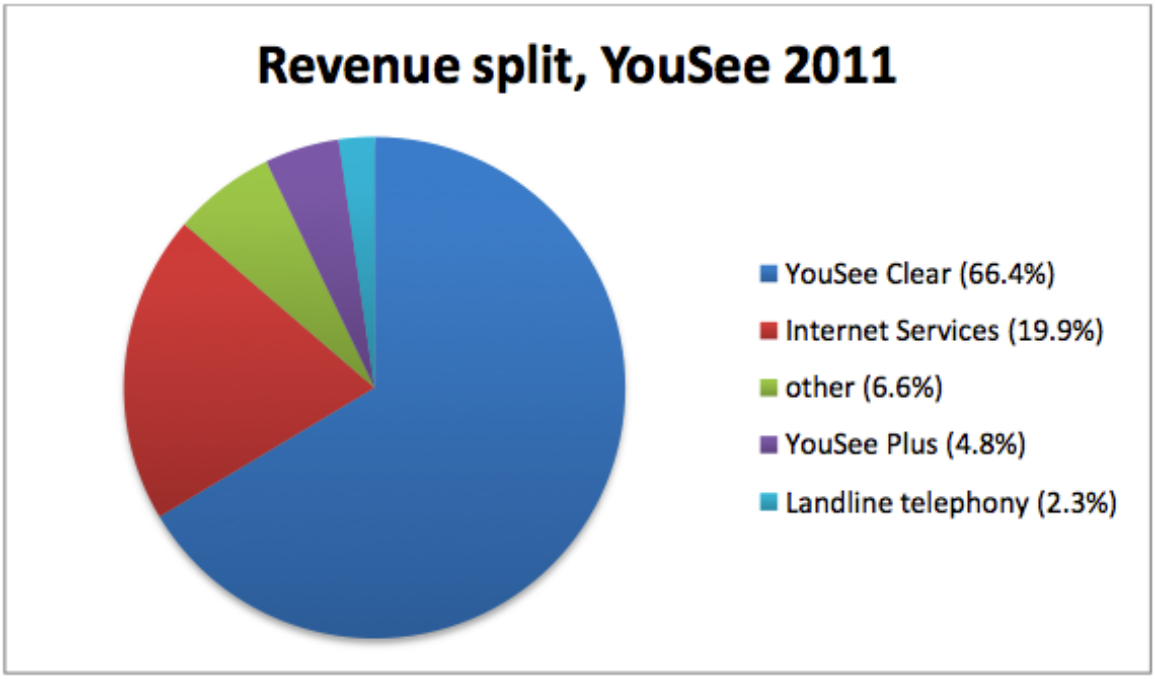


Figure 24: Revenue Split, YouSee 2011

Even though the subscription fees were raised which reflected a wide range of TV channels and increased the content cost, this had a limited affect on the customers and the ARPU (Average Revenue Per User) increased by 6.4%.

And there was a raise in YouSee Clear revenues by 6.9% compared with the previous year.

As for the YouSee Plus, the raise reached 10.2% compared with the previous year despite the raise in the copyright fees and the less expensive choice of TV packages from the customers.

YouSee gained the market share in 2011 for the Internet services because of the customer's demand for higher bandwidth. This demand had a positive effect on the revenues from the Internet services, which rose by 3.5%.

6.1.5.3 Turnovers

YouSee A/S revenues was DKK 4,259 [106] million in December compared with DKK 4,012 million for the same period a year ago, which means a rose by 415 million or 11.5%. The EBITDA (earnings before interest, taxes, depreciation, and amortization) of DKK 1,521 million compared with DKK 1,353 million for the same period a year ago, which means a rose of 18.6%. This was achieved by the increase number of the

Revenue Generating Units (RGU) within all product groups (TV, Broadband and telephony) and increased the Average Revenue per User (ARPU). Despite an almost saturated TV market and strong competition in the broadband market, revenue in YouSee rose by 7.4% compared with 2010.

6.1.5.4 Market Share

YouSee is the largest cable-TV provider in the Danish market; it has a market share of approximately 58% [106] in Denmark. YouSee makes a great effort to achieve the delivery of the premium cable TV and a range of other products and services as well, such as the Internet. Its main product is 'YouSee Clear' that enables the customers to choose from standard digital TV packages or the 'Extra Channels'. The add-on products helped on increasing the market share for YouSee due to its flexibility and different features such as the start-over and pause. Nevertheless the video-on-demand feature that made YouSee get a market share of 49% of the Pay - TV market.

6.1.5.5 Business Model for Web TV

As a leading provider of both broadband and broadcast solutions, YouSee focuses on adding more value added services such as YouSee WebTV for the customers and the new TV access iPad and iPhone apps. WebTV is a television that can be watch over the Internet and uses different forms of new media to deliver the original series or shows to the audience. Through YouSee WebTV, customers can watch different live channels, rent movies and also see DR programs from the last 30 days. Customers can watch TV when they are at work, in a café, on the train and in the home. YouSee WebTV gives more opportunities for the consumers to watch TV on selected devices such as PC, tablets, iPad and iPhones.

"The business model forYouSee WebTV is very simple. If the customer has broadband and TV subscription from us, you can watch our channels on PC or tablet or iPhone or iPad or whatever when you are connecting to your broadband home network. We know you are in your house and we know you have already paid for these channels, so we can make our channels available to you in your different devices. We bundle that into our broadband product, if you have broadband and TV from us, you can watch channels for free on your different devices and people really liked it. So it is a way of differentiating our broadband product from other competitors like Full Rate, Telenor or Telia because we can offer you to

access to TV channels if you have broadband from us, so we compete with others on something different other than speed and price" [See Appendix 7].

Pricing and content for WebTV subscription

When consumer subscribes to YouSee's WebTV, they get access to 22 different channels. Channels which comes along with WebTV subscription are: [107] DR1, DR2, DR update, DR Ramasjang, DR K, DR HD, TV 2, TV 2 Zulu, TV 2 News, TV 2 Charlie, Canal 9, The Voice TV, STV 1, SVT 2, ARD, ZDF, Discovery, Animal Planet, National Geographic, Euro Sport, Disney channel and Disney XD. The monthly fee for WebTV subscription is 199 DKK

Customers can also rent movies both Danish and English movies of different categories and all the films cost between 19 and 39 Kr for 24 hours access. Customers have possibility to select movies by different genre (action, animation, children movies, drama, adventure, horror etc) and also select movies by theme (disaster movies, dance film, Christmas movies, prison movies etc.). Other possibility to select movies is by directly entering the name of the movies.

6.1.5.6 Why YouSee is interested in HbbTV

YouSee has been continuously working to improve its services and focus on value added service to its customers. So YouSee is very much interested in HbbTV, as this technology has the possibility to combine broadcasting services with broadband services, thus add value to the user by leading more interactivity with multimedia content.

Along with new technologies and new services, users behaviors are also changing. Users are more demanding, which leads service providers to provide more channels by which choices are multiplied massively and according to the Jacob Jørgenson, choices are going to be even bigger with TV archieves and cache-up services. As a result of converging technologies, users will benefit from a significantly different and new user experience to fulfill their demand.

Moreover, there are lots of things happening in the market, right now there is a lot about Netflix and HBO companies as strictly online streaming services. Netflix has launched its services in Denmark in mid October and Danish consumers can sign up the service for only 79 DKK($14), with first month free trial. That is really a bypass way that Netflix or whoever that bypass beyond television by buying stuff and then sell it directly to customers without having been seen on television channels. "*In the*

US there is been some suggestions of what we can say called cable cutting, which is when people drop the cable subscription in favour for just the streaming services. In a way they go from big package to medium and then drop for Netflix and the cable-shaving thing is probably what will happen and probably we will see it here in Denmark as well"[See appendix 7].

So there is a big possibility that online streaming services such as Netflix takes part of the YouSee's market by providing attractive streaming services in cheaper price. HbbTV in this case might help broadcasters to stay in the market in an attractive way, by providing extra services that are interesting for subscribers, those services will be with a better streaming quality and is delivered directly to their big screen.

"*We want to do the same as DR for the HbbTV to make it as a test, launch it to the public and observe without having a finite business model and of course to test for errors in the application if any. We are on a trial basis, but if you have for an instant way say TV2 put out their stuff for free on an HbbTV platform and say if you have access to this channel, then you have access to all this stuff, then we would be on a tremendous pressure to put the signalling into our network. We could really avoid it I think that would lose a lot if want to stay a competitive in the market and so on, we would need to do this. "* [See appendix 7].

According to the interview with technical Director at YouSee, YouSee is well prepared for HbbTV. In fact they want to get rid of set-top boxes. They have chosen Samsung TV; because it is a major TV brand in Denmark; so they have put effort putting their on demand services on the Samsung TV sets directly.

6.2 HbbTV Potentials

The purpose of HbbTV (Hybrid Broadcast Broadband) is to make TV shows available directly on the TV screen whenever the user has time by clicking on the red button and entering the broadcast portal. With HbbTV services, content providers can be able to develop attractive applications that suit the consumers such as the personalised Electronic Program Guide (EPEG) or many other services such as the most popular ones for date, the VOD and the catch–up TV.

Many studies have been made about the usage of the Internet and TV in Europe, these studies were made to know how fast will be the adoption of the new technology and how people are accepting the new technology in the market, such as the usage of the TV, Internet, TV services, or if they are willing to buy the new smart TV sets or even own them.

As seen from the different case studies above that there are many European countries that are supporting the HbbTV. In September 2012 gave Spain the green light the HbbTV standard, where the Ministry of Industry has approved a formal text backed by the electronics industry and TV broadcasters including 54 companies to adopt the HbbTV standard to develop new connected TV services. Spain follows the example of Germany, France, Holland, Austria and other Scandinavian countries in adopting the HbbTV standard.

In Denmark, Peter Mølsted, the Senior Consultant at Danish Broadcast Corporation, is expecting that from 2013 all Integrated Digital TV (IDTV) manufacturers will have activated HbbTV in recipients TV sets. This means that DR has already pushed the HbbTV into the Danish market and the opportunities for it to be adopted in the Danish market are becoming high. DR then can force the different stakeholders such as the manufacturers to push the HbbTV into the Danish market.

Whereas the senior product manager at TDC DSL Torben Rasmussen, he sees that there are no potentials for the HbbTV, because he can't see the user experience with it and thus can't see the scenario. For him it is not a killer application, "*The way I see is as long as you are creating product which are not evolving from the customer perspective and needs, you are going to loose. There is no chance for surviving and I don't see why I as a customer should use this specific service, well I can gets apps on my TV, why would like to have apps on my TV because I would like to check my Facebook and play games. But all of these things I can do on the iPad, my PC and the iPad has keyboard and PC has keyboard, so why should I use this service. We are providing services to our customers via the Set Top Box any how, so why should we use HbbTV*". He continues by explaining that before providing customers with a new services, a study for the market will be relevant to know if the HbbTV going to be a new platform, and if it is going to provide a new user experience, but he can see that broadcasters are facing a problem and HbbTV is the way they are trying to solve it, but this solution is not going to change the customers behavior, because it a solution for the broadcasters problem.

6.3 HbbTV market penetration

Many global studies were made to learn more about the potentials and penetrations of the connected TV sets. In this section the status of the European market will be presented.

After adopting the standard in September 2012, the Administration in Spain paves the way for the introduction of HbbTV, where all TV sets with Internet connection capabilities will include the standard and a label to identify them. The Electronic Manufacturers Association Ametic estimates that this year the sale of HbbTV-ready TV sets will double to 1.1 million – one in four TV sets sold [108].

A study made by SevenOne Media In Germany showed that users today uses the TV and Internet simultaneously where there are 50% between the ages 14 to 49 users; whereas 63% of the users search the web for TV related content. And that there is a quick market penetration of the connected TVs and HbbTV because there is a high consumer acceptance where, 11 million Germans are interested in Internet–based TV–services where [109]:

- 70% of the Germans have heard of the Internet TVs, Smart TV and HbbTV
- 11% of the Germans have an Internet–TV
- 90% of the Households have access to broadband Internet.

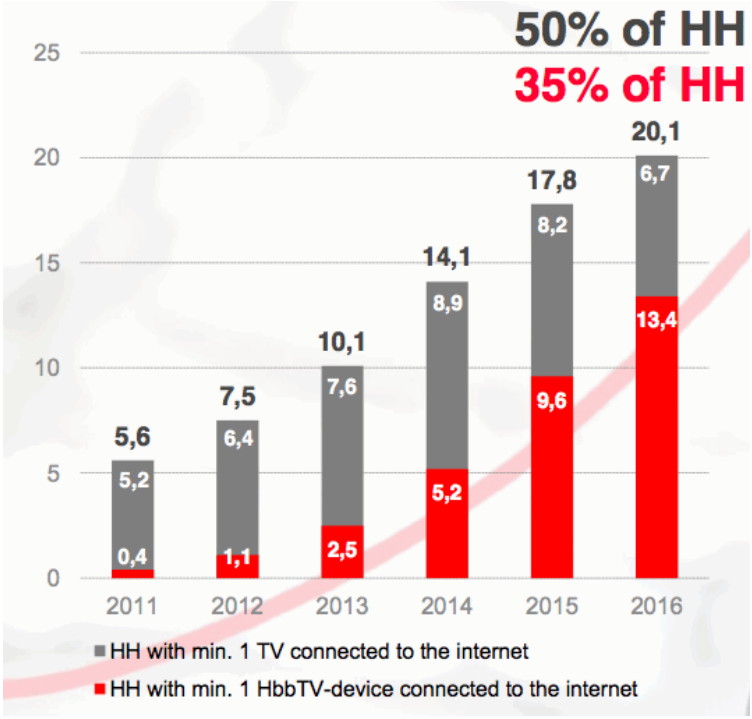


Figure 25: Forecast Connected TV and HbbTV [109]

The expectations are that 20 million German households will be having connected TVs by the year 2016.

According to a study made by YouGov, the smart TV sales will reach £ 2.5 billion in the United Kingdom, because the TV and Internet all in one market in Britain is growing and brits are willing to buy them. This study was made to show if there is an

increasing will from the customers to connect their big screen to the Internet. The results showed that 55% [110] of the population in Britain already have their TV sets connected to the Internet. And this result could be considered as a driver to an increase in sales of the smart TV, because customers are willing to change their behaviours.

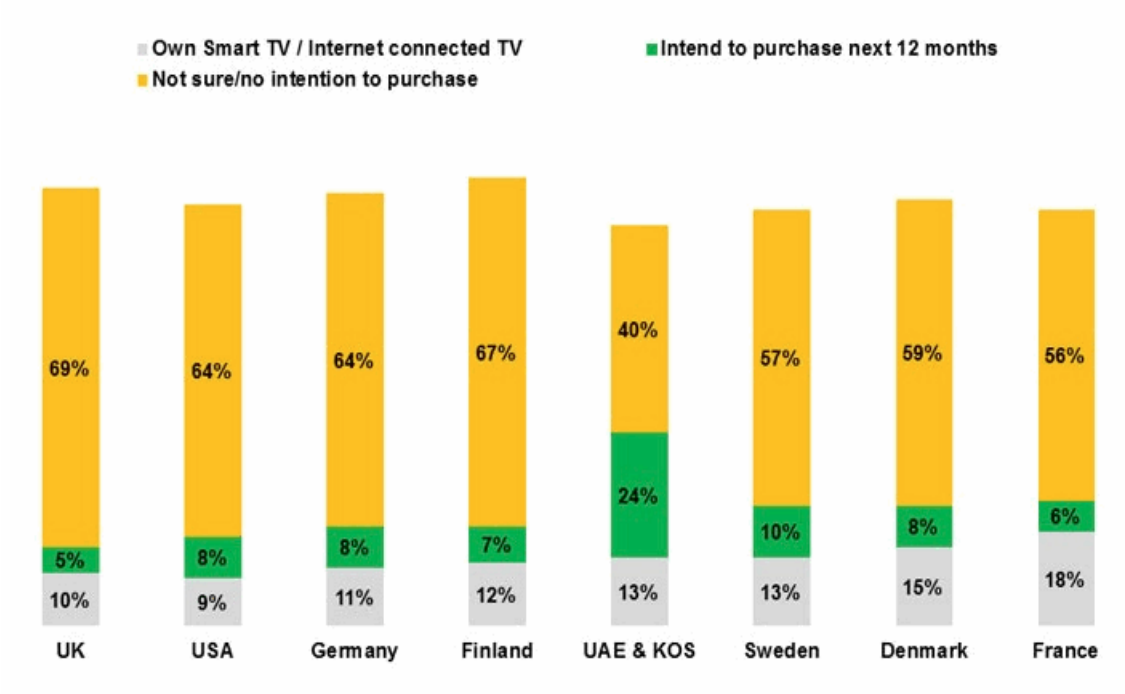


Figure 26: Smart TV penetration [111]

The above figure shows that the global adoption of the smart TV is still relatively low, where only 10% of the UK population owns a smart TV almost similar to the low market for smart TV in USA. However, the levels are high in France and Scandinavia especially in Denmark. As for the intentions to purchase the smart TV is particularly high in UAE (United Arab Emirates).

In Denmark, and as shown from the above figure, 15% of the Danish population already owns a smart TV, and according to the study made by YouGov that shows that 1 out of 5 Danes who watch TV shows and movies regularly will change their televisions out within the next year and in particular, to the new Smart TV that gives access to Internet-based services on television. Whereas every one out of two Danish, who watches TV series and movies, are considering on changing their TV with a smart TV within the coming year. Andreas Ishøy, the research consultant at YouGov [112], says that many Danes would like to have access to stream TV shows and movies quickly and legally without having to sit with a laptop in hand. And this gives Smart TV a fast and easy access to Internet based services such as video on

demand, social networks, and online games at the same time television comfort is maintained. It is a unique combination that sounds attractive to many Danes.

Even though the demand on the smart TV is increasing, but yet the use of TV apps is very low. According to the YouGov study only 12% of the Danes have tried to download apps on their TV sets, 35% never heard about it, and 48% knows about it but never tried it, Andreas Ishøy think that it is a matter of time, because the demands on smart TVs are increasing significantly and soon will be the knowledge on using the TV apps especially when the Danish users will experience them as a user friendly.

6.4 Summary

The HbbTV is a new technology in the market and many broadcasters are trying different types of business models along with it in the test period, thus case studies from different European broadcasters helped us to analyse the potential of the HbbTV and different stakeholders interest behind it. The success of HbbTV depends on the smart TV penetration, which is relatively low now, but the demands on smart TVs are increasing significantly which influence the likelihood of success of HbbTV. In Denmark, the HbbTV trial period conducted by DR was a great success and many stakeholders in the Danish market are now waiting for the DR to launch the final version.

YouSee being the largest cable –TV provider in the Danish market is ready for the HbbTV. Streaming companies like Netflix and HBO are big threat for YouSee at the moment. YouSee being a content aggregator and content provider will need to emphasize on its inherent advantages in content and picture quality and need to develop alternative services that counter Netflix's advantages in cost and flexible.

7. Services

Services are the core of the HbbTV application, the more attractive services applied on the application the more it will make it succeed and attract more viewers as seen from the ZDF case study where the success of the ZDF- Mediathek made them decided to make sports, news and weather programs available through the HbbTV portal.

The new generation is supposed to be accepting the complex propositions brought up by the Internet, but according to Peter MacAvock [113] this shouldn't be the case with the broadcasters and the CE vendors. The offers have to keep simplicity as it always was in the past and this shouldn't change in the future.

Aggregators/ distributors are trying to find a solution to represent their services in an alternative way to the set top boxes. Jørgen Michaelsen, the technical director of YouSee is optimistic about the HbbTV, because according to him, they are missing the standard way to deliver their services.

The main goal of the HbbTV solution is to help broadcasters empower their position in the market by keeping the hybrid solution simple for the consumers and add attractive services to the application. The EBU members testify the popularity of the on demand services based on their web-based services including the VOD and the catch-up services. The teletext service as well in the form of the HTML- based as well is popular according to MacAvock. The third most popular service is the weather application.

During the internship at YouSee (3rd semester), we found out the most popular services are the on demand service in VOD and catch-up TV forms, News and the weather. In a discussion, with Kristoffer Bo Jørgensen, about the most beneficial services for YouSee, he explained YouSee's need for the VOD service in the HbbTV, since most of their revenues come from that service. Jacob Sørensen (on demand chef of YouSee A/S) explained the need for the sports service beside the VOD, the weather and the Highlights, which was because YouSee have a partnership with a new sports channel called "Kanal sport", so adding the service sports where you can read more about the sports news and bet on the sports will add value to the HbbTV application at YouSee.

Another beneficial service for the YouSee could be personalized Electronic Program Guide (EPG). An electronic program guide (EPG) is an interactive schedule of current and upcoming scheduled programs that are or will be available on each channel and

a short summary or explanation for each program as user has a broad range of programs to select with the growing number of terrestrial satellite and cable channels made available. Though EPG provides menu, which allows consumer to see list of programs scheduled, and short summary description, with the increasing number of channels, it also makes difficult for consumers to make a selection according to their interest as they are overwhelmed by choice. Moreover, different members of the same household often have different tastes, each family member subscribing to different channels. This results in a TV that contains hundreds of channels, of which every member only watches a very small subset [114]. Thus personalized EPG will save consumers time by making the program schedules available according to his or her favorites and interest, thereby decreasing the negative effects of information overload. For example, if consumer's favorite program is sports, personalized EPG will display the schedules only related to the sports, and thus user will always enjoy exactly the content he or she is most interested in right time. Therefore, personalized EPG in HbbTV will increase the personal benefit of watching television. Moreover, personalized EPG in HbbTV will help in faster adoption of the HbbTV as more attractive services applied on the application the more it will make it succeed and attract more viewers.

Personalized EPG provides following benefits to the user: [115]

- **Ease of use**: The system should be easy to use, interface to browse and search through TV show listing. Ease-of-use is essential so that all users will be able to easily find shows interesting for them and feel at ease with the system's everyday use, irrespective of how much they want to get involved and interact with the system.
- **Trust**: Explanations of recommendations in simple that creates the trust in the recommender system. The concern of trust come when an unknown show was highly recommended to users, they tended to imagine that the recommender was unreliable.
- **Accuracy:** Personalized EPG is an accurate recommender system that can record users viewing habits and automatically personalize the interface presentation so as to aid the viewer in making viewing or recording decisions.

EPG is also a great source of revenues for different players in the value chain. Direct EPG revenues mainly come from B2B transactions [116]: implementation of EPGs in end devices, from technical development, software and programme updates and licenses. In 2008, the revenues generated in Western Europe from EPG amounted to

about €156 and Goldmedia and Screen Digest[4] report forecasts that these revenues will nearly triple by 2014 to €451m. The EPG is becoming both a sales portal for pay-TV operators and interactive advertising medium and other content providers. Furthermore, EPG is quickly gaining importance as a transaction, communication platform and advertisement. Many different players are involved in the EPG market, covering different areas of the value chain: TV platform operators; content providers; middleware, end-device vendors and application developers. In order to create and maintain innovative and interactive EPG, a variety of companies are responsible for the development, implementation, and maintenance of EPGs.

From the above analysis, a decision was to add the personalized Electronic Program Guide to the HbbTV used by YouSee.

Before discussing the scenarios of the service personalized EPG, the characteristics of the services will be discussed in the following sub-chapter.

7.1 Characteristics of the Services

7.1.1 Interactivity

For the Hybrid TV, interactivity means that the viewers can interact with the TV content, application content, but it does not mean that the audience can change the storyline of the broadcast channel. According to Günther Hölbling [117], an interactive application offers different levels of interactivity:

- *Level 1* - Basic TV: basic functions for watching TV, turning TV on and off, changing the channels.
- *Level 2* – Call-In-TV: telephone call or text messages are used for interaction between audience and broadcaster. Example: TV shows where audience can select a music video using text message.
- *Level 3* – Parallel TV: suggest different content on multiple channels. The audience is able to change the way they view a broadcast content. Example: change the sound/subtitles depending on desired language.

[4] **Screen Digest** is the pre-eminent firm of industry analysts covering global media markets and specialist analysts covering film, television, broadband, mobile, cinema, home entertainment and gaming.. **Goldmedia** offers: in-depth analysis of markets and competitors; forecasts and strategic consulting services; the implementation of new business models; and consulting for restructuring whole companies, including M&A processes in the field of corporate finance.

- *Level 4* – Additive TV (also known as enhanced TV): Well know example of this level on interaction is Tele-text. Also, EPG or synchronized program-related services are advanced examples of this.
- *Level 5* – Service on Demand: The viewer is able to consume content independent of the TV schedule. This kind of interaction requires the return channel between the user and content provider.
- *Level 6* – Communicative TV: In addiction to broadcast content, online services can be accessed. Example: chats, social networks, email, etc.
- *Level 7* – Fully Interactive TV: The viewer is able to create his/her individual storyline for program. At this level, the program is presented as a kind of video game in which the user decides what is going to happen next.

Nowadays Levels 4, 5, 6, can describe most of the interactive TV (iTV) applications. Application on Level 7 is still being developed.

Nowadays, HbbTV is not the only technology for interactive TV in the market, but what differs HbbTV from the rest is that it enables an extension of the broadcast services to be delivered through the IP connection and provide an all-in-one audience experience of the broadcast content. The ZDF and DR case studies are examples on interactivity with HbbTV.

7.1.2 User – Centrism

To keep track of the recent development of multimedia, the user-centrism concept is considered to be one of the techniques. Reiterer et al. [118] defines the following requirements for the multimedia systems:

- *Easy access to available content repositories:* the focus here is on the integration of the content that is provided by different resources and a common way to use it.
- *Context awareness:* the information is used to provide continuous use of the multimedia content.
- *Session migration:* in this requirement the user should be able to take media sessions with him by migrating the sessions from one device to the other.
- *Content adaption:* for a satisfying media experience, the content is personalized to the specific target device characteristics and properties.

7.1.3 *Convergence*

Convergence is generally understood to mean the capability of different network platforms carry similar kinds of services, or the coming together of consumer devices such as television, telephone and personal computer. HbbTV is a convergence of broadband and broadcast delivery of entertainment to the end user. There are different types of convergence such as convergence in terms of market, convergence in terms of service, convergence in terms of regulation and convergence in terms of technology and these convergence are explained detail in section 5.

7.1.4 *Personalisation*

At the conceptual level, personalization means different things to different people in different fields. The meaning of personalization is to provide person-centered services to everyone. It is the process that enables people to have more control on the services they receive. For example, personalized news can be presented to the viewer according to his likes/dislikes or habits.

The term personalization has been studied in different fields and each field has its own definition and goal of personalization. For computer scientist, personalization is a toolbox of technologies to improve the web experience through graphic user interface; for architects, personalization means creating friendly personal space; for social scientist, personalization is a way of enhancing social relationship and building social networks. The marketing/e-commerce shows personalization as a way to manage customer relationship by delivering unique value, thus benefiting each specific customer [119]. Instead, computer scientists in the computer human interaction (CHI) group view personalization as a method to close the gap between computer and user.

The most relevant definition or the goal of personalization in terms of HbbTV service relates to the definition of personalization by marketing/e-commerce: a way to manage customer relationship by delivering unique value, thus benefiting each specific customer. Personalized services in HbbTV will benefit the specific customers, by always providing the content that he or she is most interested in, thereby decreasing the negative effects of information overload.

HbbTV provides, among other things, the possibility of a personalized television. For example, Electronic program guide can be presented to the user according to his

likes/dislikes or favorite. An HbbTV application could suggest new items according to the viewer's habit, or HbbTV can suggest new items according to the user favorites. This could be realized with HbbTV [120] using cookies on the TV set or STB. The cookies could store a user ID or user profile. HbbTV provides the opportunity of interaction with a web-service, where TV sets, which are low interactive devices, can benefit from the high interactivity of web-services, which can lead to personalization.

Moreover, personalized services in HbbTV could help in the faster adoption of the HbbTV among the consumers, as researchers has indicated that when consumer are focused on their unique identity as an individual, they respond differently as their motivation is largely driven by their particular needs, when they are indivuated. Personalization in terms of Hybrid TV can play the huge role while aggregating the content and serving it to the particular user.

Personalization thus has several benefits. It helps users to manage with the plenty of available information. Advertisers and marketers have long recognized the advantages of personalization and have taken advantages for many years now. Survey done by Choice Stream [121] indicates that 76% of consumers said that they would like to receive personal content, which means that more users want personalized content. Further more, research in communication and psychology has shown that people favor objects or experiences that are narrowly related to themselves, compared to the experiences or objects that are not related to them [121]. Personalization has positively affect users attitudes towards the device, raising their tendency to use it repeatedly [122]. According to Oulastvirta and blom [121], personalization can:

- Promote autonomy (unpressured willingness to engage in activity),
- Maintain the need for relatedness (the need to establish close emotional bonds with and attachments to other people) and
- Support competence (by increasing the effectiveness of the users' action).

The author also examines a number of positive outcomes of personalization including performance, persistence, engagement, identity, social acceptance and social status.

However, there are some serious barriers of personalization: purely designed systems interface; users refuse to provide the personal data due to the security issues, etc.

7.1.4.1 A classification scheme for implementations of personalization

There are different perspectives on the variety of approaches to personalization: the target of personalization, the part of the information system that is manipulated to provide personalization, and degree to which personalization is automated. The scheme for implementation of personalization is constructed along three dimensions: [119] what is personalized, to whom to personalize and who does the personalization.

What is personalized?

The aspect of what is personalized represents necessary elements of the information system that can be used in a personalization system to make the system more personally related to the user. In terms of the aspect what is personalized, there are four aspects of the information system that can be personalized:

- The content (information itself),
- The user interface (how the information is presented),
- The channel/information access (the media across which information is distributed), and
- The functionality (what users can do with the system).

Whom to personalized?

The second aspect, whom to personalize, indicates the target of personalization. Personalization can be done to either a category of individuals (Group- centered) or a specific individual or mixed.

- **Group-centered**: Here, recommendations are generated to group of users based on their similarities, such as age, location, profession etc. and the recommendation is being addressed to the whole group of viewers. Example of group-centered personalization is for example, a particular category of user such as women, kids, members of a specific club or single child families.
- **Individual**: Individuated personalization is aimed to a certain individual with an objective to deliver services, goods, or the information unique to each individual as an individual. Here, recommendations are based on a specific user's likes and dislikes and generated recommendations are presented to individual users.
- **Mixed**: In this category, both individual and group-centered methods are combined to a certain degree.

To be able to categories the degree of personalization, we need to identify the user. So the users can be categorized as follows:

- **Anonymous:** recommendations are addressed to the user without identifying the current user. This kind of recommendations often is not correct as they are generated based only on the users interaction with the system.
- **Pseudonym:** the user is tagged with the source of identification, the pseudonym. The real user's identity is hidden behind his or her pseudonym. In this category, the recommendations are generated on a well-rounded view of particular user's interaction with the system.
- **Full identification**: The user provides his personal data. This category can provide the most accurate recommendations, however, often refused by the user, because of the privacy issues.

Who does the personalization?

In order to make the services personalized, data from the users should be collected to fill the users profile. In other words, there should be something that identifies the user profile and describes him. According to Günther Hölbling those are the methods that are used frequently to collect the data:

- **Implicit**: Observing user's behavior is the method to collect the data. Implicit personalization is method of collecting data from the user where data collection is done automatically by the system. This means, that user interests are being associated with the content that the particular user has consumed. Recommendations can be based on the user's action and/or similarities with others users. So the implicit personalization is user-initiated.
- **Explicit:** Explicit personalization is another way of collecting data from user where user participates by making choices or provide information to give the system guidance as to how to adapt. Here, data is being collected by directly asking the user to rate the content. This kind of approach ideally would provide a very useful and high quality feedback, so this data can be interpreted easily rather than the one gathered using, implicit approach. Hence, explicit personalization would be expected to affect users differently than would implicit personalization. However, it requires the user to perform extra actions, which often bothers the user and leaves questions unanswered.

- **Hybrid**: Combines both Implicit and Explicit methods. For instance, explicit method can be used to collect basic profile data such as: user location, age, etc., ◎When personalizing a service with TV, the key factor is the viewers and to what degree of personalization should this specific content be personalized.

7.2 Summary

Generally services are the drivers for the Hybrid TV as they add values to the broadcast content. Especially VOD has the potential to attract more viewers to the broadcast TV.

HbbTV is a convergence of broadband and broadcast delivery of entertainment to the end user and provides interactivity where viewers can interact with the TV content and application content. Additionally, HbbTV provides the possibility of personalized television where user can personalize content by which they will always get the content that they are interested in. Personalization will help the users to manage with the plenty of available information and decrease the negative effects of information overload.

8. Drivers and Barriers for HbbTV

In the case of HbbTV, barriers can also be drivers such as the main players for this technology can either push it or pull it off the market. In the following sub-chapters a list of barriers and drivers will be listed and analysed.

8.1 HbbTV Drivers

The drivers for the HbbTV are classified in terms of market and technology.

8.1.1 Drivers in terms of market

The market drivers for the HbbTV are: support from wide range of players, possibility to provide personalized services, easier access of the internet content for computer illiterate consumer and contribute to the reduction of CO_2.

1. **Support from wide range of players**: The main driver for the HbbTV is the 'players' (stakeholders) around it. The members of the HbbTV consortium represent the whole value chain (broadcasters, distributors/aggregators, network providers and CE manufactures) and HbbTV has gained wide support from those players all over the world. The standard has gone from origin to deployment in many countries just in three years.
2. **Personalized services**: One of the main drivers for the HbbTV is that it gives possibility of personalized television. With Hybrid TV, it is possible to get data back from the viewer which allows collecting data about his/ her behaviour and preferences, thus leading to personalized services. Personalization in HbbTV will benefit the specific consumers by always providing the content that he or she is most interested in (for example personalized EPG), thereby decreasing the negative effects of information overload.
3. **TV becomes high interactive device**: Historically, the TV is meant for watching the contents broadcasted by the broadcasters. HbbTV provides the opportunity of interaction with a web-service, where TV sets, which are low interactive devices, can benefit from the high interactivity of web-services.
4. **Easier access of internet content for computer illiterate consumer [**123**]**: Consumer who are not computer literate are more likely to embrace the Internet, video on

demand and so on if they can access those technologies through their big screen the TV, since TV are familiar and easy to navigate using the remote control unlike the personal computers that tend to be more text oriented and require for some persons a lot of training and a formal education.

5. **Reduction of CO_2**: HbbTV will minimize the use of different devices and contribute in the reduction of CO_2. By adopting HbbTV, consumers will be able to view all of services on their flat screen TV, via a single device instead of different devices. Also, thousand of Set Top Boxes which are being used now can be replaced with small chip within the HbbTV, saving considerable amount of materials needed to built Set Top Boxes.
6. **High speed broadband:** Denmark is leading country in the development of broadband and has very high – speed broadband connection. In Denmark, the lowest marketed data rate is 2 Mbps and most subscriptions are now atleast 10Mbps [124]. Denmark has an ambitious goal that all the Danish citzen should have access to will be 100 Mbits in 2020. Thus high speed broadband connection is one of the big drivers for the adoption of HbbTV, as hybrid TV requires more than 10 Mbps required for heavy content as VOD to get a decent quality and smoothness.

8.1.2 Drivers in terms of technology

The drivers of HbbTV in terms of technology are:

1. Built from the component of mature standards.
2. Standardised browser profile.
3. Cross – linking options (through red button).
4. Browser based interactive TV applications.
5. Open standard.
6. Easy and fast application development (XHTML/HTML5, JavaScript, CSS).
7. Security (https, TLS and HLS).
8. Backward Compatible (based on DVB MHP).

8.2 HbbTV Barriers

Similar to the drivers, barriers for the HbbTV are also classified in terms market and technology.

8.2.1 Barriers in terms of market

HbbTV has several barriers to success. These barriers consists of more bandwidth consumption, requirement of Hbb enabled TV set, changes in the consumer behaviour, slow penetration rate, and issue with the content rights and digital right management.

1. **More bandwidth consumption:** the more use of the HbbTV application on the big screen, the more consumption of the capacity on the broadband connection, so customer will need a lot of bandwidth in order to access the content and this could be a big issue for lot of people. In relation with the Hybrid TV, the full experience depends heavily on the downstream data rate: while lightweight interactivity (Voting, shopping etc.) may be satisfied with data rates down to the minimum, more than 10 Mbps required for heavy content as VOD to get a decent quality and smoothness [125]. Thus if customer wants to have HbbTV, they need to have very high broadband connection to satisfy that demand. Also cost related to high bandwidth can affect HbbTV, as customers may not be willing to pay more for the high bandwidth.
2. **Requirement of HbbTV enabled set:** The HbbTV chips have to be made available and built in with all new TV sets, which means that customer will have to buy new HbbTV enabled TV set or Set-top box. This would decrease the potential of the HbbTV, as changing new HbbTV enabled set and Set-top boxes could be expensive and there is also lots of waste of materials.
3. **User Behaviour**: TV is normally meant for watching services provided by the broadcasters. HbbTV combine broadcasting services with the broadband service and provide customer access to the different app leading to more interactivity with TV. This would require to change customer behaviour as customers are used to access app via other devices like iPad, PC, tablet and iPhone, which are much more easier. Moreover, many customers today are satisfied with the linear TV content with some catch up TV. Thus it would require changing in the customer behavior, which would take a far more time than it is expected.

4. **Decrease of revenues for TV stations:** HbbTV increase the potentials for personalisation. For the TV stations, advertisement is the greatest source of revenue and if the degree of freedom for the customer to choose exactly the channels they want is to be increased (personalized services), the TV stations would have to settle with lower customer base, which would decrease in the revenue from commercials.
5. **Content rights**: There are several dimensions to content rights and they are very important. They are for example linked to which media to transmit the signal, is it fiber or is it through the terrestrial or is it satellite, how is it transported to the end user or viewer.
6. **Members in HbbTV Consortium:** The members of the HbbTV consortium consists of broadcasters, distributors/aggregators, network providers and CE manufactures and the goal of HbbTV consortium is to create a standard that every body is satisfied with. But different players may have different interest and it is very hard to set on the standard where everyone is satisfied.
7. **Digital Rights Management:** DRM plays a very important role for securing the content. This could be barrier and huge issue for HbbTV since there is no specific DRM supporting HbbTV.
8. **Slow penetration rate**: All the barriers mentioned above leads to the slow market penetration rate for HbbTV and for the stakeholders to get benefit from HbbTV, the penetration rate should be pretty higher and this might take a long time before the HbbTV penetration is going to be huge enough to cover some part of the market.

8.2.2 Barriers in terms of technology

The barriers of the HbbTV in terms of the technology are:

1. The browsers can be misused, if the same browser is used for broadcast -related and broadcast independent application.
2. The broadcasters manage interactivity.
3. Implementation of the platform is closed source.
4. Open source code is not available.

8.3 Summary

Even though HbbTV is very promising standard and likely to become winning TV platform, it has several barriers to success. The success of HbbTV depends on the smart TV penetration, which is relatively low now, but the demands on smart TVs are increasing significantly. Also user behaviour will change slowly as the demands on smart TVs are increasing and soon will be the knowledge on using the TV apps. Some market drivers such as support from wide range of players, personalized services and high – speed broadband development greatly influence the likelihood of success of HbbTV.

9. Pilot Project "Personalized Interactive EPG based on HbbTV "

In the following sub chapters we will represent the scenario of applications based on HbbTV and the scenario made for the pilot project, "Personalised interactive EPG based on HbbTV". Furthermore we will present results of our primary research. The personal interview, online survey and user test for the pilot project were chosen as our primary data collection methods due to their strength to focus directly on the topic.

9.1 Introduction to usage scenarios

A fundamental tool in designing a business model is the story telling that can guide us to focus on the user's requirements, which are different from the technical, or the business requirements. It describes how the users can interact with the system, in other words it describes the system interaction from the user's perspective. The interactivity that HbbTV provide must fulfill the 'lean back' interaction where we have to take into consideration while designing the service that the users are typically relaxing in their living room and using a simple controller to control the TV with, which is the remote control.

The service chosen covers a variety of users need from a TV application.

- Personalized electronic program guide (PEPG) will be designed for those users who would like to individualize their EPG.

In the following sub-chapters there will be a description for the service scenarios that will explore the customer's needs regarding the HbbTV services in general and again personalized EPG service.

9.1.1 HbbTV usage Scenario in General

The end-user can switch between several channels where different channel-related applications are available. Applications can start automatically when the channel is tuned by displaying a pop-up. The user can then decide whether to watch TV services, broadcast related applications or broadcast independent application. If user decide to interact with the broadcast-related applications by pressing the red button,

user can interact with different red button application such as interactive advertising, voting, quiz, sport scoring, digital Teletext etc.

Broadcast-independent applications (catch-up TV, video on demand, games-social networking, photo sharing etc.) cannot be launched by the red button and are available through a broadcast-related application or through a portal independent from a TV channel. The user can switch to the internet enabled portal by pressing the "portal" button on the remote control, which will give access to HbbTV broadcast-independent applications related to user's device manufacturer.

9.1.2 Personalized electronic program guide (PEPG)

A sports fan sitting alone Friday night because there is a snowstorm outside and he has to stay inside, he turns on his TV and chooses the YouSee channel, where he can by pushing the red button enter the HbbTV portal and checks the TV guide. Before he does so, he goes to YouSee's website and fills a survey with his preferences, so that he can have a personalised electronic program guide. He chooses his preferences and accepts that he receives special offers according to his preferences.

When he pushes the red button and enters the HbbTV portal via YouSee, he chooses to go to the EPG service to search for a program to watch, a pop up will ask him if he wants to use a login for his personal EPG or regular EPG, he chooses to login to his Personal EPG and the TV guide will show him what is on TV according to his recommendations and that is sports, while he is searching for a program to watch, he spots an eye on a special offer that suits him and he goes online via his TV set to take advantage of this offer.

The viewer can either check other services in the HbbTV portal from the broadcaster or by pushing the red button again can always take the viewer back to the broadcast channel (the live signal from the broadcaster).

9.2 Data analysis

In cooperation with our fellow students, Humayoon Fayez and Padam Chhantyal, who are working on implementing the PEPG (Personal Electronic Program Guide) for the HbbTV service in cooperation with YouSee, we did different types of analysis to understand the user behaviour. We started by the survey, where we sent the survey out directly by email, used the AAU moodle and published the survey on Facebook

and then went out to the Elgiganten a chain of electronics stores and interviewed the salesmen and the Elgiganten customers; finally we made the user test with Jannick Sørensen at CMI.

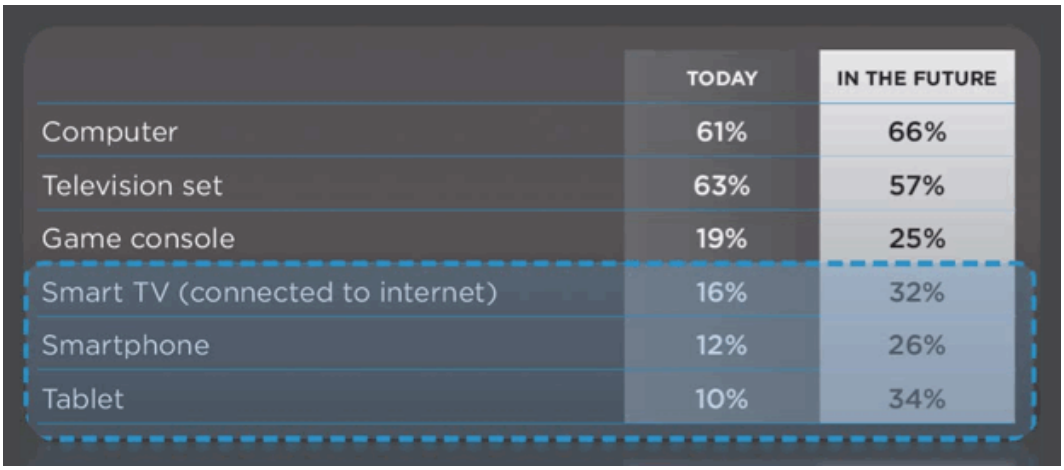
Some may argue that user survey don't lead to innovation and can't create breakthroughs [126], and when Skibsted Ideation asked Apple's designer about their view on user centric, he replied by: "*At Apple, we don't waste our time asking users, we build our brand through creating great products we believe people will love*". The reason for that user surveys don't lead to innovation could be the inability of most people to see solutions because their lack of knowledge and interest in technical concepts, prevent them to see these.

However, collecting data from social websites like Twitter and Facebook, made companies to realize that they could leverage user behavior dynamics to target their marketing efforts. Josh Williams [127], President and Chief Scientist at Analytics firm Kontagent said that:" *There is an immense amount of customer data flowing through the social web--orders of magnitude more than in the 'pre-social era' of the Internet. By tapping into analytic platforms like Kontagent, businesses now have an unprecedented opportunity to deeply understand and optimize their customer economics. By pulling the very levers that drive effective user acquisition, engagement, retention, and monetization, we are enabling our customers to build stronger businesses by acting on real-time data insights that affect their bottom line*."

Shawn Graham believes that the understanding of the users and engaging them requires the looking beyond the traditional web analytics. And to optimize the user experience across multiple platforms, companies must focus on user behavior dynamics to analyze and identify behavioral insights from their collected data.

Before entering the Nordic market, HBO made analysis of the market to know who are their future target group and found that their target group will be 31% of the Nordic population. This target group is:

- Younger with ages 15 – 44
- Neutral Gender
- With more urban demographic
- Are willing to pay for cinema and series at a lower price than existing the existing offers currently on the market.



	TODAY	IN THE FUTURE
Computer	61%	66%
Television set	63%	57%
Game console	19%	25%
Smart TV (connected to internet)	16%	32%
Smartphone	12%	26%
Tablet	10%	34%

Figure 27: HBO Target Group [128]

This target group that HBO chose to be their target group are already consumers on multiple screens and will even more in the future [128].

So understanding the TV viewer's behavior is important because those will be the future users of the HbbTV services and building any service for the HbbTV will be affected by them. But as most people hesitate when confronted with innovative technology, then asking them directly about if they would use a service running on their TV set, could lead to few or unclear answers since it requires the user to understand the basic concept of the HbbTV. The decision of asking users about their habits/ behavior when watching TV would not only give information about their behavior, but will also help understand what services the users might prefer.

The user analysis tries to look at different subjects regarding possible users of the service, starting with their behavior. The behavior of potential users will be discussed, which could help to define a focus area.

9.2.1 *Survey Questions*

We prepared the survey questions that can help us understand the user behaviour and guide us on how to improve the PEPG service.

A point to highlight is about the effectiveness of the use of social media for market research. Most of the responses for this survey came from Facebook where there was more that 60% of the replies to this survey via Facebook as seen from the figure below.

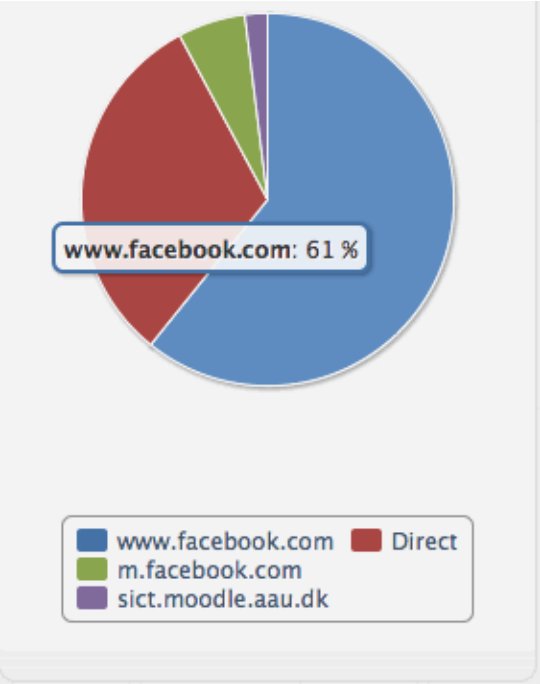


Figure 28: Response Reference

The figures below show the responses to the survey questionnaries by gender, age and education:

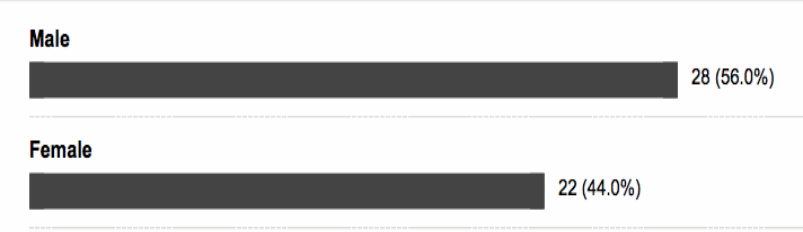


Figure 29: Gender Breakdown.

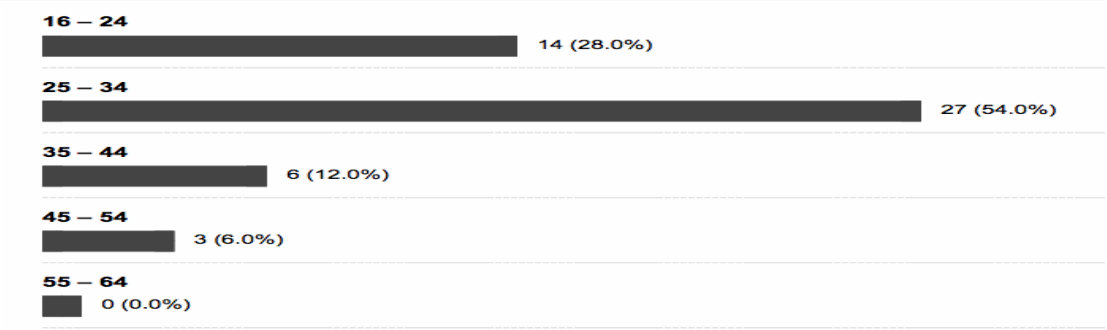


Figure 30: Age Breakdown

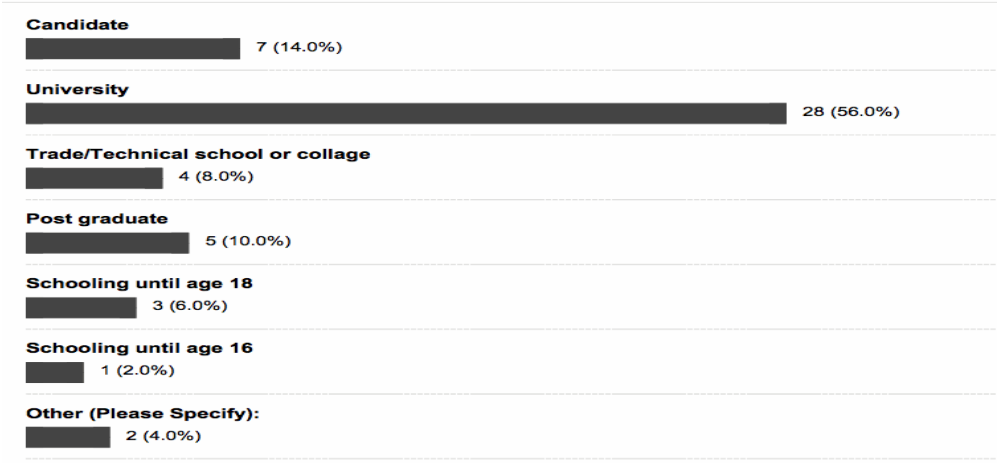


Figure 31: Education Breakdown

From the results above we can conclude that the responds are mostly adult males with higher education and this type of users are the one who use TV and the Interent and are potential users of HbbTV service.

The purpose of asking about the user usage of TV daily, can help understanding the usage statistics of the TV in general and in this case the smart TV with applications. So with the information about the usage of the TV, and understanding how the users interact with the TV can help in providing a better service in the future.

This survey showed that 92% users uses the TV between 1 – 5 hours per day, whereas 80% uses the Internet to watch videos or TV almost daily on an average of 1 – 2 hours, this include music and TV shows.

Even though as seen from the user usage analysis, 80% uses the internet to watch their TV shows or videos online using their PC, but very few compared to this number connects their PC to their TV where only 32% connects their PC to the TV between rarely and 3 times per week.

Where as for the smart TV only 26% use this type of TV sets, and for those who do not own or use the smart TV, as shown from the figure below, 76% are willing to buy a smart TV, as for the 8% of the maybe, their replies were mostly about if they can afford one then they will definitely buy it.

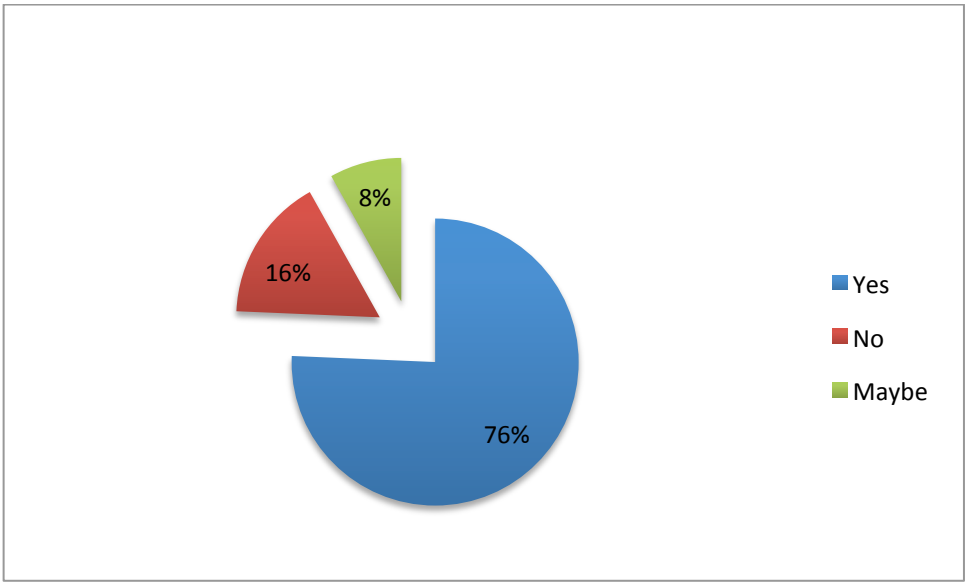


Figure 32: Question: are you willing to buy a smart TV?

In order to check the user behavior with the PEPG service provided by the broadcasters along with the HbbTV application, we needed to know if the users are already using the TV guide in general.

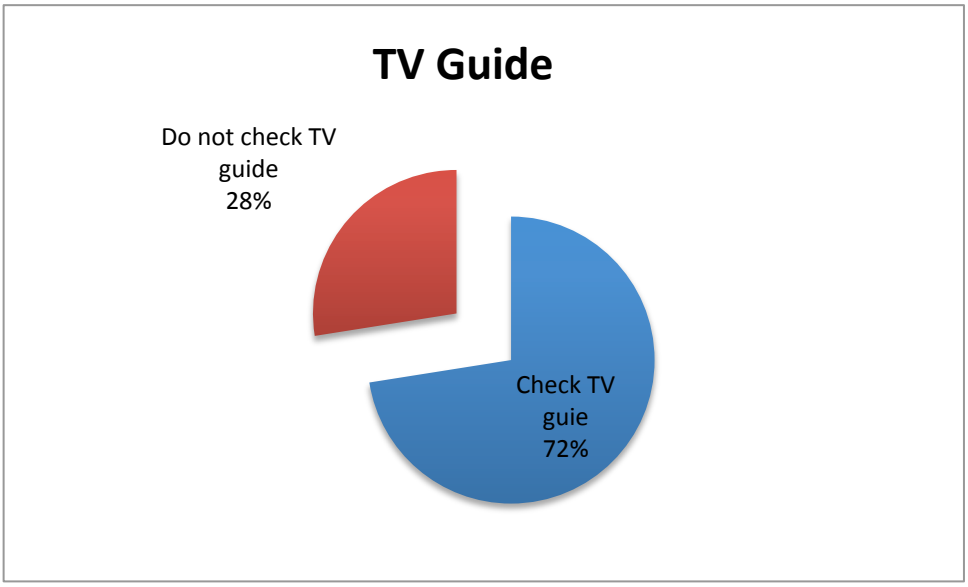


Figure 33: Check of the TV guide

The figure above is to show the percentage when asked about checking the TV guide, 72% replied by that they check the TV guide and 28% do not because they even don't care about what is on TV or not interested in checking the TV guide. The survey also showed that there are 59.1% responds on checking the TV guide 1-2 times a week,

18.2% check the TV guide 3-4 times a week and 22.7% checks the TV guide on all weekdays.

As for how they check the TV guide most of the replies were by the use of the TV. The percentages are shown on the chart below.

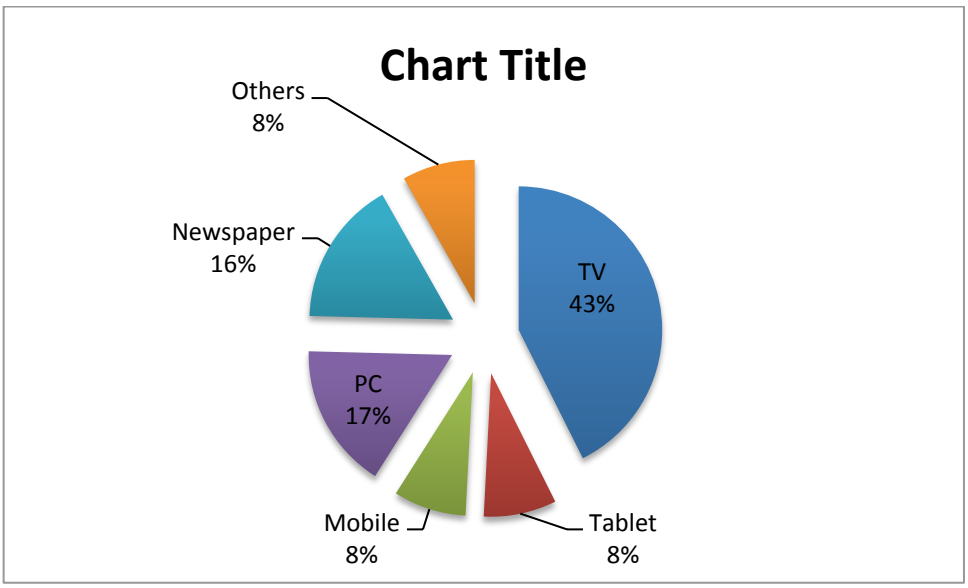


Figure 34: Question: How do check the TV guide?

To know more about the user behaviour, questions about how interested the viewers are for their TV series or shows were asked, such if they record their favourite series/ shows or set a timer for recording those, 86% replied by that they don't set a timer to record them and 74% replied by they don't record their favourite series/ shows because they are even not interested and that they can watch the review later on, or because they can watch them later by downloading them from the internet or because the shows they watch haven't come out on Danish public TV, and they don't want to pay extra for any system, where they can watch it, since they are not really bothered if they see it or not.

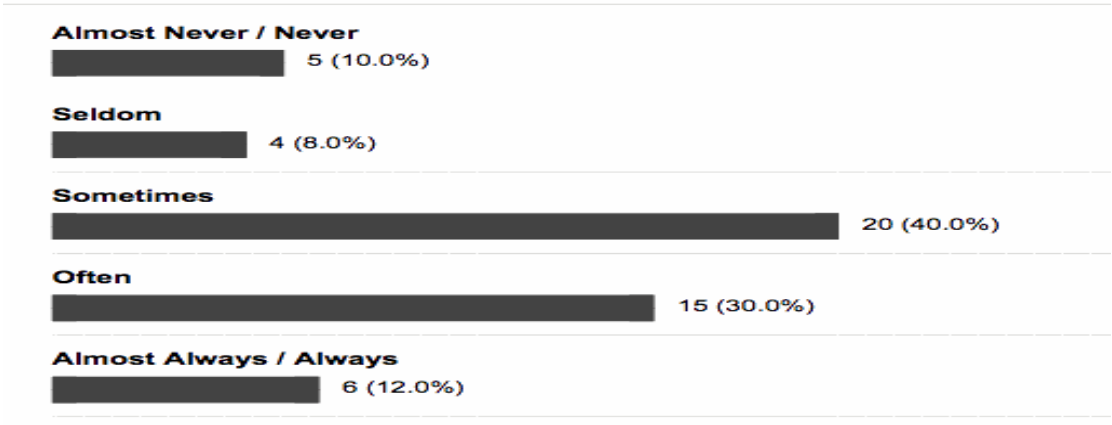


Figure 35: Watching TV based on past pattern

Only 10% as shown from the image above never watch their TV shows / series according to their past pattern.

78 % are willing to fill a scheme for their favourite TV programs, whereas 22 % are against it because some don't think that there will be need for it, others think that their life is already programmed enough, or don't want to use time on filling the survey or because they are satisfied of using their PC to download the movies or shows directly from the Internet.

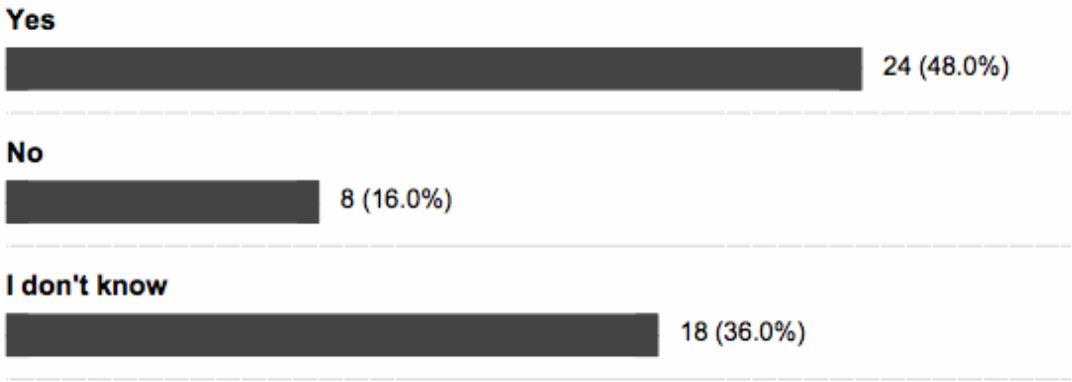


Figure 36: Special offers according to the preferences

The figure above shows that viewers are interested in having special offers according to their preferences.

9.2.2 *Interview at Elgiganten*

To investigate in research that people are interested in buying the smart TV, we interviewed some of Elgiganten store in Copenhagen customers, where we found that more than 70% were interested on buying the new smart TV sets, but mostly are looking for cheaper prices. And when asking about HbbTV, unfortunately no one knew about it and how it does work even the salesmen, when explaining about it in shortly, more than 60% were interested in trying it, the rest were only satisfied with what they can get from the regular broadcast channels. Then we asked about if they are willing to pay for the extra services, less than 40% are willing to pay for the extra service such as the VOD (Video on Demand) if the price is not higher than Netflix prices.

When asking the El-giganten salesman about the HbbTV, he said that he never heard about it. And when asking about the selling of the smart TV from 2011 in general, he replied by that around 50% of the customers are excited for the apps and they want to know more about it whereas the other 50% are not so interested and they are mostly interested in the resolution of the TV and the price, when asking about the reason, he replied by mostly because they are satisfied of having their PC connected to the internet and no need for the TV to be so. We can conclude that the salesmen did not hear about the HbbTV because it is not in Denmark yet even though DR has launced it, but it is still on trial basis.

9.2.3 *User Test for the pilot project*

We used the user test to discover any barriers of the service that the user/ service may face in the future. We used the think aloud technique when possible. Where in think aloud users are encouraged to speak up their intention before or while they act e.g. “I am selecting channel DR1 and I am expecting the system will present …” Users’ intensions, navigation, selection, clicking and the outcome of their actions was observed and feedback was collected. We invited Jannick Sørensen, assistance professor at CMI, [See appendix 3] to participate in the user test for the PEPG service prototype implemented by our fellow mates. The feedback for the user test analysis with Jannick showed that from his experience that people today are willing to participate in the managing user preferences on the Internet to get the services according to their recommendations and preferences and he thinks that having an

application on the mobile to fill a survey will also be fine because it would be very likely not to care about the revealing to a website his preferences. As for advertisements, he believes that it will be fine if Google's adword principle or Facebook ads principle is used in the EPG service and mostly that the advertisements are not out of the topic. He explained by saying," *I think it is not a big issue anymore. If you buy magazine, you get lots of advertisement and they fit very well with the content and you get annoyed if you get advertise out of topic*". He believes that the problem with advertisement will be if it is related to the broadcaster's content, he adds," *I think the problem would be if you start to sell some advertisements that are based on the DR content, then there will probably problem. But if you sell advertisement based on your wish lists, there should be no problem*". Since it is software and related to the user experience, he thinks that user would normally think that this is software that can be controlled, and normally the user prefer that the software is not too intrusive in other words, no advertisments, such as in the operating systems.

9.3 Summary

Online survey made in order to find the user behaviour concerning user usage of the internet and the TV and specific to personalized electronic program guide shows that many people are willing to buy smart TV which are potential users of the HbbTV services and many users who are willing to use the personalized electronic program guide (PEPG). As users are willing to receive offers/advertisement according to their recommendation on their program guide, it helped us to find the revenue-generating source from personalized program guide.

10. Business Model

There are many concepts that define the business model, some of them focuses on the individual company while others takes into consideration the network of companies involved in the business [129].

Since this project requires cooperation and transaction with other actors to establish this type of businesses and cannot be considered as a stand-alone product, then it is a good idea to look into the business model from the network of companies' point of view and not a single company approach.

In the following sub-chapters, an analysis of the business model describing the network approach by Pieter Ballon [130] and Faber.et.al [131]. The business model is divided into four different sections according to this approach:

- Service design
- Organisation design
- Technology design
- Financial design

10.1 Service Design

The central issue in Service Design is 'value': a provider intends a certain value proposition and a customer expects a certain value proposition [132]. The intended value is the value that a providers aim to offer to customers, in this case the TV audience and the expected value is the value that a customer expects from the service.

Generally services are the drivers for the Hybrid TV as they add values to the broadcast content. Especially VOD has the potential to attract more viewers to the broadcast TV. The main goal of the HbbTV solution is to help broadcasters empower their position in the market by keeping the hybrid solution simple for the consumers and add attractive services to the application. The EBU members testify the popularity of the on demand services based on their web-based services including the VOD and the catch-up services. The teletext service as well in the form of the HTML-based as well is popular according to MacAvock. The third most popular service is the weather application. For YouSee, the most popular services are the on demand service in VOD and catch-up TV forms, news and the weather.

Other potential services offered by HbbTV are: personalization, games and social media, interactive advertising, voting, digital text , Electronic Program Guide(EPG), temporary services (Olympic, Eurovision song contest, Euro football) and other multimedia application. Claus Blich Pedersen, the project leader at DR media explains HbbTV service as: "*Every service has a purpose. It is a service that tries to see what is possible when we combine broadcast with over the top services, so it is trying to set it up basically, the service itself is simplistic and it has limitations and errors. So it is very simplistic and we are very satisfied with that"* [see appendix 4].

HbbTV ecosystem involves multiple activities and players. Number of players are involved in HbbTV that contributes at some level to the value network and different players have different unequal roles to contribute with the service. Players involved in the HbbTV value chain are: content producers, right holders, broadcasters, content aggregators, right dealers, content distributors, network operators, device manufacturers and consumers. Some players are responsible for the creation of the content where as other players are responsible for aggregation and distribution of the content. Thus roles of each player is different according to the nature of the company and therefore players involved in HbbTV can be classified as [133]:

- **Creation of the content**: Players involved in the creation of the content are content producers and right holders.
- **Aggregation of the content:** Those players includes the broadcaster, content aggregators and the right dealers.
- **Distribution of the content:** players involved in distribution of the content are content distributors and the network operators.
- **Consumption of the content:** Devices manufactures and consumers are the ones for consumption of the content.

Since different players has different roles to contribute with the service, each player has different intended value and delivered value. For example, content distributor will have different intended value for the user and the device manufactures will have different intended value for the user. Therefore, service design provides different value from the point of the company. Thus we will classify intended value to the users from the different players and expected value from the consumers from the different players.

The table below shows the intended value for each player and expected value from the customer side.

Players	Providers Intended Value	Customers expected value
Right Holders	To provide exclusive rights of HbbTV services to the customers including reproduction and distribution by licensing all of the protected work through international legal and licensing.	The customers expect to get all the exclusive rights regarding HbbTV services.
Content producers	To produce wide range of contents that includes music, movies, news, sports, television programs, video production and other multimedia contents which provide value for the end users in specific context.	The consumers want to get entertained by accessing wide range of content according to their interest and favoutires whenever they needed.
Broadcasters	To provide different user experience to the customers by offering rich and interactive broadcast and broadband content which will enable conumer to view all of these contents in single flat screen. The intended value of the broadcaster is to keep the hybrid solution simple for the consumers and add attractive services to the application.	The consumers expect new user experience by accessing both broadcast and broadband related application which enable them to view all of these advanced series on the flat screen TV.
Content aggregators	To aggregate content from numerous broadcasters and distribute to the end user though distributor platform. Content aggregators focus on content acquisition, best user experience and commercial relationship with the customer [133].	The consumers expect that they access all the channels via single distribtor platform.
Right Dealers	To give legal assistance, writing contracts and making legal negotiations between different parties interested in the HbbTV development.	Consumers expect legal assistance related to HbbTV service they want to enquire.
Distributors	To distribute attractive products and services to the customers. Distributors also intend to focus on the content, picture quality and creating new interactive services.	The customers expect that they get attractive products and services in good price.
Network	To provide internet access services	The customers expect that they

Operators	(network services) in the wired or wireless arena to the customers and intend to provide highly competitive offers in terms of network speed and pricing.	get high network speed in good pricing and access HbbTV services in good quality.
Device Manufacturers	To manufacture Hbb enabled TV set and Set-top boxes which enables consumers to access all HbbTV services offered by broadcaster (broadcast and broadband services) on their flat screen TV, via a single device.	The consumers expect that wide range of HbbTV enabled devices from the different manufacturers are available in a good price. Moreover, users expect that by using a single device will be able to access new services from other entertainment providers (online services, CE manufacturer, etc.)

Table 8: Intended and expected value for the different players

Another important issue in Service Design is the nature of the innovation: 'new version services' that take an existing service one step further (evolutionary), and 'way new services' that are new services that are in one or more aspects really new (revolutionary)[132].

HbbTV can be classified as revolutionary innovation as HbbTV is a new services that are in one or more aspect really new. Even though MHEG and MHP lay a foundation for HbbTV, what differentiates HbbTV from its predecessors is that it puts the broadcasters in control so only they are able to relate broadband services to the broadcast program. The broadband contents in HbbTV are differentiated by broadcast related and broadcast independent applications. This relation is achieved through AIT (Application Information Table).

10.2 Technology Design

In the technology design we deal with the technical aspects regarding the services. The cooperation between the broadcasters and the broadband network providers that Hybrid TV makes the interaction with the broadcasters and the end-user possible by using the regular domestic Internet access. Moreover, users by using a single device will be able to access new services from other entertainment providers (online services, CE manufacturer, etc.).

The HbbTV is an end-to-end [134] system that combines the broadband and broadcast with the use of Internetconnected TV devices. It is an improved broadcast

system that includes different services such as interactive elements, on-demand services such as VOD and catch-up TV, and other functionalities.

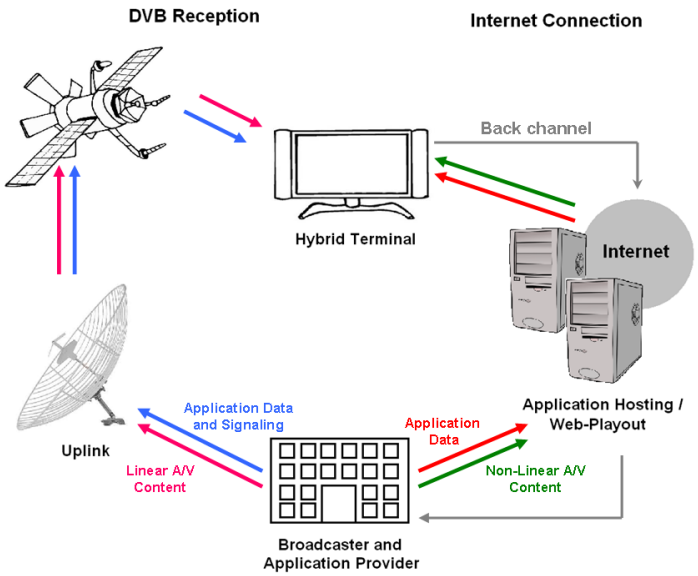


Figure 37: Hybrid TV architecture [135]

The architecture above contains the hybrid terminal, the DVB broadcast connection and the broadband connection, and this is Typically ADSL or FTTH [136]. The specification for this new technology is based on existing technologies and standards including the DVB (Digital Video Broadcasting), CEA (Consumer Electronics Association), W3C (World Wide Web Consortium) and OIPF (Open IPTV Forum).

The main goal of this new technology is to be a Free-To-Air (FTA) model, but it can also be used in different models such as Pay-TV business model.

The Broadband capacity may be a real issue for the expansion of Hybrid TV since it will impact directly the quality of services that the broadcaster could convey through the broadband, especially, heavy services such as VOD. However, the fast growth in marketed broadband capacity and the adoption of adaptive technologies (adaptive streaming for VOD for example) may help out in the near future.

Below an explanation based on Pieter Ballon's about the functional architecture parameters for this technology:

***- Modularity*:**

The clear example that the HBB TV standard makes it possible to have modularity is the association between the broadcasters and the broadband. Since there is an association, so if we develop the HbbTV application on the Broadcaster, it will not affect the Broadband. And if we make any changes in the Broadcaster side or the Broadband side, those parties will not be affected, but the service will be affected, to a better service.

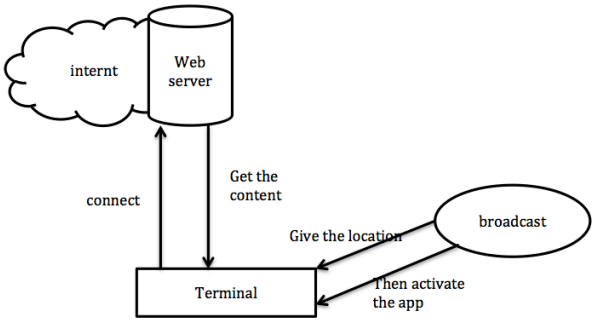


Figure 38: Modularity

- Distribution of Intelligence:

In this case, the intelligence is distributed, because technologically if you want to realize VOD or catch-up TV on Hybrid TV, then the Broadcast signal has to broadcast the location of the service via the AIT table to the terminal to enable the corresponding application. In other words, the catch-up service or the VOD services involve three elements:

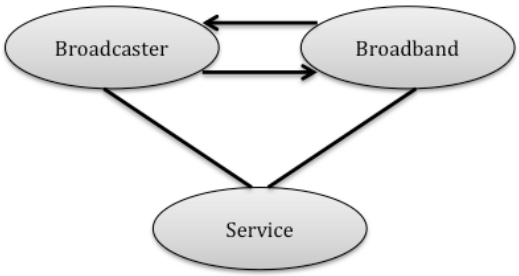


Figure 39: Distribution of Intelligence

1. The broadcast signal: that provide information about the content.
2. The terminal: that interprets the signal and accesses the content.
3. The web server: that will send the content.

- Interoperability:

Interoperability in this case depends on broadcasters interest, for example in relation with VOD, the format of the video is the issue for interoperability. There is interoperability with the streaming form MPEG-4. The interoperability will be depending on the broadcaster's interest, for example, may be DR is not interested in having non-interoperability, but may be National Geographic want to standardize the streaming.

10.3 Organisation Design

The organization design describes the value network of the service. A value network consists of actors owning certain resources and capabilities, which interact and together perform value activities to create value for the customers and to realize their own strategies and goals. The actors may originate from diverse industries and the success of the business model is dependent on the commitment of all partners involved [132]. *"Business models respond to the dynamics of the value chain because change in the value added to a product or service in each stage of its acquisition, transformation, management, marketing and sales, and distribution" [137].* Thus value chain represents a systematic approach to presenting an industry by segmenting its different market activities that add different values to the final product, thus influencing business model. Three important factors for the organization design are [133]:

- **Actors**: The entity that contributes at some level to the value network.
- **Roles**: The value adding activity the actors provide to the service.
- **Relationships**: The commitment between the actors.

The association between the different partners is the basis for the innovative success and infrastructure of the HbbTV service and the relationship between them has to be defined not only as the relation type, but also according to the necessity to the service.

10.3.1 Overview of the HbbTV value chain

As mentioned in Service Design Chapter, HbbTV involves multiple activities and players and HbbTV value chain can be classified into four main markets: creation of the content, aggregation of the content, distribution of the content and consumption of the content.

A number of industry players operate in two or more segments of the value chain. For example, YouSee is both content aggregator and content provider and they operate in both the segment. This can be powerful in terms of creating a seamless customer experience but can also be used to take full advantage of assets such as technology, brands and customer relationships in order to strengthen competitive positioning [138].

Figure below shows the main strategic segments within each market and the different services categories within those segments.

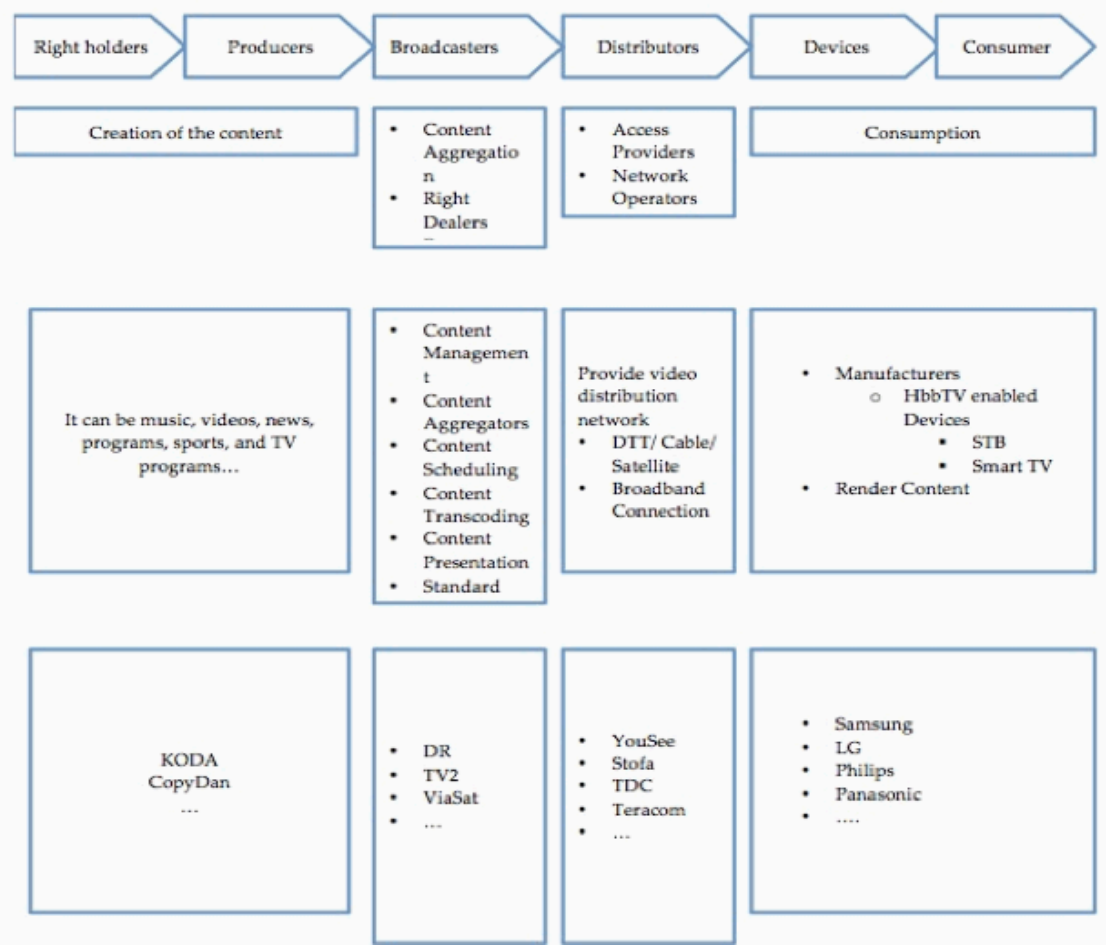


Figure 40: Overview of the HbbTV value chain

10.3.2 *Description of the Key markets in the HbbTV value chain*

Content creation

Those players are the ones to create a broad range of contents along with exclusive rights. Content producers are the ones for creating the content and right holders owns a set of right on given item.

Right holders: Right holders are the person or entity that owns a set of rights on a given content item. Those partners are the ones with exclusive rights to a protected copyrights and the related rights of the performers, producers and producers and broadcasters. They control the use of their exclusive rights for content that can include (music, videos, news programs, videos, TV Program and other multimedia

application) including reproduction and distribution by licensing all of the protected work through international legal and licensing.

In Denmark, CopyDan and KODA are examples of right holder organization. CopyDan manages copy rights for number of right holders: AVU copies, pictorial, Tape copy, cable TV and text and music. KODA administers Danish and international copyrights for music creators and publishers and act as an agent for its member in order to collect license fees whenever their musical works are performed in public, broadcast and to pay out performing royalties.

Content producers: Content producers are the one responsible for creating the content for the end users. Role of the content producers is to produce a wide range of contents that includes music, movies, news, sports, television programs and video. Content owners are typically media companies such as Warner Brothers, Columbia pictures, the BBC or electronic arts and provide thier content for a share of the revenues and license fees. Content right owners typically retain 50 to 70 percent of the revenues generated by the online service provider that makes the content accessible to Internet users [138].

Content aggregation

Content aggregator aggregate content from different broadcasters and distribute it to the customers. Broadcaster themselves are also content aggregator. As number of players work as a content aggregator in the value chain, Jacob Sørenson suggest to avoid using aggregator as a descriptive for any of the players in the Danish market.

Broadcasters: Broadcasters are the basic players of the HbbTV standard, they created the HbbTV standard to protect themselves. They are the owners of the content and they have a full control on it, in some cases they also rent the content. The role of those players includes content management, content aggregation, content scheduling, content transcoding, content presentation and standard conversion.

DR, TV2 and Viasat are the broadcaster in Denmark and they are the basic players of the HbbTV in the Danish market.

Right dealers: Right dealers give legal assistance, writing contracts, making legal negotiations between different parties interested in the HbbTV development such as

aggregators and broadcasters. They can also play a role in finding legal solutions for the HbbTV regulations.

Content distribution

Content distributors are the one to distribute services to the end users. Players involved in distribution of the content are content distributors and network operators.

Content Distributors: they can be the heart of the system because they work on the technical, editorial, sales and marketing. A distributor may have financial relationships with advertisers, for its own applications or applications offered by vendors. Distributors, in the broadest sense, appear best positioned to create new interactive services.

In Denmark, YouSee and Stofa are the content distributors. They will distribute HbbTV service to the end users.

Network operators: Network operators provide conectivity to the internet by fixed or wireless. Network operators will be playing a crucial role in the delivering of the services on the HbbTV devices. Their interest in this situation is connected with utilization of their resources. However, the quality of the service will affect the service delivery and may become a barrier for HBB TV. So they can take advantage of the HBB TV in that the customers might need to upgrade their subscriptions to get better HBB TV quality service.

Many customer will arrange thier internet access service via their home telecommunication provider, but cable TV companies , independent resellers or service providers and wireless operators provide highly competitve offers in terms of network speed and pricing [138]. These services are typically provided on the basis of a monthly subscription fee, which in some instances can include the fixed-line subscription fee and bundled voice calls and TV subscriptions.

TDC is the biggest network operator in Denmark. Other network operators are Telia, telenor and Waoo which might contribute to the development of HbbTV services in the future.

Content consumption

Content consumption is essential part of the HbbTV value chain, involving both devices and end users. Device manufactures and consumers are the ones for consumption of the content.

CE Manufacturers: They have the ability to interact the devices with the Internet. Some of them have already started their online services portal by integrating their own applications and services, and defining their business model, including marketing offers advertising space to advertisers.

Key players in the device manufactures are Samsung, LG, Phillips and Panasonic and they will manufacture Hbb enabled TV and Set-top boxes.

Customers: Revenues are generated from by end user using the HbbTV services, so from the financial perspective the customers are the ones providing the basis to the success of the service, beside that they play a big role in todays personalization factor, which is an important characteristic for the HbbTV service, with providing personal data that will be helpful for the commercial aspects in terms of innovation. The loyalty of early adaptors helps building a foundation to reach the majority of users.

10.3.3 Danish players Status for HbbTV

We interviewed all the major stakeholders of the TV infrastructure in Denmark that includes Broadcasters (DR, TV2 and ViaSat), Distributors (YouSee), Network Operators (TDC), Access Providers (Teracom) and Device Manufacturers (Samsung). Interviews were held in order to collect their future plan on HbbTV, possible cooperation with other players and market of HbbTV.

The table below shows the players status (ready or not ready) for the HbbTV in the Danish Danish market and their personal opinion bebind their status.

Players	Status	Reasons

DR	Ready	*The value of HbbTV is that we will be able to guarantee access to the users (who are paying licence fee) if they only have Internet connections, so it could be live or it could be on demand. HbbTV is a way of making sure that we don't have some gateways or party's controlling the networks for instance different app stores within the Samsung TV or Phillips or whoever, which HbbTV do we as a broadcasters as a unified broadcasters make sure that we have a chipset within the TV sets which allows us access to give content as a public service providers* [see appendix 4].
TV2	Not ready	*At the moment, all focus and commercial development is on OTT-delivery of video/TV and companion devices/second screen. I might be wrong, but I simply see little commercial logic or potential in HBB, if you work as a commercial broadcaster or operator* [see appendix 11].
ViaSat	Not ready	*From the Danish perspective we are not working with HbbTV and have no current plans to do so* [see appendix 12].
YouSee	Ready	*We know that when DR comes with an actual official service then we can't really avoid selling it in our network, When it comes to HbbTV and DR, we don't really have a choice. We will just use it as a sort of mechanism for requesting on demand content, then we have some promise at least we can use the standard when it comes to the Smart TV. We consider ourselves as an aggregator, so if HbbTV would be kind of standard it will be very interesting to work with that but it still needs a better work I think* [see appendix 9].
TDC	Not ready	*We are currently using MS TV as our TV platform. MS TV requires a STB where services are handled partly locally by a client on the STB. If we are to provide TV to the customers using HbbTV, we would have to develop a new TV setup where our current TV setup are handled in a HbbTV environment. The market potential in HbbTV are still very limited, which means the investment could be used way better in other areas. At this time, a very limited*

		number of pro's for TDC if changing to HbbTV. Actually from a market perspective you could say there are more pro's in not pushing the HbbTV standard [See appendix 8].
Teracom	Confidential	*Confidential. It is our strategic department who are working on this and I cannot say much because it is bit confidential, although I would very much love to* [see appendix 10].
Samsung	Ready	Ready to support when DR launches the final version *With this taken into consideration, Hbb still hasn't been implemented in Samsung TV's sold to the Danish market, and right now we are looking into 2013, weather this should be supported or not)* [see appendix 7].

Table 9: Danish players status for HbbTV

10.3.4 Relationship between different stakeholders

Based on interviews with players in the Danish market and case studies, we will now investigate possible cooperation between different players for the Danish market.

DR is dominant player for the HbbTV in the Danish market and many players in the Danish market are waiting for the DR to launch the actual version. According to Claus Pedersen Blicher, the project leader in DR media, they are going to launch the final version of the HbbTV very soon. For DR the HbbTV will be a push strategy into the Danish market and they will suggest TV manufacturers so that they should put additional chips into their TV and thereby make it possible to improve their offerings to their customers. In Denmark, Peter Mølsted, the Senior Consultant at Danish Broadcast Corporation, is expecting that from 2013 all Integrated Digital TV (IDTV) manufacturers will have activated HbbTV in recipients TV sets. This means that DR has already pushed the HbbTV into the Danish market and the opportunities for it to be adopted in the Danish market are becoming high.

TV2, being largest commercial broadcaster in Denmark is not ready yet for the HbbTV as they simply see little commercial logic or potential in HBB for commercial broadcaster or operator. According to interview with TV2, open platforms are always potentially complex when different commercial players in the industry and value chain have different strategies. Also the business model for the commercial broadcasters like TV2 is to make money from all the content, where as the aim of

public broadcaster like DR is to reach many Danish customers to watch their content. Now the conflict here is that HbbTV is broadcast driven standard and can be must have standard only pushed by the broadcasters and TV2 is not yet interested in pushing HbbTV standard. According to the interview with Jacob Sørensen, support from public broadcaster DR is not only enough to push the standard in the Danish market, they need support from commercial broadcasters like TV2 and they will have to together push the standard in the market. "*I mean DR it is available online and available on DR.DK, it might not by itself be enough to get the ball really rolling, TV2 would probably be more relevant but their strategy thus far has been to say this is all interactive services, all the catch up, all the extra materials will be something that you have to buy on top with TV2 play. So I think a lot rests on TV2, I mean some of the broadcasters are relevant such as Viasat and DR, but TV2 would be a big one. So I think if broadcasters really push it, then it would be sort of a must have and then manufactures would push it, then we would be forced to*"[See appendix 9]. Similarly, Viasat is not prepared for the HbbTV and do not have any plan yet.

These broadcasters (TV2 and Viasat) are not ready at the moment as they see limited potential of the service, but reflecting the case study in Germany and UK where there is cooperation between commercial broadcaster, public service broadcaster and pay TV operators in delivering HbbTV services and has contributed in the HbbTV development [139], we can assume that in future DR (public broadcasters), TV2 (commercial broadcasters) and Viasat (direct satellite television broadcasters and pay TV operator) will corporate for the HbbTV development. When it is pushed and supported by the broadcasters, it increases the probability of success of HbbTV in the Danish market. According to Jacob sørenson, TV2 is dependent on YouSee and other distributors. Thus when YouSee and Stofa will start to work on the implementation for HbbTV in Denmark, TV2 may also be interested in HbbTV to stay attractive in the market.

YouSee is ready for the HbbTV. YouSee is dependent on DR and will support HbbTV when DR launches the actual version. Also Stofa (HbbTV consortium member) will support HbbTV when DR launches the final version of HbbTV. According to the mail correspondence with Jacob sørenson, YouSee together Stofa have already created the proposal and have already send proposal to DR about the implementation for HbbTV in Denmark. "*We've proposed an implementation for HbbTV in Denmark, which would allow carriers and broadcaster to have their own signaling (i.e. red button for broadcasters and blue button for carriers). We've created the proposal with Stofa and sent it to DR".* So both YouSee and Stofa will corporate with DR for the implementation of the HbbTV.

TDC being the largest network operator is not ready for the HbbTV and do not see potential of the service. They see limited potential in HbbTV at this time and number of pro's for TDC if changing to HbbTV. "*From our perspective, we need to have penetration rate which should be pretty higher and I think this will take a very long time before the HbbTV penetration of the HbbTV is going to be huge enough to cover some part of the market where we are not. The other part is there is no reason for the customers to switch to this technology. Also the potential for the HbbTV is not for the TV distributors"*[See *appendix 8*].

Thus at the moment, TDC as a network operator is not interested in HbbTV because they see limited potential from the HbbTV. However, we have studied the case in France where network operator is within the value chain and also contributing in the HbbTV development [140]. Also within year from deployment of HbbTV they have decided to launch HbbTV services in Middle East with collaboration between differnet network operators (Orange and Arabsat). Therefore looking trend in France we think in future , TDC and other service providers will be within part of the HbbTV value chain in the Danish market.

Teracom sees a positive future for HbbTV in the Danish market even though they didn't want to reveal information on their future plan for HbbTV.

Samsung is ready for the HbbTV and according to Martin Engen, sales manager at Samsung Electronics, decision to implement Hbb in Samsung TV to be sold in the Danish market will depend on DR launching of the final version. So now if we put puzzle together, DR is going to launch the actual service and Samsung will provide HbbTV for the Danish market. When DR launches the final version of HbbTV and supported by Samsung, other manufacturers such as Phillips, LG and Toshiba will follow within couple of months to stay competitive in the market. According to the interview with Jacob Sørenson, he doesn't think manufactures will promote HbbTV because it will replace their services, however, they will be forced to in order to stay competitive in the market.

We have seen case from Poland where Samsung decided to supply HbbTV in the polish market supported by polish broadcaster TVP. We have also investigated cases from Germany where even though Humax iCord HD came into the market as the first HbbTV set-top box, many more major manufactures such as Phillips, LG, Toshiba, Technisat and others followed within few months [139]. We can see that there is dependency within the value chain, when the broadcasters moves, the manufacturers will also move and then all other players will start to support within

few months. It is understood that faster adoption of HbbTV depend on the broadcasters as they are main players for the HbbTV, thus in Denmark DR can suggest/force TV manufacturers to put additional chips into their TV so they can make it possible to improve their offerings to their customers.

We can see that value chain of HbbTV in the Danish market will be more like in France where HbbTV value chain consists of diverse groups of players comprised of major international television manufacturers, broadcasters, aggregators, advertisers and service providers [140]. In France, before launching HbbTV services by France Television they decided to link with the number of partners : French telecom, commercial broadcaster, consulting firm, network operators and CE device manufacturers [141] and we can see similar trend in Denmark where broadcaster (DR) and distributors (YouSee and Stofa) are already corporating for the HbbTV services and DR might corporate with manufacturers and other players before lanching of the final version.

Concluding the corporation for HbbTV between different stakeholders in Denmark, DR will launch the final version of the HbbTV and will corporate with YouSee and Stofa as a distributors for the HbbTV service. TV2 is not interested at the moment but they might corporate with DR in the future and push standard together with DR to make HbbTV standard in the Danish market. Then Samsung will supply HbbTV for the Danish market, which will followed by other manufactures such as Phillips, LG and others. When market moves towards HbbTV, TDC and others network operators will also support HbbTV and contribute in HbbTV development. So network operators, distributors, broadcasters, device manufacturer and consumers will be part of the HbbTV value chain.

10.4 Financial Design

The major question to answer in any business model is how to earn money with the service/ product the company is producing. That's why the financial analysis is needed in order to have an overview of any business future in terms of revenues. This part is crucial for any investor and for any stakeholder involved in this business. In other words, financial reporting is critical in order to identify how money and resources are spent, in order to track internal revenue sources, and in order to compare actual results to budgets and forecasts. Weak internal financial analysis can

lead the company to overspend or fail to capture key market share due to lack of cash flow and poor planning.

In Germany, there are different revenue generating sources from the HbbTV [142] such as:

- Public value service: The Arte+7 push-catch-up TV application: ARTE+7 service gives access to ARTE's programs over a period of 7 days in catch-up mode [143]. This could allow ARTE to reach its objectives to dramatically increase its audience and shows its capability of adding catch-up TV and VOD services to its DTT service via satellite, thus benefitting from a sustained demand for its best selling satellite bouquet with leading edge value added services.
- Commercial Free TV: The ProSieben's added banners on the pages and per- roll-ads: ProSieben's Banner ad is a form of advertising delivered by an ad server. This form of online advertising entails embedding an advertisement into a web page. If user click on them,the internet browser will take to the advertiser's website.

  A pre-roll ad is a promotional video message that plays before the content the user has selected. The video advertisements are often purposed television ads, ranges between 15 to 30 seconds.
- Commercial Free TV: The XDF's linking of advertisement applications: let users link to other products a by linking to XDF application.
- Pay Video on Demand (VoD): by having attractive monthly subscription offers such as starting with a month for free followed with a monthly subscription.

HbbTV needs good cooperation between the major players. Then HbbTV needs a good marketing strategy to assure the success of its launch. Broadcasters need to convince the users that the application is useful.

Major stakeholders (broadcasters, network providers and CE manufacturers) need to create a communication campaign in order to communicate the outstanding quality and the value of the HbbTV services. An example would be having an HbbTV ambassador when commercializing for a TV set in the shops, where he can explain how the application work and show a demonstration from different broadcasters who already launched their application, because when asked at for example Elgiganten Store Copenhagen, even the sales man do not know what HbbTV means and which device have enabled HbbTV even though it is only enabled from the German market.

As for the pricing strategy for the HbbTV application:

- From the public broadcasters in Denmark, the application should be free of charge for the users and free from advertisments, because the public broadcaster gets their revenues from the media license.

  There is retransmission fees that DR can get if there is more cable TV and satellite TV will use their content, that can also be business model in the future. In fact DR is going in this direction now, they were very conservative about keeping the power but now they can see that they can get monetary financial advantages by opening to other players.

- From the private broadcasters, a 'Freemium' will be a good starting point along with the test period for the HbbTV application, followed by a monthly subscription for the specific services, such as the VoD service.

The reason behind choosing Freemium business model for the HbbTV application is to attract a large number of users for the HbbTV application and later prices would be set up for using advanced features of the application. Offering free product or service will attract more HbbTV seers and wins on basis of zero price and value proposition.

The service analyzed in this thesis, the PEPG (Personalised Electronic Program Guide) should be:

- Totally free of charge and free of advertisement from the public broadcasters to the users.
- From the private broadcasters, the service should be free of charge to the users and broadcasters can gain revenues for this service from commercials as seen from user behavior analysis, in such a way that these commercials are related to the user's recommendations or preferences and are using the Google Adsword style.

The value parameters for the HbbTV will be as follows:

- The revenue Model: there are two different trade-offs of a choice depending on the application domain:
  - Advertisement- based and customer- paid: Interactive advertisement could be a revenue possibility for the actors depending on relationship they might have. However, some might earn more money by having interactive advertisement and some might loose because there will not much people who will click and they will not open the advertisement.
  - On the content and transport (according to the Mbytes).

We have presented revenues generating possibility in other countries like Germany which could also be in the Danish market. In Denmark, it is very difficult to define the revenue stream at this point of market development because it is simply the actors who are not cooperating yet like in Germany. Broadcasters wants to keep the control and other players are not interested because of this control. There is not clear on how this value chain will corporate which makes it very difficult to define the revenue stream.
However if the broadcasters are more open then more players will be interested in cooperating. Right now, the broadcasters try to close and keep everything for themselves, therefore other players are waiting what will happen. In fact in the future there is very big advantages for the broadcasters if HbbTV can be used in different devices and different platform and then they can get this revenue from per click or revenue for reselling the content, if they have very attractive content, there will be sure good business model. Cable operator and Satellite operator will have to pay, then broadcasters will see opportunity of making revenue by making their content available to others, may be later on other players can put their advertisement or corporate and make business together. Then of course this standard has option to go on and in the future possibility, it has to be more flexible from the broadcasters side so that other players will see the business opportunities.

10.5 Summary

Services are the drivers for the HbbTV as they add value to the broadcast content. Thus the future of HbbTV depends on the broadcasters taking the opportunity by offering attractive services.

HbbTV ecosystem involves multiple activities and players and each player must deliver the intended value to the users in terms of a service offering from the point of company. The success of business model depends on the commitment and contribution of all the partners involved thus adding different value to the final service. As different broadcasters has different business model, the viable pricing strategy for the HbbTV services would be free of charge for the public broadcasters and freemium for the commercial broadcasters.

The value chain in terms of HbbTV in the Danish market is now very much dependent on DR. Major players in the Danish market are waiting for DR launching the final version. It would of course depend on how this marked will develop and how the product offering would end up to be.

Broadcaster's control of content display preventing third parties from using broadcaster owned content with their application.

11. Future Perspectives

In the future perspectives we will highlight the different Danish stakeholder's, whom we personally interviewed, perspective about the future of the HbbTV and finally our own perspective and how we can see the future of the HbbTV.

Danish stakeholder's perspective about the future of HbbTV:

For DR the HbbTV will be a push strategy into the Danish market, and since DR is a member of the EBU; they will suggest TV manufacturers so that they should put additional chips into their TV and thereby make it possible to improve their offerings to their customers. In this sense Claus Blicher Pedersen said in an interview with us: "*We need to make sure that TV sets have chips available to give the best experience to the user, even though we do not have chipset available can we make it available through internet browsers content like advanced web app available through Internet. But HbbTV will significantly help user experience, right. So make sure that chips are made available within the TV or make sure that best services are made available within browsers which is freely available online and use advanced technologies.*"

So having the manufacturers adding the additional HbbTV chip to the TV sets will make DR sure that, in the future, they will have a way of reaching the viewers without having the viewers pay additional fees for whoever control the gateway such as TV manufacturers, distributors, aggregators, etc.

Claus means that it can be one way to do and the other way in his opinion can be "*time will tell us if it will work or not but we have to whatever we can and Denmark is too small to push into anything. So it is not Denmark, it is broadcasters within part of the world, not only in Europe but also in states and Asia.*"

As mentioned before [Section 2.5], Danish market is too insignificant to have any influence on any hardware producers, but the unified HbbTV standard that is supported by EBU and can include whatever law, can help the Danish broadcasters to do have influence on the manufacturers. [See Appendix 4]

Lars Kierkegaard, Teracom [Appendix 10], he believes that HbbTV will definitely come in Denmark, he believe that it will come in Denmark because there is still viewers with roof top antennas, and nowadays there is an improved indoor DTT coverage which will make it easier to get DTT signal. He added, "*I definitely believe that even though there is high fiber penetration in Denmark, the last survey I saw that almost 40 percentage of the Danish households have fiber, but there are 60 percentage which does not.*

So I definitely believe that hybrid TV will gain success in Denmark, no doubt about it. It is definitely hard to say when, again I should mention DR has a lot to say on it, but others can also say if they are willing to invest." He believes that DR has the perfect platform to push the HbbTV into the Danish market, but others can do as well if they want.

Unlike DR, TDC DSL will not support the HbbTV into the Danish market because for them there are more pros in not pushing the HbbTV standard [Appendix 8]. Even though the principles of the HbbTV from a certain perspective are good, but since there are a lot of players in the market, then there are more disadvantages than advantages. Torben Rasmussen believes that the potentials are low and this is why at this time TDC will just follow to see how things will go with this new standard, he explains:

- *An increase in the demand would require full integration on smart TV's, which again would mean that the Danish households would have to change all of their TV set's, which is not going to happen. When the penetrations of the TV sets are high enough, it would still require a change in the customer behavior, so from my point of view there's a long way to go.*
- *Another perspective is the willingness of the TV stations to go into this market. The most of them would prefer a status quo in order to ensure a large customer base by being represented in the basic TV packages in the market. If the degree of freedom for the customer to choose exactly the channels they want to see is to be increased, the TV stations would have to settle with lower customer base, and as a cause of this, a decrease in the revenue from commercials.*
- *Also the potential for the HbbTV is not for the TV distributors. The potential is only for people who want to sell things to the customers and then they will have to rely on the customer's willingness to buy. Why would I use Big Screen, why not iPad and computer and so on.*

For Torbren (TDC), in order to have a service that will not loose in the market, the service should be evolving from the customer perspectives and needs. In the case of HbbTV he doesn't see that the customers are ready to switch to this technology, because what they will get is something from the Internet and this content is not certain in terms of quality. The other issue is that the more capacity used in the broadband connection need to have a lot of bandwidth, and this could be a big issue for a lot of people. [See Appendix 8]

Since the standard needs to proof itself/ its commercial value for the commercial broadcasters, TV2 for now still think that this standard is dodgy [Appendix 11]. For Stig Møller Christensen, the future of HbbTV is still uncertain, he adds," *the*

commercial models and logics are not clear at all. It might work as supplementary standard for license-financed broadcasters like DR. For us and the commercial TV operators/distributors, I see a lot of question marks."

For the commercial broadcasters or operators, open platforms are always potentially complex when different commercial players in the industry and value chain have different strategies. And since at the moment, all the focus and commercial development is on OTT – delivery of video/TV and companion devices/second screen. This is why TV2 sees little commercial logic or potential in HbbTV.

The OTT expert Allan Hammershøj, believes that HbbTV is never going to work, because broadcasters are trying to defend their wall garden, for him HbbTV is another way of telling the old set top boxes with MHP and MHEG and it is way for operators to keep the users and make them difficult so that it becomes difficult for them to switch to other operators. He believes that TV should only present the content and no need to put any clever stuff on it, using the second screen can do this. The way HbbTV is now, making sure that broadcasters control everything that reaches the viewer, and because there is nobody that wants to be controlled by anyone, then HbbTV will never succeed. He believes that in order to HbbTV succeed is by making a common ground for different providers, " *if they make a common ground for OTT providers, IPTV providers and broadcaster providers in a way making sure that there is fully control on how you bind the service together and value chain is in clever way making sure that they all get part of their stake here, it really make a sense to have a common standard for it.*"

So broadcasters should work more on sharing the screen, because the main problem with HbbTV is that broadcasters want to control the big screen. [See Appendix 6]

The future of the HbbTV according to the TV manufacturers depends on DR, in an interview with Martin Engen, Sales manager at Samsung, he explained to us by saying, "*DR has made a trial period, which will end now, and then they will consider the future with this as an option. With this taken into consideration, Hbb still hasn't been implemented in Samsung TV's sold to the Danish market, and right now we are looking into 2013, weather this should be supported or not.*" [See Appendix 7]

Even though HbbTV will make it hard on TV broadcaster that are not HbbTV enabled if it become a standard, it is important for DR to push HbbTV into the market because it is a non – commercial standard and they cannot build an application for on TV platform, doing this they will favour one commercial partner over another. So DR forcing HbbTV into the market can be interesting for YouSee as a service provider.

Jakob Sørensen said that, "*if HbbTV becomes standard in the Danish market, it will definitely be interesting for us to build our services on HbbTV platform. Right now, we are moving our interactive services to IP and doing HLS implementation. So in many ways HbbTV could be just a new way of requesting services from already building and it would make a lots of sense. The problem of course is we have to protect our content and DRM is a major problem. Some of the newer flat screen like Samsung has supported DRM that we have chosen.*"

YouSee can see the benefits of HbbTV if they want to use the rights that they have cleared and just use a sort of mechanism for requesting on demand content then they have some promise especially with Smart. They consider themselves as an aggregator and they are not good at hardware. YouSee are specialized on only few items, so if HbbTV would be kind of standard it will be very interesting to work with that but it still needs a better work from YouSee point of view.

YouSee are interested in HbbTV and to work with it, Jakob Sørensen explained to us,"*We've proposed an implementation for HbbTV in Denmark, which would allow carriers and broadcaster to have their own signaling (i.e. red button for broadcasters and blue button for carriers). We've created the proposal with Stofa and sent it to DR.*"

He believes that the problem is that the HbbTV consortium has tried to recruit everybody (broadcasters, distributors, CE manufactures…) and not all players have the same interest, and for this the different players can't agree on anything that works. [See Appendix 9]

Personal perspective about the future of HbbTV:

HbbTV has been supported by wide range of players and the standard has been deployed in many countries just in 3 years and it looks like HbbTV is going to be winning TV platform. HbbTV is the much-needed edition to the existing TV sets; if we look backward to what connected TV sets are today, it is a very fragmented environment where each vendor has its own technology, so each TV manufacturer is operating vertical environment with the TV set which gives the fragmented market and it is very difficult for the broadcasters to develop services for all these different devices.

As HbbTV is broadcast driven standard, the future of HbbTV now very much relies on the broadcasters capturing the opportunity by offering the services. With HbbTV, broadcasters have the opportunity to have direct access to their consumers through TV sets with nobody in between, which is not the case for the connected TVs.

However, HbbTV's widespread deployment and the world's interest in the HbbTV industry will depend on the continued standard development work, planned or currently work in progress and the viable business model.

We can see there is positive future for the HbbTV in the Danish market. Major players in the Danish market like DR, YouSee and Stofa are ready for this technology. Other players in the Danish market are waiting for the DR, and the future of HbbTV is relying very much now on the DR. The standard will be widely deployed in the coming 5 years, and many players who do not see potential will start considering it as a potential revenue opportunity from 2 years from now.
For the user behaviour, from our own market analysis we can see that the future users are willing to use the new technologies presented for them especially that they are already well educated so we can see that they are the future potential users for HbbTV services.

12. Conclusion

Considering support from major players and possible cooperation between other players, increasing penetration rate of the smart TV, changing user behaviour, high broadband penetration rate, HbbTV is likely to become standard TV platform in the Danish market.

In addressing our problem formulation about, **what could be the viable business model for HbbTV**, our work has addressed by exploring a recommended framework of a viable business model for network of companies which include: the description of the service, the technology, finance and organization, incorporated to meet the objectives of the business.

As public broadcasters and commercial broadcasters have different business model, the pricing strategy should be free for the users using public broadcasters and Freemium for the users using commercial broadcasters, followed by the monthly subscription for the specific services such as VOD. However, the more users benefits from the Freemium service, the bigger will be the opportunity to switch into the Premium. In other words, broadcasters will benefit a lot from using the Freemium business model, because this will attract more subscribers to use the services.

The TV industry is a two-sided market where both advertisers and viewers play an important role. Broadcasters show interesting programms to draw in viewers and access to this audience is sold to advertisers and sponsers. In other words viewers can get free programs whereas advertisers gets revenues from responsive viewers.

We have identified all the key players who would play important roles in the HbbTV development namely: the User (TV viewer), Device Manufacturers (Samsung, LG, Sony, Phillips), Broadcasters (DR, TV2, Viasat), Distributors (YouSee, Stofa), Network Operators (TDC, Waoo), Right Holders (CopyDan, KODA) and Content Producers. The success of HbbTV in the Danish market will depend on all the players involved in the value chain, however, main player would be broadcasters as they are the main drivers for this technology and they will decide whether or not HbbTV becomes wide spread standard in the Danish market.

As services are drivers for HbbTV, which add value to the content, all the players in their segment must deliver the intended value to the users in terms of a service offering from the point of company. Broadcasters need to capture this opportunity by offering attractive services to the end users.

HbbTV is broadcast driven standard, which is favoured by the broadcasters where broadcasters themselves control the services and content, as they do not lose control over the content. The benefit of HbbTV to the broadcasters is that it helps broadcasters to stay attractive in the TV market by delivering value added interactive and on demand services to the end-consumers through TV sets with nobody in between them. HbbTV also opens a new area of application for service providers to push their content to the consumers in a friendly way, in a "lean back" TV environment. The triple play providers will be benefited by having more subscribers buying the TV packages with HbbTV and subscribe to the high – speed Internet package. Through a single device, the end-users (TV viewers) will be accessing broadcast related application, interactive and on-demand TV services on their TV screen. Device manufacturers would be benefited by selling more TV sets and set-top boxes and also by providing HbbTV independent application related to device manufacturer (typically the CE manufacturer's portal).

However, HbbTV poses threat to device manufacturers; the major TV manufacturers want to have their own market place and providing HbbTV would be a competition with their own app store where they go directly to the Internet without considering other players in the value chain. Even if manufacturers are not interested, they will be forced to support HbbTV in order to stay competitive in the market.

In addressing our problem formulation about, **How can HbbTV gain widespread adoption in the Danish market,** our work has addressed by exploring different barriers such as the low penetration rate of the Smart TV, no specific support for DRM, changes in user behaviour, more bandwidth consumption and requirement of Hbb – enabled TV set. Different players in the Danish market such as ViaSat, TV2 (especially TV2) and TDC see a very limited potential from this technology and are not ready to support HbbTV.

The problem is that HbbTV is broadcast driven standard, where broadcasters wants to control the big screen and they are the one who are mostly benefited. This makes other players not interested in this technology, especially the ones working with the OTT technology and gaining revenues on for example VoD service. So first of all, the technology itself need to be updated, there must a newer version with more functionalities such as allowing the distributors to be a part of this technology not as a carrier but also as a distributor, and the use of the new version of the standard, should be active with the new features especially the DRM.

The faster adoption of HbbTV in the Danish market now relies very much on DR by offering attractive services. DR can suggest all the manufacturers to have built in HbbTV that all they should put additional chips into their TV so that they could improve their offerings to the customers. Moreover before launching the final version, DR can corporate with number of other players like distributors (YouSee, Stofa), manufacturers (Samsung, Phillips) and network operators (TDC, Waoo). Major stakeholders (broadcasters, network providers and CE manufacturers) need to create a communication campaign in order to communicate the outstanding quality and the value of the HbbTV services and broadcasters need to convince the users that the application is useful.

13. Appendices

Appendix 1. Survey Questions

We are building an Interactive Electronic Program Guide (EPG) service; we want to study the users behaviour concerning usage of the Internet and the TV.

1. Do you watch TV?
    - Yes
    - No
    - If Yes, how many hours/day
2. Do you use the Internet?
    - Yes
    - No
    - IF yes, do you watch movies or videos on PC?
        - Yes
        - No
3. Do you connect your PC to the TV?
    - Yes
    - No
    - If yes, how many times per week?
4. Are you interested in checking the TV guide?
    - Yes
    - No
    - If No, why:
5. How often do you check the TV guide?
    - 1 – 2 times/ week
    - 3 – 4 times/ week
    - All week days
6. Do you check it using: the TV?
    - TV
    - Internet
        - Mobile
        - PC
    - Newspaper

7. Do you use a smart TV?
    - Yes
    - No
    - If no are you willing to buy one?
        - Yes
        - No

If No, please jump to question 9.

8. Do you use apps on your TV?
    - Yes
    - No
    - If No, are you willing to use them?
9. Do you record your favourite series?
    - Yes
    - No
    - If No, Why?
10. Do you set the timer for recording your favourite Series?
    - Yes
    - No
11. Do you watch TV based on the past pattern?
    - Yes
    - No
12. Are you willing to fill a Survey for your favourite programs, so that the app on your TV screen can provide you with your favourite program guide?
    - Yes
    - No
13. Do you like to have special offers according to your recommendations shown on your program guide?
    - Yes
    - No
14. Your gender?

- Male
- Female

15. How old are you?
    - 16 – 24
    - 25 – 34
    - 35 – 44
    - 45 – 54
    - 55 – 64
16. You education?
    - Candidate
    - University
    - Trade/Technical school or collage
    - Post graduate
    - Schooling until age 18
    - Schooling until age 16
    - Others

Appendix 2. Elgiganten Interview Questions

1. For you as a buyer, what differentiate one TV from the other? Is it:
    a. Resolution
    b. Extra functionalities such as apps?
2. Do you know what HbbTV means?
3. If TV2 offers you an extra service for a small subscription fee, are you willing to pay?

Appendix 3. User Test with Jannick Sørensen /AAU-C

Question: If DR provides you such an application and tells you that have to download such an application on your mobile or go the online and fill the survey for recommendation, would you do it?

Answer: yes, I think downloading the app, go to the app stores and download it, I would definitely do it. I think I would also be very like not caring about the typing on the website that I am interested in, I think there is no privacy issues as well, I mean Google knows everything about us anyway, as long I am not forced to it is just me, it is just like go out and find something. The problem you are dealing with is only if people are unsatisfied, they will start to use your application or may be if they are curious, but if they are curious and if you satisfy their curiosity immediately, there is future of your application.

Question: you said you will be happy to have such an application, to add programs on your wish lists. So if for example you fill such an thing and you started to get commercials according to your wish lists, like you are interested in sports and you are getting advertisement from inter sports, would you prefer this?

Answer: I think the way Facebook ads as a part of their news feeds, I think that in the mobile is very nice, now they are getting bit annoying as long as it is text on the side or Google ad words, it would be no problem if it is inter sport or whatever. I don't think because I mean in most cultures, this is advertising medium and even Denmark public service broadcasters DR says we have no ads because it is being trustworthy, then some years ago there was discussion about commercials on German public service broadcasters because it has been there for many years and the private media they think as a public service broadcasters you can do everything on the internet you want, if you stop making advertising on the TV. There was debate about how much are public broadcasters are allowed to do on the internet and in Germany, they are not allowed to do anything, even cooking recipes they are forced to remove from internet because there was fight between public service broadcasters and private service broadcasters, anyway so they were offered saying we will let you do everything on the internet if you remove TV commercials and then you the general director of the big channels said no, commercials makes it more trustworthy that is real TV and that was so strange conversation. So what I wanted to say is that this is advertising area, so if it is small inter sport logo provided by inter sport, I think there is no problem.

Question: DR uses advertisement for their own data. So for their advertisement , they pay the right holders for the content but not like commercials.

Answer: what you are offering is channel guide, so it is anyway outside DR's territory, if you are looking DR on Facebook, it is also advertisement next to it, I don't know if they can't decide or what. I think the problem would be if you start to sell

some advertisements that are based on the DR content, then there will probably problem. But if you sell advertisement based on your wish lists, there should be no problem. Probably it is about user experience because normally you think this is software that I control, I don't want it to be too intrusive that means no advertising, same you don't have advertising in operating system, Apple is very clever in advertising by selling books on Steve jobs.

Question: here commercials will be according to your wish and it will be the way it is done.

Answer: I think it will be the way with Google ad words, they are not too intrusive, but it is a very good and clever way.

Question: in the survey we made, we got around 70% of the users says it is ok to have a personalized ads with the personalized EPG.

Answer: I think it is not a big issue anymore. If you buy magazine, you get lots of advertisement and they fit very well with the content and you get annoyed if you get advertise out of topic.

Appendix 4. Interview with Claus P. Blicher / DR

On 28th September 2012, we had interview with Claus Pedersen Blicher (project leader in DR media). The purpose of interview was to collect his opinion about collaboration between the different stakeholders, value chain, strategies that will help faster adoption of HbbTV in the Danish market and other issues related to HbbTV. The interview was semi structured and summary of the interview is listed below.

1. **Are you satisfied with the trial version of the HbbTV?**

   Well, the service has a purpose. It is a service that tries to see what is possible when we combine broadcast with over the top services, so it is trying to set it up basically and we are satisfied with that, the service itself is simplistic and it has limitations and errors. So it was a prove concept of how it will work and then tries to put it up in the real environment instead of having internal test, it is testing out. So it is very simplistic and we are very satisfied with that.

2. **Are you going to launch the actual version? If yes, when? If not, why not?**

   Not in the near future but we will launch the actual version. Of course with better version whether it is 1.7 or 2.0 or whatever and it really doesn't matter. But it will be part of our basic offerings where we mix or integrate our different solutions. So it is

just recognizing that more TV within the market have Internet access and by having Internet access, do we have an opportunity of offering the users with more content and if we are able to relate to the stuff that they are actually seeing right now, will we be able to evaluate the view experience. It is also recognizing that given that you have Internet connections, you can see whatever doesn't broadcast through whatever cable or satellite or terrestrial will seize to exist pretty much. So time will user will not care about the source of the TV received and giving that is the fact, that is why we make the service and we will keep improve different offerings where we integrate or mix or further improve the services.

3. **What is going to be the relationships between DR and digital terrestrials (Teracom) in term of Hybrid TV projects?**

   Digital terrestrial is the broadcast channel that is where broadcasters broadcast the channels. They are making sure that our contents are also transmitted through the territorial network, on the other hand you have opportunity to make digital content available through their broadband services and these services are nearly data, they could be made available on whatever screen and when you talk about mixing them together, this is not a collaboration as such. We are making sure that terrestrial works and we are also making the multiple services available for the Internet and if you as a customer has specific equipment, will you be able to receive different types of offerings.

4. **What is going to be the relationships between DR and cable/satellite TV providers in term of Hybrid TV projects?**

   HbbTV is a way for us as a broadcaster to be sure that users who are paying the licence fees to us having a subscription will be able to receive our content also in the future where we might not have terrestrial network in the future or the users do not have equipment to receive it. So the value of HbbTV is that we will be able to guarantee access to the users if they only have Internet connections, so it could be live or it could be on demand. But it is a way of making sure that we don't have some gateways or party's controlling the networks for instance different app stores within the Samsung TV or Phillips or whoever, which HbbTV do we as a broadcasters as a unified broadcasters make sure that we have a chipset within the TV sets which allows us access to give content as a public service providers.

5. **When a customer pays a license fee for DR he/she expects full service. In case of Hybrid TV he/she has to pay for Broadband access, provided by a third party, to get the full service. How this can be handled?**

Our job is to make user service available in the channels they have. Right now, we guarantee that we are available terrestrials giving that you have the right equipment but you need to have a TV, so you need to have monitor to watch TV, you need to have radio to listen to music. So you need to have some sort of equipment. Our goal is to reach majority of the people who might be our customers that is who pays the license fees. So it will primarily be terrestrial for sometime, part the market will within be cable and satellite and within those channels, we make our signal available. We handle terrestrial part our self, but when you go into TDC or whatever, then they are responsible for bringing in the signal in the right quality. So that is our objective, we just want to make our core offerings available. Then it depends on which device that you decide on what service we offer. So if I understood your question correct, how do we make sure that our content available, do we basically do it through terrestrial and we make our service available through service providers such as YouSee, STOFA or satellite. So that our channel are within the basic offering.

6. **Will you push HbbTV into the market and force the manufacturers to have this built in HbbTV enabled?**

Well it is very difficult to push it into the market but yes it is not a pull strategy as well, so we will try to push it we as a member of European Broadcast Union (EBU), suggests to Philips or whoever that they should put additional chips into their TV and there by make it possible to improve their offerings to their customers. So it s a way of making sure that in future we will also have a way of reaching our users without having them to pay additional fees to whoever controls the gateway but it could be the TV manufacturers, it could be YouSee, it could be whoever but we need to be able to reach our customers and that is one way of doing it and then time will tell us if it will work or not but we have to whatever we can and Denmark is too small to push into anything. So it is not Denmark, it is broadcasters within part of the world, not only in Europe but also in states and Asia.

The Danish broadcasters organizations in regards to Samsung, Sony, Phillips or whoever, are not really important. They really do not care about us. We are too small to influence them in the marker for them to make specific attraction for Denmark. That is why we as a unified European Broadcasting union try to make this standard within the Internet based TV services. So we will not be able to influence the different chips going into the TV, it is only unified as a European Broadcasting Union. Lots of broadcasters organization having many millions of users, two hundred million users or so will be able to influence.

7. **A TV is a social media: family members sit together to watch a program. The hybrid TV gives the possibility to get interactivity on the top of the linear content; while the interactive aspect may be personalized, this may break the social aspect of the TV. Are you considering the possibility of conveying the interactive part through personal services such as EPG (electronic program guide).**

   EPG in my understanding is related to broadcasting. Given the fact that we personalize, in this case do we personalize our offerings to our customers will EPG seize to exist? It will just be data stream that we provide through data to the Internet through the customer.

   If you try to study the different screens within the living room, you might have a TV, you might have laptop, you might have iPad, and you might have iPhone. Laptop, iPad and TV are something that you might share within the living room as a combine screen but the mobile is not. So difference between the different screens that users want to interact with us. Talking to the similar offerings of HbbTV, just be that we hook up different services exactly the same as you have in HbbTV, where you will mix it and receive even in your mobile or iPad, it is exactly the same offerings but we are targeting different screens.

   But Given that HbbTV has to be used on that one, is it a whole family who has user behaviour on that, so HbbTV is personalized content from our database point of view. So we will be able to make personalized offerings to the content that you are seeing right now and we do it based on the EPG. So we know what we are broadcasting right now and based on that we will be able to make related offerings that might be interesting to the users and that is solely our data. That is the purpose of it and then you can personalize it, what they say like we do not want anything about cultural news, we hate it. So we make a user profile where he or she is in control of saying what she prefers and want, their favourites and also need to have subscription. So every time piece of content, you ensure whatever becomes available by pressing the red button, you make sure that news is available based on what you wanted to see it. That is not based on related data about the user but user having user profile.

8. **With Hybrid TV you get data back from the viewer allowing you collecting data about his/ her behaviour and preferences. How these data can be useful for you? Are there any limitations in using these data?**

We will never user specific question about specific customers or users without he or she has given us the specific right or so. So if we are about to use the information it is because we have an agreement that they have a prove of it is ok for us to improve the services to personalize the service by collecting their behaviour, by understanding he or hers needs.

9. **What do you think the role and effect of DRM in HbbTV?**

   HbbTV is just browsers making it available. So when we control all the data stream, if we do not make this Disney movie available for the system then it does not matter whether there is digital right management available or not within the HbbTV because the content is not available. So the way that we control it right now is only making the content available which has the correct right associated with it. So it is not about which circumstances something should be available, it is simply that we put the content online which we have rights to do so. Some programs we make available online only for 14 days and then we move it, so it is catalogue of content where we push or pull content in and out to make sure that we live up to the digital right management system. So we are vey specific about the specific DRM and I have no knowledge about the standard related to HbbTV but even if exists it does not matter because all the broadcasters have different DRM, so there is big difference between NRK in Norway, STV in Sweden or BBC and they build DRM within their content. Even though we have different DRM, which are standards within Europe it doesn't matter because different providers and broadcasters are paying for different rights depending on what they want to pay for, the focus of negotiations. So the problem of focus is not DRM, it is how they negotiate when they buy the content and it is totally different in the private market I know. But in our way, we buy content with specific rights associated to that and rights will be different because sometimes it might be specific needs which might be only with terrestrial to broadcast and sometime we know that we want to use it for a long time and we buy rights associated with it. But the way they control is making the rights available same as YouTube video or whatever and of course our content is limited to geographical area. That is what we have the rights for. There are lots of right issues, which we have to hold specifically how we do it.

10. **What strategies do you think will help the faster adoption of HbbTV in the Danish market?**

    Well time first of all. We need to make sure that TV sets have chips available to give the best experience to the user, even though we do not have chipset available can we

make it available through internet browsers content like advanced web app available through Internet? But HbbTV will significantly help user experience, right. So make sure that chips are made available within the TV or make sure that best services are made available within browsers which is freely available online and use advanced technologies.

The second part is wait until the users start to have Internet built in TV. Do you know that you should find the fact that how many percentages of the TVs that are sold right now have Internet access and how bigger the share in the general market. How many percentage of the TV in the general room have the opportunity to have Internet?

11. **What do you think are the barriers and drivers for the HbbTV in the Danish market?**

The elements that will drive the adoption of HbbTV will be all players around it. It will be big players in the market like Apple TV, Google TV, all the apps available within TV set, it will be Samsung who dongle tablets and TV together to make better experience to the user, so will be the users adopting the internet service and start to use them in a TV device and when they have that, will they use our service and offerings? When the user behaviour, when the user start to use these new offerings in a greater scale in Internet based offerings or whatever which are not broadcast will need to have valuable offerings and HbbTV is part of our solution for that. There will be mixture between HbbTV and also browsers based experience users and we know that development is going very fast and it is tough to keep the track. We also need to know that we need to have these types of services in the future.

So the barriers are the chips have to be made available and built in, they have to change all the TV set which are not internet enabled and they also have to start to consume all the data product on the TV set and we know that all these changes to user behaviour takes far more time then we expect.

Appendix 5. Interview with Jannik Kirk Sørensen / AUC

On 18th September 2012, we had interview with Janick Kirk Sørensen, assistance professor at CMI. The interview was to collect information about personalization and how personalization will help in adoption of HbbTV in the Danish market.

He explains personalization from his own point of view by giving some examples. He has journalist friend at Christian Borg where he can get news about politics that

would be the highest level of personalization and highest value as a user for him because this person at Christian Borg will know what he is interested in. So the producer of the media content, they are always speaking to the mass. So you introduced personalization, then it is a very little element of the value of the product that can be personalized.

So he thinks the main problem of personalization is media content the actual part of the product that you can change or modify according to desire that is what is delivered and how it is presented to him. The content itself cannot then he also thinks he found that the social element is more important than personal element when it comes to media content. It is more important to know what other people know, your friends than to avoid things that are irrevelent.

He thinks the problem with media content compared to all other products is that this is nondirective and it is novel. So the essential quality of the media product is that novelty. The only exceptional is the music because if you listen to the music or if you want to watch same film again and again, you don't want the new version but you want the same version that you watched two years ago or other day. So all the media content has to be novel to predict the value for the user you are actually on because you try to make assumptions based on similarities that these media product has other products that is consumed by the same user. There is also an amazon way of recommending, people who bought this book also bought other books, so it tells the shopping behavior of customers and when you look people bookshelves, there are some similarities. So instead of trying to understand what is media content is about, you just say observes what people are doing.

He thinks broadcasters are very good at deciding what to show at which time. They have very good feeling of what should be the best program for Tuesday at 9 o clock and so on. Over the years, they have analyzed the ratings for different programs. If you buy the rights to broadcasts say X factor or who wants to be the millioner, it will come with the complete description which type of segments. He thinks that is difficult. He thinks instead of like this in the debate of personalization, there are both pros and cons. You can also just define some success criteria that a system must be able to get adopted. Of course there will be a few people that would accused that whole idea that the system takes decisions on our behalf, if we exclude those and we just look on all the positives that are turning on the big Screen, he doesn't call it TV but called it Big Screen because center provider decides what it should display on the screen comparing to small devices who are the one to decide, then we can just say ok,

it should not require work, it should not take power away from me, it should make me feel powerful and so on. On the other hand, you can analyze TIVO in the USA, but may be it is different in the Europe because I don't see there are personal video recorder and recommender system. In the USA, there is big success apparently with TIVO.

When TV schedulers sits and decide, next Friday what should we put on our TV channel, then they try to think of how do we crate a channel brand so that it fulfills peoples requirements and how do we relate to what is happening. May be in winter you want to watch movie of the spring and in the summer time I saw some TV channels put movies with the ice in the winter and mountain and so on.

He explains about user viewer's concept of broadcasters in this way: When you do programing for broadcasters channels, you look constantly at a TV meter, this is I think thousand responders and they you multiply. TV meter is a box that is installed and measure second by second logs like who is sitting infront of the television and so on. So you have thousands of box placed at different places in Denmark and out of that you can say how this many viewers does TV program had but actual data behind this is much more detail, you can actually say second by second. So like when we show these program, this many people slept away and when you design the next program. When many people slept away, then may be many people didn't like that program, so try to analyze that content production side but also on the scheduling side like should we put romantic movie on Friday night or is it better to show comedy movie.

He suggest one thing that we can add with the personalization is that it is incremental he would argue and that is what TV schedulers has been very good. If there is TV series that does not perform as it was expected, after two or three days it is removed. Sometime we can see that they take off the schedule very fast, if they see it is not preforming well.

He thinks that reason why many personalized services in many broadcasters failed is because the brand identity of any mass media is that they select for you. They have well trained journalist to pick out the best stories, so why should he pick it because they have more knowledge about what have happened to day in the world than he have. So if they say we will let you take part of this decision, then they actually do not add me more value but add me more work without an increased value. He says: So if I say I want to have news only about earthquakes in Latin America, first of all I would miss the social aspect and I would also have to conduct work that normally is

conducted by someone else, at least mental work. So I think now we are back to the personalization, it also depends on if it is implicit or explicit. Explicit personalization if one where user have to click something, for example choosing one among three films. So this requires extra work from the user.

Appendix 6. Interview with Allan Hammershøj /AUC

On 18th September 2012, we had interview with Allan Hammershøj, research assistance and technical project coordinator (department of electronic system in AAU Copenhagen). The interview was to collect his opinion about DRM in market perspective and on the content provider such as broadcasters and how they will affect the market.

According to him, when we define DRM, we have to consider that from whom we are talking about, are we talking about the content owners, the content distributors or the end users. The end user doesn't care about the DRM, actually it is very annoying to them if it is something that is problem to them and includes extra step to the user, it is in a way you can say giving them something that could say I don't want this. This is due to the extra DRM step and could end up with opposite step and it might be easier for them to find the pirated version of this which could be the other thing that end user might prefer. DRM compared to security is just the matter of having some more functionality inside regarding securing the contents.

Looking for the distributors, he thinks it is a big problem. If for example content owners for example allow the video on demand services, you are allowed to watch the full content to have DRM protected, then you say what kind of DRM? Then you look at it, there are many kind of DRM, yes but there are only some that we approved. But then there has been a collaboration of production of content owners here, Decellc. In this they have defined that there are five technologies for the content owners, which are basically Hollywood production companies except Disney. Then there has approved that there should be a standard and one of these is READY for Microsoft, the other one is DOVY flash access for DOVY, then there is DRM Marlene, which is interesting one and maintained by intertrust and open standard, then there is original OMA standard, which is of course DRM by OMA and OMA 2.1 is the newest version. There is standard that Nokia has very very much involved in but it is does not exist anymore. There is of course Widevine DRM that is widely used.

He thinks Marlene is very good standard here. Then there is HbbTV and the standards here made by some different consortium where different people gather and want to have their technology. They have decided to use standard that should be a way to present and send out together with existing TV like HBB and then made broadcast TV and they came out with version which is 1.0 and they have updated where they have made some extra changes for making possible to stream some content but actually these standard today is a old fashion in many ways. HBB is a standard, which is lacking behind what has been going in the market as they are trying to converge different technologies and this is a converged standard trying to converge what is going on the Internet technologies side and going on the broadcast side. And their original ideas about combining technologies is to get extra services available for existing content here but interesting is this is not what user wants. What they want is if they want extra information on the controller's side and on the second screen device instead and actually it was the first version, they have nothing out there, which means it is already faced out before even it is started.

He said that he talked to the head of HbbTV consortium in London and then he said this to him and he said these are the problems but he said with 2.0, they are really going to work the world of inter technologies in a way to see how can we update this standard. This actually meets the expectation of the customers because if no user wants it then why should the owners even try to consider these standards. The only thing HbbTV is happy about is if more services are already there because they have the web and also to be sure that they can control what is going in the channel. So because it is content owners specific standard, and then you have been working with YouSee for example, then they also want to work with HbbTV, then they would love to work with existing channels and put some content of their own but then that is not what the broadcasters want. But the HbbTV is taking the broadcast into consideration the content owner, which is the ones to control the content. But back into the standards here, 2.0 will meet the world of inter-technologies; I would call it the OTT world.

When we asked him about his views on market for OTT service like Netflix, he says: I don't think they will take the market because we will still have what we say in Denmark house alter which is going to be a big expensive TV and this is going to be stupid again instead of smart because there is no need to put intelligence on the TV because if you are going to do that, you will have to buy a very expensive television at home with clearest color and best quality and you change it after 7 years or something like that which should be enough for best quality. But in 7 years, smart

functionality is like going from now to the Stone Age of technologies and this will not be worth and might end up with HTMI cable so that smart TV becomes dump TV again. But I still believe that not everything will become OTT. You have house alter which has much better quality, I will not watch a football match in poor quality and services through OTT might not be the best quality. The only thing that might die is terrestrial DBB TV because why do you need DBB TV. But to question about what DRM can do and so on in the HbbTV that is because content owners requires DRM for some of the TV shows and just to be on the secure side because you can see from the provider.

As HbbTV supports only one DRM, he thinks Marlene would be the one most interesting to use because it actually maintains the same as Google does. You cannot get it without paying fees but of course you can get access to it and select one DRM. But for me, it is ridiculous no matter what, you do not need DRM. It is just the matter of Studios who does not know how to secure their content by using good secure solutions.

The idea of DRM and the idea of securing is that they should be difficult for the commenters (man in the middle) to get the hands on it. The thing is that if hackers want it they can hack it any way and is not special for them. It is lawyers that are doing this and not the technicians and lawyers does not know about security at all, they just know how to put title on it and there has to be DRM on it.

He thinks DRM should be killed and they should instead for example if content owners say what will you do in order to protect our data here and they could put some guidelines and say this is what you need to do and this is what they really do. So the good thing is that what you get is actually technical questionnaire (TQ you can called), and then you answer the question to how you are going to protect the data and they look at it and then they can say what kind of contents what you can get access to. So actually the way they work is pretty good.

When asked about his openion for the future of HbbTV, he thinks it is never going to work. He thinks HbbTV is a stupid thing, it has been tried for billion of times and it should be kicked out, there is no need for HbbTV. The thing is that because broadcasters are trying to defend their wall garden that is all. This is another way of telling the old set top boxes with MHP and MHEG and it is way for operators to keep the users and make them difficult so that it becomes difficult for them to switch to other operators.

When asked about the difference between OTT and HbbTV?

He answered by OTT is a concept, HbbTV is a standard and HbbTV stands for hybrid broadband broadcast television meaning that you combine something from the broadband world with the something from the broadcast world which is you know existing antennas, satellite cable whatever you combine these two things. OTT stands for over the top and only thing is that you provide the service where you do not own the infrastructure meaning that for instance you have an ISP that provide internet and you are watching Netflix on your PC, they do not get single dime from Netflix by allowing you to access their services so you access their services over the top. When we talk about the broadcasters, they own the infrastructures in a way at least you can say the broadcasters network, for example in Denmark it is gatekeeper that is owning the DTT but you can say it is a broadcasters, it is an infrastructure completely controlled by the providers meaning that for example if DR send on specific frequency which is maintained by the gatekeeper and received by the terminal and you cannot use other services that is defined by the gatekeeper. There are some obligations towards the Danish government in the broadcast world; you need to have this kind of channels actual before being the gatekeeper.

By combining broadcast and broadband meaning that you also take something from the OTT world meaning that you open the opportunities to get something but the big problem why there is a need for the Hbb is that if you combine some broadband with some broadcast, that could be something like put something on the top of the picture for the broadcast, then suddenly the broadcast cannot control what the viewers are watching and they do not like to have some sort of middle man to put something on top of their picture. So HbbTV is built by broadcasters in order to ensure that no one in the middle can put something else on the top of it by at least from the standard point of view. So they could at least control what is available at Internet services at end users point. You can say the way the HbbTV is built right now is a way of providing HTML, webpages, links or whatever you need from the broadcast perspective so that broadcast control the services available. Next generation HbbTV will do better OTT than it is now, with HbbTV 1.5 they have included OTT streaming technologies but then it is a standard. OTT is a concept provided over the top but OTT streaming technologies called MPEG-DASH and MPEG is you know committee of standards and they have dynamic adaptive streaming over HTTP DASH, they have made an upgrade into the wide adaptive standard. So in some way, they are open up for the OTT services to be combined. So this is what HbbTV is all about it is a standard.

HbbTV includes OTT. Comparing OTT and HbbTV is like comparing Apple and Dog, here HbbTV and OTT is completely two different things. HbbTV is a way for the broadcasters on their managed networks to control what is going on the same screen from the unmanaged networks which is best effort networks called internet. Broadcast is best effort in IP world, OTT is only in the internet world meaning that the service providers does not necessarily gives you a way to access to except if you already have an ISP that you are subscribing.

What is interesting in the converging world is that LTE antennas where it can provide broadcast over a mobile Internet so you actually have a part of broadcast and there is some hole on the TDD band and this frequency can actually be used for broadcast. HbbTV is way of expressing that there are such kind services available, it is just a standard. With LTE, you don't have any more circuit switch and all phone call are all IP based. There is nothing else; it is just a broadband.

And when asked about his opinion of the barriers and drivers for the HbbTV he replied: It is very simple; it is never going to work. I think HbbTV is a stupid thing, it has been tried for billion of times and it should be kicked out, there is no need for HbbTV. The thing is that because broadcasters are trying to defend their wall garden that is all. This is another way of telling the old set top boxes with MHP and MHEG and it is way for operators to keep the users and make them difficult so that it becomes difficult for them to switch to other operators. OTT says you pay for what you get and every time you want to buy some hot dog, lets say with YouSee, you will get hot dog wrapped in one piece of paper and extra box decorated with some extra stickers and glossy. HbbTV is a way for the operators for anyone interfering with their signal and that is all. It is a protective technology and it is stupid technology, there is no need for this and before it is born in the market, it is already dead.

Let the TV present the content; don't put any clever stuffs into it. If you are using second screen, that makes sense but two things on the same screen is very stupid idea. I think it is vey stupid and it is just to protect their wall garden and there is no such driver exists for HbbTV.

Do you know in USA, how many smart TVs are connected? It is only 9%. Why should they because they have boxer and they watch Netflix.

Appendix 7. Interview with Martin Engen / Samsung

We wrote mail to Samsung to discuss the HbbTV adoption in the Danish market and the role of Samsung as a manufacture in the adoption of the new technology in Denmark. Martin Engen (sales manager at Samsung Electronics) states that the future of HbbTV in Denmark will depend on the launching of actual version of HbbTV by DR.

"As you might know, no final decision has been made about implementing HbbTV on the Danish market. DR has made a trial period, which will end now, and then they will consider the future with this as an option. With this taken into consideration, Hbb still hasn't been implemented in Samsung TV's sold to the Danish market, and right now we are looking into 2013, weather this should be supported or not. So based on fact, that we haven't got any experience with HbbTV yet, I don't think I can clarify this further at the moment."

Appendix 8. Interview Torben Rasmussen / TDC DSL

On 25th October 2012, we had interview with Torben Rasmussen, Senior product manager at TDC DSL. The purpose of interview was to collect his opinion about the future of HbbTV in the Danish market, barriers for the adoption, collaboration between the different and other issues related to HbbTV. The interview was semi structured and summary of the interview is listed below.

1. **Are you working in the Hybrid TV field? If not, why?**

   We are currently using MS TV as our TV platform. MS TV requires a STB where services are handled partly locally by a client on the STB. If we are to provide TV to the customers using HbbTV, we would have to develop a new TV setup where our current TV setup are handled in a HbbTV environment. The market potential in HbbTV are still very limited, which means the investment could be used way better in other areas.

   At the same time the strength in providing the customer with our own STB are, that we are in full control of the TV experience. We are able to prioritize and cache the TV traffic in the IP net and thereby ensuring the customer experience. If we are to change to a setup where we are not in control of the IP, we are no longer able to ensure the proper quality. The problem is still the limitation in the access, combined with the increasing demand for higher TV resolution and more screens in the home. To meet this demand, we need to be in control of the full supply chain to ensure the UI.

   At the end of the day, there are, at this time, a very limited number of pro's for TDC if changing to HbbTV. Actually from a market perspective you could say there are more pro's in not pushing the HbbTV standard.

2. **We made interview with DR and Samsung and DR is going to launch the final version of the HbbTV in the beginning of the next year and Samsung's potential for this**

technology in the Danish market will depend on DR.. So now if we put puzzle together, DR is going to launch the actual service and Samsung is going to do it as well, what will be your role?

Well, it is not going to change anything at all because the things that they will deliver to the customer is nothing new. So what they are going to provide via HbbTV is something we already got. So from a customer perspective, there is of course Samsung who would like to do it with as if they have HbbTV, they can sell more TV. But from our perspective, we need to have penetration rate which should be pretty higher and I think this will take a very long time before the HbbTV penetration of the HbbTV is going to be huge enough to cover some part of the market where we are not. So the penetration of HbbTV will take a long time in the Danish market before it is relevant to the Danish households, that is one part.

The other part is customer readiness to switch to this technology and the question here is why would the customer do it. If it is something's that they have got already, why should they switch to this technology. Will they get something new, well no. What they get is something provided over the internet which are not certain in terms of quality, so the more you use your the big screen, the more capacity you use in your broadband connection so you need to have lot of bandwidth. That could be a big issue for lot of people

3. **Are you going to support the HbbTV standard to be pushed into the Danish market?**

   No, at this time we are just following the way things goes. As said, from a market perspective there's no potential for us at this time.

4. **Are you cooperating with manufacturers and middleware development companies?**

   Yes, but not with the aim of developing HddTV features.

5. **What is going to be the relationships between TDC DSL and Digital Terrestrial (TeraCom) in term of Hybrid TV projects?**

   None, we are proving our customers with the same TV channel offering as the DTT supplier, so why invite them in to our distribution platform?

6. **What is going to be the relationships between TDC DSL and cable/satellite TV providers in term of Hybrid TV projects?**

   The same as for DTT.

7. **When a customer pays a subscription for TDC package he/she expects full service. In case of Hybrid TV he/she. In terms of HbbTV are you going to monetize it? How? (Commercials or extra subscriptions for the services?)**

   This is one of the reasons for not wanting to push HbbTV; we would have to change the business and distribution model, which are not in our interest.

8. **A TV is a social media: family members sit together to watch a program. The hybrid TV gives the possibility to get interactivity on the top of the linear content; while the interactive aspect may be personalized, this may break the social aspect of the TV. Are you considering the possibility of personalizing the services?**

Of course, as a start we are looking in to creating a setup where we are switching to personalized recommendations at all levels, and on top of that integration of social media. The options for personalized services are wide, but I believe you still have to be careful not to force the change of TV into something it's not. The nature of TV is to be entertained, in a setup where the level of freedom is high, and the content are relevant. Within a household TV could be for a family at one time, and at another time for a random family member. Therefore you have to be very careful to not pushing the personalization to hard.

9. **With Hybrid TV you get data back from the viewer allowing you collecting data about his/ her behavior and preferences. How these data can be useful for you? Are there any limitations in using these data?**

   We already have those data, since we are able to track the usage via the STB we are providing to the customer. The limitations are primarily set in legal terms. There are very strict rules for storage and use of data on a personal level

10. **When do you think you will be ready to launch the hybrid TV? Are you in contact with hardware/set-top-box manufacturers to support your launch?**

    It depends on the market development. As for now it's not on our roadmap.

11. **What do you think the role and effect of DRM in HbbTV?**

    This would be a requirement, I guess.

12. **What do you think about the future of Hybrid TV in Denmark?**

    The principles are good from a certain perspective, but on the other hand, there's a lot of players on the market where there's more disadvantages than advantages. It's therefore hard to say what's going to happen. In short terms I must say that I believe nothing will happen. The potential is low, an increase in the demand would require full integration on smart TV's, which again would mean that the Danish households would have to change all of their TV set's, which is not going to happen. When the penetration of the TV set's are high enough, it would still require a change in the customer behavior, so from my point of view there's a long way to go.

    Another perspective is the willingness of the TV stations to go into this market. The most of them would prefer a status quo in order to ensure a large customer base by being represented in the basic TV packages in the market. If the degree of freedom for the customer to choose exactly the channels they want to see is to be increased, the TV stations would have to settle with lower customer base, and as a cause of this, a decrease in the revenue from commercials.

    Also the potential for the HbbTV is not for the TV distributors. The potential is only for people who want to sell things to the customers and then they will have to rely on the customer's willingness to buy. Why would I use Big Screen, why not iPad and computer and so on.

13. **So in your opinion, HbbTV will end just like MHP and MPEG-5?**

    Yes, it is going to be something like that. It is of course standard for some way to provide customers with different options, different possibilities, and different ways to

provide customers with the content. But you should still look how the smart TV is right now. I don't know if you have smart TV, if yes have you ever tried to use the app.

So there is no logic reason for why the customers would change their behavior because it is HbbTV, does not matter. You are not going to get some new possibilities, you are not going to get remarkable better experience, it is just an app, it is something easier to get via the iPad and PC and tablet. I don't see the user experience. I could be wrong but it is my opinion.

The way I see is as long as you are creating product which are not evolving from the customer perspective and needs, you are going to loose. There is no chance for surviving and I don't see why I as a customer should use this specific service, well I can gets apps on my TV, why would like to have apps on my TV because I would like to check my Facebook and play games. But all of these things I can do on the iPad, my PC and the iPad has keyboard and PC has keyboard, so why should I use this service. We are providing services to our customers via the Set Top Box anyhow, so why should we use HbbTV.

14. How do you see the value chain in terms of HbbTV in the Danish Market?

Well, this is almost impossible to answer. It'd depend on how this marked will develop, and how the product offering would end up to be. There are several ways for the market to evolve, so at the end of the day, it all about who's the future players on the market.

15. What strategies do you think will help the faster adoption of HbbTV in the Danish market?

You would have to ask those who actually see this as a fantastic opportunity. The barriers are at this time to high, as described in the question regarding the future in Denmark. We, as TDC, doesn't necessarily want to push the adoption at this time.

16. What do you think are the barriers for the HbbTV in the Danish market?

There's a lot, both on the supplier side, but also on the customer side. First of all, you need to find out why should we support HbbTV. Is there market potential for this, is it going to open new part of the market, is it lower cost, there need to be reason for us to do this. That reason now is pretty hard for us to find for start. Of course if it is the market standard that is going to push in every TV set, then it is another question, then we have to this.

One of the barriers I can see is, in a typical Danish household there is 2 to 3 TV's right now, so they need to change all the TV's and that is not going to happen. So what you can do is you are going to change the old one and replace with new one, then you still have two elder TV which is not HbbTV enabled. So HbbTV cannot standalone for long, it need something else which is one part. So the penetration of HbbTV will take a long time in the Danish market before it is relevant to the Danish households that are one part. The penetration of the HbbTV in Danish market is another obstacle, which will take a long time.

Appendix 9. Interview Jakob Sørensen / YouSee A/S

On the 22nd of august, we had meeting with Jacob Sørensen, on demand chef of YouSee A/S. The meeting was mainly about the discussion of the project problem formulation and his opinion on future of HbbTV, drivers and barriers and YouSee's interest behind HbbTV and below is the summary of the meeting.

1. **Are you interested in HbbTV?**

   Sure, but we are still in the trial bases. If you have for an instant way say TV2 put out their stuff for free on an HbbTV platform and say if you have access to this channel, then you have access to all this stuff, then we would be on a tremendous pressure to put the signalling into our network. I mean we could not really avoid it and I think that would lose a lot if want to stay a competitive in the market and so on, we would need to do this. If TV2 wants to hide it behind a pay wall and say you can have access to all this but you have to buy it from us, then I think we would be less inclined. I am not sure we would be really willing to help them bypass us and selling content directly to customers. So we are like device manufacturers would like to not be really the ones pushing this standard but we could be forced to follow it, so to speak. We might speak figure a way to harness it, I mean if there's some sort of model where we would gain, broadcasters would gain this would make sense in the biggest schema thing then we could push it. Right now we want to know as much as we can about it, we want to think a lot about it, follow everything going on try to understand. We know that when DR comes with an actual official service then we can't really avoid selling it in our network, because our customers expect that everything from DR will be available for them because they are paying for it twice, they are paying us and they are paying license fees and most likely DR will also, I mean the signalling will carry status a lot of stuff, DR2 we could not pull off our network. If you are a distributor in Denmark then you have to distribute DR2 and you have to so it in the basic package and most likely HbbTV signalling would be past of that must carry commitment so you can't change the signal that you get from DR. So we would probably be legally forced to signal it. When it comes to HbbTV and DR, we don't really have a choice. When it comes to everyone else I mean commercial broadcasters, we do have a choice. Again if they make it freely available and gives you access to a lot of cool stuff and so on we might be forced by the market by customer demand, but otherwise we would be forced and we would have to think about whether or not it make sense in the broader perspective.

2. **Netflix is coming soon in Denmark, do you think it is threat for service providers?**

Netflix is greatest threat in the market now. There are a lot of things happening in the market. Right now there is a lot about Netflix and HBO companies as strictly online streaming services and as you might read they are coming to Denmark and we are sort of preparing a reply. So far right now, it seems like everybody is going to watch Netflix and at the end of this year probably no body is going to have TV packages and this is bad for TV stations such as TV3, but that's not the reality. We might see 5% of the market going that direction. Even though it is a huge number, it won't destroy the market. The market will still be there, the market will still be massive What many people can't really decide to stay with the television packaging or go to the video streaming on the Internet. So the Internet streaming would it be substitute for television or complementary. There's however trend towards cable shaving, which is when people downgrade their cable subscription. In a way they go from big package to medium and then drop for Netflix and the cable-shaving thing is probably what will happen and probably we will see it here in Denmark as well.

3. **What do you think the role of DRM in HbbTV?**

DRM is a really tricky thing because you have a number of different ones and sort of changes all the time which one is most relevant for like the movie studios and the TV broadcasters they will come to us and say if you want to present our content, then you need to have a DRM that is approved by us and these are the ones that we approve, and that list is not the same from every company. So we will be having different lists for different companies such as warner bros, Disney, from discovery network and so on. So it is all about finding the one which is the common and they change quiet a lot these lists like this and there is a big hype about the ultraviolet which is not really a DRM but more of grouping of DRMs that are consolidated on the certain principle and so on. So we feel pretty certain that Verimatrix solution we've used is the right one at least for HLS. We spent a lot of time analysing which streaming format to go with which DRM, we need several streaming for different formats.

4. **If broadcasters are going to promote the HbbTV into the market, do you think they would force the manufacturers to promote it?**

Exactly, I don't think that they will be running ahead and promoting, but they will be forced to respond. If the market goes into HbbTV, I mean if DR pushes it sometime next year for an instant and I can see that happening, then and say LG goes out and says we support HbbTV, then everyone else will follow within 6 months. I mean we've seen it a lot before HD ready TV, full HD TV, the whole concept of TV, DVBC

tune, MPEG2, MPEG4, everything. I mean that's the way it just work whenever someone launches a feature that is interesting, then everybody wants to have it then it became a must thing. And then you'll be wondering what will they compete on next, because right now there is the smart TV platform, which does really separate regular TVs.

5. **Is there any agreement with YouSee and DR on how to launch the HbbTV on your network?**

   Yes, I mean presumably but they are not, they don't see us as much as a distributor you know. We distribute them to reach all households in our network, so they will probably launch it and say you can take it or leave it, but by the way, the law says that you have to take it. Then we just say ok and we have to take it, but the whole DR catch up service on our set top boxes is something that we pay quiet a lot of money to copyDan. DR they actually don't own their content in the manner of speaking. So we've bought the rights for their content from copyDan.

6. **We want to discuss business model of WebTV so we can fit our business model into YouSee business model.**

   Generally, our focus is on building the best on our core products. This goes for WebTV as well, we have included in our broadband subscription, if you have broadband from us, you can watch our channels on PC or tablet or iPhone or iPad or whatever when you are connecting to your broadband home network. We know you are in your house and we know you have already paid for these channels, so we can make our channels available to you. You get selection of some of those channels available outside your home but thinking here again we don't believe you can charge consumers additional money for access to TV on your iPad, you don't want to pay your TV package and then pay 50 kroner extra to pay watch TV on your iPad. So instead, we bundle that into our broadband product, if you have broadband and TV from us, you can watch channels for free on your different devices and people really liked it. So it is a way of differentiating our broadband product from other competitors like Full Rate, Telenor or Telia because we can offer you to access to TV channels if you have broadband from us. So we can compete with others on something different other than speed and price.

7. **What are the barriers of the HbbTV in your opinion?**

   I think it is pretty hard to say who is going to push the standard, DR is probably going to push pretty hard but that is the guy working in the technical department have different knowledge than guys working in the accounting department so they

don't really care about the money stream and the revenues but they have already had strategies on this now, how are we going to get some money out of this that will pay money to the actors and who ever necessary. So I think DR has separate personality on this and it is harder for them to push into the market and I don't think pushing the flat screen will push it but that will drag it along by DR pushing it, I don't think we would push it because there is lot of ideological package in it and as long as the technology is not up to expect for our purpose we don't have really interest in pushing it. I don't think commercial broadcasters are really aware of it and I think TV2 is dependent on us and other distributors. Even if TV2 via play strategy is very fenced off and we have been negotiating for a while. The commercial broadcasters are very reliable on the distributors so before they could push HbbTV, they want to have sense of if it helps to bring some money in and also not pissing off all the distributors, I don't think they know if HbbTV exist for the most part. So there is a big hurdle. I think most of the barriers in HbbTV comes from HbbTV mixing sort of technological solution with normative approach or a designation about who does what and it does not fit completely with the reality and it hampers the technology I think. But on the other hand, it gives some actors namely DR give some strong incentive to push it. So it is normally broadcasters who benefits form HbbTV. I think one of the problem is that HbbTV consortium, they have tried to recruit every body, they have broadcasters, distributors , CE manufactures and they have said that every body should be involved and we should find a standard that everybody is happy with and they might not be able to do that. We have different interest, we might not have the same interest as Samsung has and Samsung might not has the same interest as DR has and may be we cant agree on anything that works. In some sense I think they need to find one focus group and make sure that this is the strong group to push it onto every one else. I think it is very hard to set on the standard with every one signed on it, I think it sort of has to win the battle.

8. **Can you as a YouSee see a benefits of HbbTV?**

   Yes, of course. We will just use it as a sort of mechanism for requesting on demand content, then we have some promise at least we can use the standard when it comes to the Smart TV. We consider ourselves as an aggregator, so if HbbTV would be kind of standard it will be very interesting to work with that but it still needs a better work I think.

Appendix 10. Interview with Lars Kierkegaard / Teracom

On the 7th November 2012, we had interview with Lars Kierkegaard, deputy head (Souschef) at Teracom A/S. The purpose of interview was to collect his opinion about the future of HbbTV in the Danish market and barriers for HbbTV and his opinion is summarized below.

Lot of the questions that you have asked, some how it was difficult to answer and it is our strategic department who are working on this and I cannot say much because it is bit confidential, although I would very much love to.

About the future of HbbTV in Denmark, it will come, it will definitely come. It will come in Denmark because you still have a lots of viewers with roof top antennas, you will also see DTT indoor center working more efficiently today, you have improved indoor DTT coverage which will make it easier, you don't have to invest inexpensive antennas on your rooftop to get DTT signal. You can buy indoor antenna for 300 kroner and then you are connected. I definitely believe that even though there is high fiber penetration in Denmark, the last survey I saw that almost 40 percentages of the Danish households have fiber, but there are 60 percentages which does not. So I definitely believe that hybrid TV will gain success in Denmark, no doubt about it. It is definitely hard to say when, again I should mention DR has a lot to say on it, but others can also say if they are willing to invest. DR has perfect platform to do this but other can do as well.

Concerning the barriers, I think that we mentioned the content rights; it is one of the barrier. Content rights are extremely important and you have several dimensions to content rights and they are linked to which media do we transmit the signal, is it fiber or is it through the terrestrial or is it satellite, how is it transported to the end user or viewer. Is it streaming or is it via analog co-axial cable or which media are you using and whole content right is very complicated and the content owners they don't want to risk the piracy or minimize the risk of piracy is also because if you open things on the internet, now I am talking about OTT and connected TV, if you do that, then you expose to yourself and then from content right point of view, that is something very difficult to handle. Another barrier is the adoption of the standards where the countries committing to adopt this standards fully commercial launch, equipment manufacturers of course, set top boxes, smart TV etc. can also be the barriers. They can also be the drivers depending on how you look at it.

There is also big difference is user behavior and this will really affect over the time and the demand for the interactivity because you can find a lot of service today that average people today is satisfied with linear TV content with some catch up TV, which will be very nice if you have for 10 days, but that will change soon again because you are measuring against old generation viewers. With the younger viewers, it is a different picture. They are much interactive and this is what we see in boxer part of group, when we see user behavior and of course multiscreen to switch between different screens. On the move, they used their iPhones, their iPads when they are in the hotspots, when they are home, they use PC and TVs. So the multiscreen is also critical, also with respect to hybrid. That also need to be incorporated in the technology.

Appendix 11. Interview with Stig Møller Christensen / manager of TV2 Pay-TV

1) Are you working in the Hybrid TV field? If not, why?

   No, not with the Hbb standard. We have plenty of work and investments to do in relation to HD and OTT video on our own platform

2) Are you going to support the HbbTV standard to be pushed into the Danish market?

   Not certain. We have made no formal decisions or developed any strategy regarding the standard

3) Are you cooperating with manufacturers and middleware development companies?

   No, not at present

4) What is going to be the relationships between TV2 and Digital Terrestrial (TeraCom) in term of Hybrid TV projects?

   Uncertain, if any

5) What is going to be the relationships between TV2 and cable/satelliteTV providers in term of Hybrid TV projects?

   Uncertain, if any

   6) When a customer pays a subscription for TV2 package he/she expects full service. In terms of HbbTV are you going to monetize it? How? (Commercials or extra subscriptions for the services?)

Not understood. We monetize all of our services – either through pay or ad funding. Since we have no strategy for Hbb, I cannot hypothesize on its monetization

7) A TV is a social media: family members sit together to watch a program. The hybrid TV gives the possibility to get interactivity on the

top of the linear content; while the interactive aspect may be personalized, this may break the social aspect of the TV. Are you considering the possibility of personalizing the services?◎No, since we have no strategy. At present we work a lot with our own OTT service TV 2 Play – alone B2C and in partnerships B2B with tv operators. I personally think this is how tv is going to be made personal – through device ownership of tablets, phones etc. and through the possibilities of mobility and time shift (other tv services like Netflix, Viaplay, HBO is the same). A little bit of internet layer on the big tv screen, is just tele-text/text tv with better screen resolution.◎◎Also second screen usage (not on the tv screen) along with linear tv has some promising aspects, but still in its infancy

8) With Hybrid TV you get data back from the viewer allowing you collecting data about his/ her behavior and preferences. How these

data can be useful for you? Are there any limitations in using these data?

Don't know

9) When do you think you will be ready to launch the hybrid TV?

Don't know

Are you in contact with hardware/set----top----box manufacturers to support your launch?

No

10) What do you think about the future of Hybrid TV in Denmark?

Uncertain, the commercial models and logics are not clear at all to me (personal opinion). It might work as supplementary standard for license-financed broadcasters like DR. For us and the commercial tv operators/distributors, I see a lot of question marks

11) How do you see the value chain in terms of HbbTV in the Danish Market?

Unclear. So far it's just a standard that no players have really embraced. So it is still evolving

12) What strategies do you think will help the faster adoption of HbbTV in the Danish market?

Unclear. The standard needs to prove itself – its commercial value. So far, that seems dodgy to me.

13) What do you think are the barriers for the HbbTV in the Danish market?

Plenty. First of all, open platforms are always potentially complex when different commercial players in the industry and value chain have different strategies. At the moment, all focus and commercial development is on OTT-delivery of video/TV and companion devices/second screen. I might be wrong, but I simply see little commercial logic or potential in HBB, if you work as a commercial broadcaster or operator

Appendix 12. Interview with Mads Danscher / Viasat

In an email interview with Mads Danscher, IPTV manager for Viasat, he replied about the future of the Hybrid TV in Denmark by: "From the Danish perspective we are not working with HbbTV and have no current plans to do so."

Appendix 13. Team Contract

Team Co-operation Contract

Work Load
The primary load is scheduled to be equivalent to 30 ECTS and should be accomplished during Monday to Friday. The main part of the tasks of the project should be solved at the YouSee and must be initiated immediately in accordance to the Action Item List. Action Item List and a Time schedule must be established and maintained throughout the semester. Use of weekends may come into question in accordance to mutual agreement.

Evaluation of effort
Supervisor and coordinator meeting will be held when needed. The Action Item List is updated in accordance to the progress of the individual open items. New items are added when necessary. Sharing of the load is adjusted regularly.

Information Duty

In case of any delay in appointed meeting schedules, information must be forwarded to the other team member without unnecessary delay. Phones, SMS and e-mail may be used.

Atmosphere

All suggestions should be received and treated with an open mind. Criticism may be given in order to increase the efficiency of the team and is expected to be received in a constructive manner. In case of disagreement the team consults the supervisor/coordinator.

Meeting Efficiency

We will have a group meeting every Tuesday 9:30. Showing up in the group meetings is mandatory. Repeated absence with no valid (Sickness or force-major) reason may lead to exclusion.
All meetings in the team and with the supervisor/coordinator must be prepared to ensure efficient use of time. Before meetings with the supervisor/coordinator an agenda must be prepared not later than the day before the meeting.

Exclusion

In case of serious breach of this contract a team member may be excluded from the team. This can only come into action after warnings and a written notice. Exclusion requires unanimity in the rest of the team and must be confirmed by the supervisor. In case of exclusion all documents, diagrams, programming codes etc. up to the date of exclusion, must be handed over to the group.

Evaluation of Contract

This contract may be subjected to changes at any time during the project period. Changes are only valid in case of unanimity in the team.

Group Members

Nilma Abbas …….....
Mendo Lama .....
Date: 15-08-2012

14. References

[1] "10 things you need to know about Hybrid TV " *EBU Technical - publications*, Tue, 09 Sep.
[2]Z. Lukac, M. Radonjic, B. Veris, T. M. and N. K. (2011). The experience of Implementing a Hybrid Broadcast Broadband television on network enabled TV set. Retrieved from http://ieeexplore.ieee.org.zorac.aub.aau.dk/stamp/stamp.jsp?tp=&arnumber=5967172&tag=1
[3] ”Hybrid Broadband Broadcast Explained ”, mediatvcom, september 2010
[4] “Hybrid Broadcast Broadband TV”, ETSI TS 102 796 V1.1.1 specification Overview, 2010-06
[5]HBBTV. (2010). Introduction @ www.hbbtv.org. Retrieved from http://www.hbbtv.org/pages/about_hbbtv/introduction.php
[6]Philip Hunter. (2012). Hbbtv ready go Poland. *Broadcast Engineering*. Retrieved from http://broadcastengineering.com/news/hbbtv-ready-go-poland
[7] Henten Anders. (2012). Economics of standardization.
[8] Swann, G. M. P. (2000). M ANCHESTER B USINESS S CHOOL THE ECONOMICS OF STANDARDIZATION Final Report for Standards and Technical Regulations Directorate Department of Trade and Industry University of Manchester.
[9] S. Done, '"MHEG - A Multimedia Presentation Standard ", vol. 2011, no. 12/11/2011.
[10] "MHEG-5 Broadcasting Profile (ETSI ES 202 184 v1.1.1),", 2004-11.
[11] "MHEG Interaction Channel | Impala ", vol. 2011, no. 12/14/2011.
[12] "Official website for DVB-MHP and DVB-GEM - Open Middleware for Interactive TV ", vol. 2011, no. 12/19/2011.
[13] G. Hölbling, T. Rabl and H. Kosch, '"Overview of Open Standards for Interactive TV (iTV)," *Multimedia Semantics—The Role of Metadata*, pp. 45-64.
[14] Open Cable Application Platform.
[15] Association of Radio Industries and Businesses.
[16] "DVB-GEM Fact Sheet ", May 2011.
[17] "Hybrid Broadcast Broadband TV (ETSI TS 102 796 V1.1.1),".
[18]Cnxsoft. (2012, April 5). HbbTV Specification 1.5 Adds MPEG DASH Support. Retrieved from http://www.cnx-software.com/2012/04/05/hbbtv-specification-1-5-adds-mpeg-dash-support/
[19] K. Illgner-Fehns, '"Harmonising The Broadcast And Broadband Delivery Through HbbTV," *2011*.
[20] Software, O., Televisions, F., Gmbh, R., & Corporation, S. (2012). Version 1 . 5 of HbbTV Specification Released, (April). Retrieved from http://www.hbbtv.org/pages/news_events/pdf/HbbTV V1 5 Release Final.pdf
[21] Ozer, J. (2011). what is MPEG DASH. Retrieved from http://www.streamingmedia.com/Articles/ReadArticle.aspx?ArticleID=79041
[22]Vetro, A., & Sodagar, I. (2011). Industry and Standards The MPEG-DASH Standard for

Multimedia Streaming Over the Internet, 62–68. Retrieved from http://www.computer.org/cms/Computer.org/ComputingNow/homepage/2011/1211/T_MM1_TheMPEGDASHStandard.pdf
[23] Hunter, P. (2012, April 9). HbbTV embraces MPEG DASH. *Broadcast Engineering*. Retrieved from http://broadcastengineering.com/news/hbbtv-mpeg-dash/
[24] MHP deployments. (n.d.). Retrieved from http://new.blog.mhp.org/?page_id=240
[25] Middleware, O., & Tv, I. (2011). Multimedia Home Platform, (May). Retrieved from http://www.dvb.org/technology/fact_sheets/DVB-MHP_Factsheet.pdf
[26] Petteri Järvinen. (2008). For you Own TV Channel. Retrieved from http://www.talouselama.fi/kolumni/sinullekin+oma+tvkanava/a2054653
[27] Freeview UK. (n.d.). Retrieved from http://www.impala.org/deployments/freeview-uk
[28] freeview-nz. (n.d.). Retrieved from http://www.impala.org/deployments/freeview-nz
[29] Briel, R. (2009). South Africa selects MHEG-5 interactivity. Retrieved from http://www.broadbandtvnews.com/2009/11/16/south-africa-selects-mheg-5-interactivity/
[30] Stango, V. (2004). The Economics of Standards Wars VICTOR STANGO*, *3*(1), 1–19.
[31] R. Tadayouni, "'Fixed broadband," Communication and Broadband Network Course, 09/22/2011
[32] IT- OG TELESTYRELSEN. (2012). Bredbåndskortlægning 2011, 1–29. Retrieved from http://www.erhvervsstyrelsen.dk/file/225279/bredbaandskortlaegning-2011.pdf
[33] Paper, W. (2005). Broadband Technology Overview, 1–16. Retrieved from http://www.corning.com/docs/opticalfiber/wp6321.pdf
[34] Editor, D. (2012, September). Broadband and Telecom Market Regulation. *ec.europa.eu*. Retrieved from https://ec.europa.eu/digital-agenda/en/scoreboard/broadband-telecom-market-regulation-23
[35] Specialist), V. M. (H. R. P.-N. I. R. (2010). what is DRM and what are the types of DRM. *LinkedIn*. Retrieved from http://www.linkedin.com/answers/technology/information-technology/telecommunications/TCH_ITS_TCI/656916-40487720
[36] Coyle, B. K. (2003). The Technology of Rights : Digital Rights Management Why Do We Need DRM ? Why Encryption Isn ' t Enough. *Based on a talk originally given at the Library of Congress, November 19, 2003*, (November), 1–20. Retrieved from http://www.kcoyle.net/drm_basics.pdf
[37] Fixed-mobile, H., Degree, S. M., Engineering, T., Author, M., Rodr, D., & Date, R. (2008). *Master thesis* (pp. 1–58). Retrieved from http://upcommons.upc.edu/pfc/bitstream/2099.1/6255/1/memoria.pdf
[38] Venkataramu, R. (2007). ANALYSIS AND ENHANCEMENT OF APPLE ' S FAIRPLAY DIGITAL RIGHTS MANAGEMENT, (May), 1–59. Retrieved from http://www.cs.sjsu.edu/faculty/stamp/students/RamyaVenkataramu_CS298Report.pdf
[39] Knook, P. (2007). Microsoft Announces Breakthrough Technology Enabling Simple Access to Broad Set of Digital Content, Including Music, Games, Video, Ring Tones and Pictures. Retrieved from http://www.microsoft.com/en-us/news/press/2007/feb07/02-123GSMNewTechnologyPR.aspx
[40] Microsoft. (2008). Microsoft PlayReady Content Access Technology-Whitepaper. Retrieved from http://www.microsoft.com/playready/documents/
[41] Microsoft. (2012). FAQ @ www.microsoft.com. Retrieved from

http://www.microsoft.com/PlayReady/FAQ.mspx
[42] (Microsoft), M. (2011). Supported Media Formats, Protocols, and Log Fields. Retrieved from http://msdn.microsoft.com/en-us/library/cc189080(v=vs.95).aspx
[43] Zhang, W. (2011). playready-license-server-for-content-encoded-and-encrypted-by-envivio-4caster-c4 @ blogs.msdn.com. Retrieved from http://blogs.msdn.com/b/playready4/archive/2011/09/02/playready-license-server-for-content-encoded-and-encrypted-by-envivio-4caster-c4.aspx
[44] Using Silverlight with windows Media DRM whitepaper- Final
[45] C. Mollis, C. M. (2010). OpenIPMP @ sourceforge.net. Retrieved from http://sourceforge.net/projects/openipmp/
[46] Newswire, P. (2006). Leading Open-Source, Open-Standard DRM Project OpenIPMP Announces New Version, Boasting Cross-Platform OMA, ISMAcryp, MPEG-2 and MPEG-4 Support. Retrieved from http://opensource.sys-con.com/node/247970
[47] Mutable. (2007). OpenIPMP, 1–1. Retrieved from http://mutableinc.com/documents/Mutable OpenIPMP.pdf
[48] WideVine. (2012). company @ www.widevine.com. Retrieved from http://www.widevine.com/company.html
[49] Widevine. (2012). Widevine Integrated Platforms @ www.widevine.com. Retrieved from http://www.widevine.com/available_platforms.html
[50] WideVine. (2012). Multiplatform DRM @ www.widevine.com. Retrieved from http://www.widevine.com/drm.html
[51] FAQ, G., & Marlin. (2011). What is the relationship between Marlin and OMA DRM?@ www.marlin-community.com. Retrieved from http://www.marlin-community.com/about/general_faq#relationship_with_OMA_DRM
[52] Intertrust. (2011). MarlinTutorial @ www.intertrust.com. Retrieved from http://www.intertrust.com/marlinpages/MarlinTutorial.html#slide10
[53] FAQ, T. (2011). Marlin Specifications @ www.marlin-community.com. Retrieved from http://www.marlin-community.com/develop/downloads/techfaq#2
[54] Verimatrix MultiRights for Marlin DRM- VCAS enabled open standard security for IP-based digital TV services- 2011
[55] Intertrust. (2012). Intertrust's Wasabi™ Marlin Client SDK v.1.3 supports MPEG-DASH multi-screen streaming. Retrieved from http://www.intertrust.com/news/press/MPEG-DASH
[56] What is DRM? – wiseGeek clear answers for common questions- retrieved from http://www.wisegeek.com/what-is-drm.htm
[57] Kurth, T. A. (2002). Digital Rights Management : An Overview of the Public Policy Solutions to Protecting Creative Works in a Digital Age By, (August), 1–23. Retrieved from http://www.wise-intern.org/journal/2002/trampaskurth.pdf
[58] Content Scrambling System (CSS), by Margaret Rouse-April 2005- Retrieved from: http://searchsecurity.techtarget.com/definition/Content-Scrambling-System
[59] what is DRM - posted by allure.sai – October 1, 2009- retrived at: http://allurisai.blogspot.dk/2009/10/drm-advantages-and-disadvantages.html
[60] Editor. (2011). Global DRM market to reach $ 2.5 billion by 2017@ advanced-television.com. *Advanced Television LTd*. Retrieved from http://advanced-

television.com/2011/11/21/global-drm-market-to-reach-2-5bn-by-2017/
[61] Access, O. F. (2002). Present State and Emerging Scenarios to JMM, *4*(3), 164–171. Retrieved from: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.114.9794&rep=rep1&type=pdf
[62] Anderson, P., & Daugherty, T. (2002). INSEAD MBA Program D IGITAL R IGHTS M ANAGEMENT :, (February), 1–26. Retrieved from http://sepulvedanet.free.fr/DRM.pdf
[63] (EFF), D. O. (2009). License to Kill Innovation: the Broadcast Flag for UK Digital TV. *Electronic Frontier Foundation*. Retrieved from https://www.eff.org/deeplinks/2009/09/broadcast-flag-uk
[64] Buckley, R. (2012). Intertrust Demonstrates Marlin-enabled HbbTV 1.5 Solution at IBC 2012 @ www.intertrust.com. *ibc2012_demo*. Retrieved from http://www.intertrust.com/news/press/ibc2012_demo
[65] Intertrust. (2012). Marlin DRM @ www.intertrust.com. Retrieved October 29, 2012, from http://www.intertrust.com/technologies/standards/marlin
[66] An, O. (1997). GREEN PAPER ON THE CONVERGENCE OF THE TELECOMMUNICATIONS , MEDIA AND INFORMATION TECHNOLOGY SECTORS , AND THE IMPLICATIONS FOR REGULATION, (December). Retrieved from http://ec.europa.eu/avpolicy/docs/library/legal/com/greenp_97_623_en.pdf
[67] S.(2008), CONVERGENCE-USER EXPECTATIONS, COMMUNICATIONS ENABLERS AND BUSINESS OPPERTUNITIES, John Wiley and Sons, Ltd
[68] (ICT/KTN), E. T. (2011). UK Future Internet Strategy Group FUTURE INTERNET REPORT, (May), 1–59. Retrieved from https://connect.innovateuk.org/c/document_library/get_file?p_l_id=3001521&folderId=861750&name=DLFE-34705.pdf
[69] Papadakis, S. (2006). Technological convergence : Opportunities and Challenges Defining technological convergence Opportunities of Convergence Challenges in Convergent World, 1–3. Retrieved from http://www.itu.int/osg/spu/youngminds/2007/essays/PapadakisSteliosYM2007.pdf
[70] Brendan McGuigan, G.Wiesen, N. F. (wisegeek). (2012). what is technological convergence? @ www.wisegeek.com. Retrieved from http://www.wisegeek.com/what-is-technological-convergence.htm
[71] Henten, A., & Melody, W. H. (2003). *WDR Dialogue Theme 2002 Designing Next Generation Telecom Regulation : ICT Convergence or Multisector Utility ?* (pp. 1–55). The World Dialogue on Regulation for Network Economies (WDR). Retrieved from http://www.regulationbodyofknowledge.org/documents/111.pdf
[72] Affairs), J. E. F. (Legal. (2008). Converging media – convergent regulators ?, (October 2007), 1–127. Retrieved from http://www.coe.int/t/dghl/cooperation/media/publications/Converging media - converging regulators_en.pdf
[73] David Naylor, R. B. (2012, April 4). A smart approach to Smart TV. *www.digitaltveurope.net*, pp. 1–8. Retrieved from http://www.digitaltveurope.net/22879/a-smart-approach-to-smart-tv/
[74] InfoDev, I. (2012). Convergence @ ict regulation toolkit. Retrieved from http://www.ictregulationtoolkit.org/en/Section.2084.html

[75] Windekilde, I. M. (2011). Introduction_to_Green_ICT_Concept .
[76] Prasad, A. (2010). Back to Green, 89–110. Retrieved from http://researchwebshelf.com/uploads/108_article1-5.pdf
[77] Union, E. (n.d.). The Challenge to Meet EU's 2020 Efficiency Goals.
[78] Curis, C. (n.d.). The-sustainability-and-economic-benefits-of-video-conferencing @ community.ca.com. Retrieved from http://community.ca.com/blogs/greenit/archive/2012/03/05/the-sustainability-and-economic-benefits-of-video-conferencing.aspx
[79] Cloud Computing and Sustainability : The Environmental Benefits of Moving to the Cloud. (2010). Retrieved from http://www.accenture.com/SiteCollectionDocuments/PDF/Accenture_Sustainability_Cloud_Computing_TheEnvironmentalBenefitsofMovingtotheCloud.pdf
[80] Namur, G. (2010). Convergence: Seeing the window of opportunity @ lifeasahuman.com. *Life as a human*. Retrieved from http://lifeasahuman.com/2010/mind-spirit/inspirational/convergence-seeing-the-windows-of-opportunity/
[81] Rouse, M. (2005). Convergence @ whatis.techtarget.com. Retrieved from http://whatis.techtarget.com/definition/convergence
[82] Stobbe, A. A., Stefan, E., Technical, H., Sabine, A., Deutsche, K., Internet, M. G., & Mayer, M. T. (2011). Convergence markets : Smartphones and triple play continue to erode sector boundaries, 1–16. Retrieved from http://www.dbresearch.com/PROD/DBR_INTERNET_EN-PROD/PROD0000000000276493.pdf
[83] Franklin, M. (n.d.). Will Web and Television Converge. Retrieved on October 2012 from http://graphics.stanford.edu/~bjohanso/cs448/
[84] Boorstin, J. (CNBC C. (2010). What YouTube's 2 Billion Daily Views Mean to Google @ www.cnbc.com. Retrieved from http://www.cnbc.com/id/37196041/What_YouTube_s_2_Billion_Daily_Views_Mean_to_Google
[85] Wöhler-Moorhoff, F. (2007). ip-tv-versus-web-tv_2007_06_29 @ www.detecon-dmr.com. Retrieved from http://www.detecon-dmr.com/en/article/ip-tv-versus-web-tv_2007_06_29
[86] (vision3). (2012). Internet TV vs. IPTV Same Same but Different opinions_12 @ www.3vision.tv. Retrieved from http://www.3vision.tv/opinions_12.html
[87] Cervieri, M. (2007). WebTV versus IPTV: Are they really different @ www.scribemedia.org. Retrieved from http://www.scribemedia.org/2007/11/21/webtv-v-iptv/
[88] Bringuier, L. (2010). White Paper OTT Streaming, 1–14. Retrieved from http://www.anevia.com
[89] (theGuardian), C. A. (2011). Google TV: how soon will it be on your set? google-tv-forecast-reality @ www.guardian.co.uk. Retrieved from http://www.guardian.co.uk/technology/blog/2011/dec/08/google-tv-forecast-reality
[90] What do people want online?- Jay Conrad Levinson- June 2012- http://www.marketing-magic.biz/workshops/website-selling/what-do-people-want.htm
[91] Dixon, C., & Partner, S. (2012). Television Moves Online : How the Experience of TV is

Changing TDG : Creating actionable intelligence and helping industry players, 1–20. Retrieved from http://cbcmedia.dk/wp-content/uploads/2012/11/04.-TV-Moves-Online-TDG-Research-Colin-Dixon.pdf
[92] Higham, W. (2012). Intellect launch trial Hbbtv specification for the UK. *www.intellectuk.org*. Retrieved from http://www.intellectuk.org/media-centre/media-releases/8486-intellect-launch-trial-hbbtv-specification-for-the-uk
[93] digitaltveurope DTG makes UK connected TV spec openly available (2012). Retrieved from http://www.digitaltveurope.net/28660/dtg-makes-uk-connected-tv-spec-openly-available/
[94] ZDF. (2012). ZDF in figures. Retrieved from http://www.zdf.com/index.php?id=181&type=98
[95] HbbTV_ZDF_Presse_1200 @ www.irt.de. (2010). Retrieved from http://www.irt.de/fileadmin/media/Contentbilder/Presse/HbbTV_ZDF_Presse_1200.jpg
[96] Clover, J. (2011). German ZDF expands multi screen offer. *www.broadbandtvnews.com*. Retrieved from http://www.broadbandtvnews.com/2011/10/10/german-zdf-expands-multi-screen-offer/
[97] ZDF to expand HbbTV, online offering. (2011).*www.digitaltveurope.net*. Retrieved from http://www.digitaltveurope.net/16118/zdf-to-expand-hbbtv-online-offering/
[98] Globecast and FRANCE 24 to lead HbbTV experiment with Orange and SES. (2011, December 21).*www.france24.com*. Paris. Retrieved from http://www.france24.com/en/globecast-france24-orange-ses-hbbTV
[99] France 24 launches HbbTV interactivity in Middle East. (2012, September 20).*www.digitaltveurope.net*. Retrieved from http://www.digitaltveurope.net/28391/france-24-launches-hbbtv-interactivity-in-middle-east/
[100] DR. (2012). DR gennem tiderne- Se billeder fra DRs historie.
[101] DR. (2012). Licens & ProgramService. Retrieved from http://www.dr.dk/OmDR/Licens/sprog/english.htm
[102] DRs årsrapport. (2011). Retrieved from http://www.dr.dk/NR/rdonlyres/D0F84992-F0E6-4107-A2B2-72B6F35B42D4/3758901/dr_aarsrapport_2012.pdf
[103] Summary, E. (2008). DR - Danish Broadcasting Corporation ANNUAL REPORT 2008, *2008*, 1–5. Retrieved from http://www.dr.dk/NR/rdonlyres/B96D837A-CC87-4F49-B7A6-7B7FE89E1E22/1297815/2008DRANNUALREPORT.pdf
[104] Statistik, F. R. A. D. (2012). Størst befolkningsvækst i København By, (231), 2012–2013. Retrieved from http://www.dst.dk/pukora/epub/Nyt/2012/NR231.pdf
[105] Mølsted, P. (2012). HbbTV – Broadcast og Bredbånd Copenhagen Future TV Conference 1. November 2012, (November), 1–71.
[106]TDC Annual Report - YouSee. (2011). Retrieved from http://annualreport2011.tdc.dk/Menu/Annual+Report/Business+lines/YouSee/YouSee
[107]YouSee Web-tv Indhold og Priser. (2012). Retrieved from http://yousee.tv/kanal-oversigt/
[108] Forums, H. (2012, September). Spain gives green light to HbbTV standard. *Hybrid TV for Europe and Beyond*. Retrieved from http://www.hdforum.fr/node/332
[109] Unternehmen, E., & Unterf, M. A. G. (2012). HbbTV drives fusion of TV and online Basic information on HbbTV, 1–22. Retrieved from

https://www.sevenonemedia.de/c/document_library/get_file?uuid=b9110153-89fb-4a21-b9fe-a025ddf53f86&groupId=10143
[110] YouGov. (2012). Smart TV. London. Retrieved from http://research.yougov.co.uk/services/smart-tv/
[111] Brilot, D. (2012). Smart-tv take up. *The Guardian*. London. Retrieved from http://www.guardian.co.uk/media-network/media-network-blog/2012/feb/15/smart-tv-take-up#_
[112] Rasmussen, R. El. (2012, July 16). smart-tv-hitter-hos-danskerne @ www.altomdata.dk. *alt om Data*. Copenhagen. Retrieved from http://www.altomdata.dk/smart-tv-hitter-hos-danskerne
[113] MacAvock, P. (2010). The Campaign for content over technology. Insight from EBU Technical.
[114] Brandenburg, R. V. (2009). TNO report Towards multi-user personalized TV services Introducing combined RFID Digest authentication.
[115] Buczak, A. L., Zimmerman, J., & Kurapati, K. (2002). Personalization: Improving Ease-of-Use, Trust and Accuracy of a TV show Recommender. In L. Ardissono & A. Buczak (Eds.), *Personalization in Future TV: Proceedings of the AH'2002 Workshop on Workshop on Personalization in Future TV* (pp. 9–19). Málaga, Spain, May 2002: Universidad de Málaga - Departamento de Lenguajes y Ciencias de la Computación.
[116] GoldMedia. (2010). content overload will increase the importance of electronic programme guides.
[117] Günther Hölbling. (2011). Personalized Means of Interacting with Multimedia Content. Retrieved from http://www.opus-bayern.de/uni-passau/volltexte/2011/2421/pdf/hoelbling_guenther.pdf
[118] Reiterer, B., Concolato, C., Lachner, J., Le Feuvre, J., Moissinac, J.-C., Lenzi, S., Chessa, S., et al. (2008). User-centric universal multimedia access in home networks. *The Visual Computer*, *24*(7-9), 837–845. doi:10.1007/s00371-008-0265-5
[119] Fan, H., & Poole, M. S. (2006). What Is Personalization? Perspectives on the Design and Implementation of Personalization in Information Systems. *Journal of Organizational Computing and Electronic* Commerce, *16*(3), 179–202. doi:10.1207/s15327744joce1603&4_2
[120] Kosch, H. (2011). Personalized Means of Interacting with Multimedia Content. Retrieved from http://www.opus-bayern.de/uni-passau/volltexte/2011/2421/pdf/hoelbling_guenther.pdf.
[121] Lavie, T., Sela, M., Oppenheim, I., Inbar, O., & Meyer, J. (2010). User attitudes towards news content personalization. *International Journal of Human-Computer Studies*, *68*(8), 483–495. doi:10.1016/j.ijhcs.2009.09.011
[122] Jan O.Blom and Andrew F.Monk. (2003). Theory of Personalization of Appearreance: Why users Personalize their PC's and Mobile Phones. Retrieved from http://www.cse.unr.edu/~syco/papers/hci/HCI/PersonalizationtheoryOfApperaance_Blom.pdf
[123] Rouse, M. (n.d.). convergence @ whatis.techtarget.com. Retrieved from http://whatis.techtarget.com/definition/convergence
[124]Bredbåndskortlægning 2011. (2012). Retrieved from http://www.erhvervsstyrelsen.dk/file/225279/bredbaandskortlaegning-2011.pdf

[125] Paper, W. (2005). Broadband Technology Overview. Retrieved from http://www.corning.com/docs/opticalfiber/wp6321.pdf
[126] Ideation, S., & , Kuang, C. (2011). user-led innovation can't create breakthroughs just ask apple and ikea. *FastCompany*. Retrieved from http://www.fastcodesign.com/1663220/user-led-innovation-cant-create-breakthroughs-just-ask-apple-and-ikea
[127] Graham, S. (2011). Are User Behavior Analytics The Real Predictors Of Customer Engagement? *www.fastcompany.com*. Retrieved from http://www.fastcompany.com/1788485/are-user-behavior-analytics-real-predictors-customer-engagement
[128] Louhelainen, P., Company, L., Vkl, O., & Demand, L. O. (2012). PERSONAL TV – TULEVAISUUDEN, 1–16. Retrieved from http://www.vkl.fi/files/2146/Louhelainen_Personal_TV.pdf
[129] P.B. Seddon and G.P. Lewis- Strategy and Business Models: what's the difference?- 2003
[130] P. Ballon, "Business modelling revisited: the configuration of control and value, info, Vol. 9 Iss: 5, pp.6 - 19, Aug. 2007
[131] E. Faber et al , "Designing business models for mobile ICT services", 16th Bled Electronic Commerce Conference eTransformation, Bled, Slovenia, Jun. 2003
[132] Faber, E., Ballon, P., Bouwman, H., & Haaker, T. (2003). a collaborative effort of multiple companies to offer a joint proposition to their consumers. When comparing different definitions of business models (see e.g. Slywotsky, 1996; Timmers,.
[133] Tv, B., & Ii, I. (n.d.). The race to dominate the future of TV, (Ii). Retrieved from http://www.accenture.com/SiteCollectionDocuments/PDF/Accenture_Communications_Media-Entertainment_OTTV_Future_of_TV.pdf
[134] EBU- TECH - Requirements for the Standardization of Hybrid Broadcast/Broadband (HBB) Television systems and services- Source: Project Group D/WMT (Web Media Technologies)- Geneva- January 2010
[135] HbbTV: Hybrid Television- Xavier Giró-i-Nieto - http://bitsearch.blogspot.com/2010/02/hbbtv-hybrid-television.html
[136] Hybrid Broadcast Broadband TV- ETSI TS 102 796 V1.1.1 (2010-06) - Technical Specification - http://www.etsi.org/deliver/etsi_ts/102700_102799/102796/01.01.01_60/ts_102796v010101p.pdf
[137] Chan-Olmsted, S.M., and Kang, J. (n.d.). Theorising the strategic architecture of a broadband television industry. Retrieved from http://web.ebscohost.com.zorac.aub.aau.dk/ehost/pdfviewer/pdfviewer?sid=39287a12-8eb0-4ec7-8a6c-cdcdd2db6616%40sessionmgr14&vid=2&hid=19
[138] Kearney, A. T. (2009). Internet Value Chain Economics. Retrieved from http://www.atkearney.com/documents/10192/a70da6a8-aa98-4e43-999b-3a83a58d1c80
[139] Hybride, A. (2011). HYBRID-TV, (August). Retrieved from http://www.hbbtv-infos.de/downl/hybrid-tv_white-book_2011.pdf
[140] Télégramme, L. (n.d.). OpenWidget / openHbb «, 1–6. Retrieved from http://jcp-consult.net/openhbb/wp-content/uploads/2011/09/openHbb-Mod%C3%A8le-

Economique.pdf
[141] Issue, T. H. (2010). The Hybrid Issue, (04). Retrieved from http://tech.ebu.ch/docs/tech-i/ebu_tech-i_004.pdf
[142] Cullen, E., Workshop, I., & Merkel, K. (2012). HbbTV – a basis for connected TV : State of play and forecasts ► current market status of HbbTV. Retrieved from http://epra3-production.s3.amazonaws.com/attachments/files/1944/original/02-klaus-merkel.pdf
[143] Set, A., & Box, T. (2011). Quadrille enables ARTE and FRANSAT to showcase ARTE+7 catch-up TV services over satellite at IBC 2011 based on an Aston Set Top Box, 51–55. Retrieved from http://www.quadrille.fr/data/docs/mod_news/pr-quadrille--arte--fransat--aston-2011-09-08_131548960632751100.pdf