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# Utilizing Distributed Multimedia Plays for Networked Virtual Shopping

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# Problem Description

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Ecommerce and online transactions has seen a widespread use over the last years. At the same time the security of these transactions are at risk, privacy and integrity of the data may be violated. Distributed Multimedia Plays (DMP) provides a more secure environment for networking than the Internet. DMP implements IPsec in comparison to the Internet which commonly is secured through SSL/TLS and all entities of the network are authenticated before communicating with each other, leaving DMP less vulnerable to the attacks present in the Internet today (DoS, eavesdropping, modification). In DMP one wants to reduce the openness in the network and leave more responsibility and control with the network provider, which opens up for new business potential for the network providers. Utilizing the DMP network to provide a near natural virtual store can offer a more secure, customizable, "green", and cost-saving, virtual networked store to please customers of the future.

Tasks to be performed during this study:

- A background study on DMP
- A background study on ecommerce
- Create a business case for a networked virtual store
- Describe the physical infrastructure needed to realize the business case
- Evaluate business potential that emerges for the network providers
- Using Osterwalders business model ontology to analyze the potential of the product

Assignment given: 20.01.2012

Supervisor: Harald Øverby



# Abstract

This thesis studies the market of e-commerce and a futuristic solution to shopping by utilizing the Distributed Multimedia Plays network architecture and its Collaboration Space, which provides users with a near natural virtual reality. Several scenarios have been defined for a future virtual store exploiting the possibilities of DMP. One scenario was chosen for further development resulting in a proposed solution. A business model was developed for the solution using the Osterwalder business model ontology. A financial analysis was conducted to evaluate the potential for the solution and its business model. Through studies on e-commerce and DMP it is certain that there exist potential for a service such as a virtual store utilizing the technology of DMP and ideas of Real-time Internet. However, some changes to the solution and its pricing strategy may be necessary to ensure a more profitable solution.



# Sammendrag

Denne oppgaven tar for seg e-handel og futuristisk sammhandlings teknologi. Studiene har gått ut på å finne en ny famtidsrettet og sikrere måte å handle på via kommunikasjonsnettverk ved å ta i bruk Distributed Multimedia Plays og dens sammahandlings grensesnitt Collaboration Space. DMP kan gi brukere en nær-naturlig opplevelse av en virtuell virkelighet. Arbeidet har fokusert på å foreslå ulike scenarioer innenfor e-handel der DMP kan vise seg nyttig, og et scenario har blitt videreutviklet. En forretningsmodell har blitt laget for den foreslåtte løsningen, i tillegg til å gjennomføre en økonomisk analyse for å evaluere forretnings potensialet til løsningen. Gjennom studiene på e-handel og DMP, og utviklingen av en framtidsrettet løsning er det tyddig at det er potensialet for en virtuell butikk. Noen endringer bør tilføres løsningen for å sikre bedre lønsomhet.





# Preface

This thesis has been performed at the Department of Telematics, Norwegian University of Science and Technology (NTNU), as a completion of the five year program Master of Science in Communication technology.

I would like to thank my professor Leif Arne Rønningen and my supervisor Harald Øverby for valuable guidance and comments throughout the work on this thesis.

At last I would like to thank my parents for the support throughout my studies and my fellow students for many good memories.

*Beate Eide Trollvik*

Trondheim, June 14th, 2012



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# Abbreviations

**3D** 3-Dimensional

**2D** 2-Dimensional

**AH** Authentication Header

**AKE** AppTraNet Key Exchange

**AppTraNet** Application,Transport,Network

**AR** Augmented Reality

**CBC** Customer Buying Cycle

**CS** Collaboration Space

**CSu** Collaboration Surface

**DMP** Distributed Multimedia Plays

**ESP** Encapsulation Security Payload

**ICT** Information and Communications Technology

**IPSec** Internet Protocol Security

**IRR** Internal Rate of Return

**ISP** Internet Service Provider

**MHS** Multimedia Home Space

**MSC** Message Sequence Chart

**PCIe** Peripheral Component Interconnect Express

**PT** Payload Type

**SA** Security Association

**SOTA** State-of-the-art

**SSL** Secure Socket Layer

**SWOT** Strengths, Weaknesses, Opportunities, Threats

**VAT** Value Added Tax

# Chapter 1

## Introduction

The Internet has revolutionized how we shop and do business today. The convenience of shopping on the Internet is appealing to most consumers who are often looking for alternatives to save time, getting the best price, or to follow trends. Along with the advantages follows disadvantages, increasingly we have seen that information security are of big concern in the e-commerce industry. Technology improvements and innovations will form the shopping of tomorrow, but in the long run it is often in the power of the consumers, and what they pay interest to. With the comeback of 3D-technology one can vision a future of virtual shopping in a near natural way. Utilizing the Distributed Multimedia Plays architecture and its Collaboration Space one can create a virtual shopping environment which can satisfy, not only a more secure process of networked shopping, but the comfort of having access to everything in one store. A convenient, costless, secure and environmental friendly way of shopping for the modern person. This thesis will present a vision of how we can shop in the future.

### 1.1 Motivation

Technologists and professors argue the need for a 'new Internet', as professor Woodward of University of Surry states it was built without it in mind that people would try to intercept messages and use it in the wrong way, it was not built for economic and social purposes as we use it today[56]. Based on a studies on security comparing DMP with the Internet, DMP has been found to have

a more secure approach utilizing IPSec and reducing the openness providing a more controlled network environment, where responsibility lies at the hands of the network provider. Distributed Multimedia Plays implements IPSec which has authentication and protection of communication, making sensitive transactions confidential and non-authorized entities out of the network. Integrity protection is important to ensure that no one but the stores administrator can access and change prices for the products posted on the web site.

DMP and its Collaboration Space provides user with a near natural virtual reality through the use of 3D technology. 3D technology can enhance the user experience of virtual networked shopping. How can we utilize DMP in a futuristic way of shopping, providing the consumers with more security, as well as convenience? Visualize a merging of a physical store with an online store, with all surfaces being displays showing 3D and the availability of all products you can imagine. A virtual store is a 'green' alternative to shopping, saving cost of setting up real stores and transportation of products to the store. The market is mature for a virtual store due to the increasing popularity of buying items online and waiting for delivery, the traditional e-commerce has prepared the customer for virtual shopping.

## 1.2 Goal

The goal of this master thesis is to study the market of e-commerce, 3D-technology, together with the DMP network. To define and study potential scenarios of an application of e-commerce using the architecture of DMP and its idea of Real-Time Internet and Collaboration Spaces. Create a business model for a proposed scenario and evaluate the solution and its business potential. Is there a potential profit for this type of futuristic application? In specific these tasks will be performed:

- Background study on e-commerce
- Background study on 3D-technology
- Background study on DMP
- Define scenarios for using DMP in shopping

- Develop a business model for a chosen solution utilizing Osterwalder's Ontology
- Evaluate the profitability of the chosen solution

## 1.3 Methodology

During my work with this thesis I have taken use of the following methods:

**Literature study:** The first chapters of the thesis presents background theory on E-commerce, 3D technology and DMP that are involved in the resulting service to be developed in this thesis. A literature study was made in order to get full insight and overview into various topics important to be able to create a scenario to be used with DMP.

**Business Model Framework:** Osterwalder Business Model Ontology[28] will be used as a framework to create a business model for the potential service. The framework is presented in depth in chapter 6, and it is utilized for developing the business model in chapter 7.

**Financial analysis:** Key figures of the company and service is presented at the end of chapter 7, based on cost and revenue identified in the business model. A financial analysis will indicate the stability and profitability of a business model, and will say something about potential generated revenue and the payback period of invested capital.

**SWOT-analysis:** It provides a framework for analyzing information, and is a basic step in a strategic decision making process. The SWOT-analysis identifies internal strengths and weaknesses in a company, as well as external opportunities and threats found in the market. The analysis is presented in chapter 8.

## 1.4 Limitations

The thesis is focusing on developing a future scenario and solution for shopping utilizing the DMP architecture. To evaluate the solution through a financial

analysis. It is not within the scope of this thesis to focus on performance of the network and extensive technical details of the infrastructure needed by the suggested solution is out of the scope of this thesis. Details on network performance and other research regarding DMP can be studied in work performed by L.A. Rønningen and others working on the DMP network at the Department of Telematics, NTNU.

## 1.5 Contributions

Throughout the work on this thesis I have studied a new area of application for the Distributed Multimedia Plays architecture. In more detail I have defined and suggested potential scenarios for utilizing DMP in e-commerce and one scenario was chosen to be developed further, the work is presented in a case study in chapter 5. A business model was created for the solution chosen to be developed, and all elements making up the business model were identified. The business model is presented in chapter 7 along with a financial analysis, which is used to state the financial aspects of the business model and its profitability. A discussion on virtual stores, the developed solution and its business potential, in addition to the potential of partners taking part in the business model are presented in chapter 8.

## 1.6 Key Words

Distributed Multimedia Plays, real-time Internet, e-commerce, futuristic shopping, virtual store, business model.

## 1.7 Structure

This master thesis will be structured in chapters as follows:

- **Chapter 2** will present a background study on e-commerce and a brief overview of problems related to e-commerce and existing virtual stores.



- **Chapter 3** is an introduction to 3D technologies and the human depth perception. 3D is part of the DMP Collaboration Space and is used to provide users with near natural feeling of a virtual reality.
- **Chapter 4** gives a background study on Distributed Multimedia Plays, its network architecture, and Collaboration Spaces which will be the base and the network to host a future scenario of shopping.
- **Chapter 5** presents a case study of 'The Virtual Store' with defined scenarios for utilizing DMP for e-commerce. Requirements and equipment needed to realize it a chosen scenario is presented.
- **Chapter 6** is a presentation of Osterwalders Business Model Ontology, the framework used to create the business model.
- **Chapter 7** utilizes Osterwalders Business Model Ontology to create a business model for 'The Virtual Store' and presents a financial analysis of the service.
- **Chapter 8** presents a discussion of the results in the thesis.
- **Chapter 9** presents a conclusion of the master thesis and future work.



# Chapter 2

## Electronic Commerce

Electronic commerce, e-commerce or web based commerce is a the term to describe the activity of using the Internet for shopping or making online transactions. It refers to the buying and selling of products or services over electronic systems such as the Internet or other computer networks[51]. Business-to-consumer e-commerce can provide consumers with both the convenience and availability to a wide range of products and services which also allows retailers to reach a wide range of different consumer segments.

### 2.1 Categories of E-commerce

There are several categories of e-commerce[34]:

- **B2B** - business-to-business
- **B2C** - business-to-consumer
- **P2P** - consumer-to-consumer commonly known as peer-to-peer
- **C2B** - consumer-to-business

A description of each category with examples follow in table 2.1.

E-commerce provide different services within different areas such as, online goods and services (streaming media, electronic books, and software), retail services

<b>Categories of electronic commerce</b>		
<i>Type</i>	<i>Description</i>	<i>Example</i>
B2B	Consists of e-commerce that can occur between two organizations.	Dell, General Electrics, etc.
B2C	The exchange of service between business and consumer. Exchanges can be either physical or digital products or services and are much smaller than B2B transactions	Amazon, Yahoo, etc.
P2P	Transactions between and among consumers and third-party involvement such as auction and classified websites.	eBay, finn.no, etc.
C2B	Consumers can bond together to present themselves as a buyer group on a C2B relationship	Groupon

Table 2.1: Description of e-commerce categories.

(banking, food ordering, DVD/music by mail, travel bookings, and etc.), marketplace services (trading communities, auctions, price comparison services), and mobile commerce which has increased over the last few years along with smart phones (payment, ticketing, and banking)[34]. B2C commerce is what is most common when we think of an e-commerce site on the Internet, it is the category thought of when it comes to a traditional brick-and-mortar analogy. B2C will be the type of e-commerce focused on in the development of a future virtual store.

## 2.2 History of E-commerce

E-commerce emerged with the birth of the World Wide Web, and has over the last years evolved into a million dollar industry. Originally e-commerce was identified as commercial transactions performed electronically using EDI (Electronic Data Interchange) and EFT (Electronic Funds Transfer) in the late 1970s allowing businesses to send documents and invoices electronically. Credit cards and ATMs were also considered forms of electronic commerce along with airline reservation systems. The general e-commerce as we know it today began when Tim Berners Lee in 1990 created the World Wide Web, writing the first web browser and the Internet emerged. The popularity of the Internet rose quickly, but commercial enterprise on the Internet was not allowed until 1995. Amazon.com was launched in 1995, and started to use the Internet for commercial transactions. At the same time, Dell and Cisco aggressively exploited the Internet for commercial transactions. Security protocols to use with applications and web browsers were

introduced later, and the most common in use is the SSL (Secure Socket Layer) protocol, which protects the sent and received data between a user computer and the server which runs the application[51]. Today, people still argue the security of the SSL protocol, and the issues will be addressed in the following section.

## 2.3 Issues with E-commerce

Security is an important component of an e-commerce system. During an increase in online transactions, the opportunity for credit- and debit card fraud has risen and the need to counteract these problems grow bigger Data routed through the Internet can be easily monitored or intercepted if not secured. It is up to the merchants and online websites to ensure security of transactions. Considering that e-commerce is a billion dollar industry, competitors strive to be first in the market which often results in security being prioritized after usability and functionality, which are crucial to attract and retain customers.[25, 34]

There are three major aspects of securing e-commerce: securing the transfer of data between the consumer computer to the merchants e-commerce store, transfer of data from the merchant to the payment processors, and the protection of customer data stored in the merchants database e.g. credit card information. Data transactions can be secured through the use of secure protocols, and most commonly used is the SSL protocol. A disadvantage with the SSL protocol is that it requires the web browser to be SSL capable to ensure security[34].

Threats emerges as e-commerce progresses, demands for functionality from users in addition to new and sometimes complex technology increases the threat of new attacks, when security is down prioritized[34]. Often, threats towards e-commerce are performed on vulnerabilities in third-party software like shopping carts, which often are utilized by e-commerce web sites, unless they develop their own solutions. Other weaknesses are exploited through web application vulnerabilities. Most e-commerce sites use application security, SSL, leaving the application vulnerable to several attacks such as SQL injection, Cross-site Scripting, Price Manipulation, Buffer Overflows, Remote Command Execution, and Weak Authentication & Authorization which are all common in web applications [25]. *SQL-injection* is a technique used to attack databases through a web site e.g.

to access database content such as credit card information and passwords. It is a code injection technique that exploits a security vulnerability in a website's software[55]. *Price Manipulation* is a vulnerability directly exploited in the dynamically generated HTML field in the web page. The vulnerability can be exploited by using a web application proxy to modify the amount payable when the information flows from the user's web browser to the web server. This vulnerability is unique to shopping cart and payment process of e-commerce[25]. Maybe these threats, will force us to think in new directions, as Woodward suggests in his article about the broken Internet[56]. Do we need a new Internet or shall someone govern the Internet? DMP will meet many requirements and answer the need for control and security in the network.

## 2.4 Online Shopping Today

With the increase of users on smart phones and tablets, there will most likely be seen a high increase in electronic commerce shopping, in some cases referred to as m-commerce. Customers find it interesting and convenient to shop directly from the retailer, who often can offer a better price. They can search information about the product, look at pictures and skip the trouble of trying on the clothes in the store. Customer reviews are also contributing to making decisions about products easier, e.g. Amazon.com provides detailed product review and rating. Most e-commerce sites have a shopping cart, where items are collected and summed up at check out. During check out, it follows the human analogy, leaving information details about the buyer such as billing information and contact address for delivery. Payment is usually done by credit- or debit cards, or online transaction applications such as PayPal. The credit card process may be done in real time or in a fulfillment process. Once payment has been accepted, product delivery can be made.

Online shoppers are attracted to e-commerce not alone because of convenience, but due to higher level of selection, competing prices, greater access to information. Retailers seek to offer online shopping to reduce costs and to meet customer needs. Some organizations build their business around only being available online, reducing costs and dropping prices, for more satisfied customers. Consumers are motivated by price and convenience.[34]

With an online environment that is changing fast, companies strive to be innovative and beat their competitors in sales and market share. E-commerce is likely to change in the future, by only finding a solution that will make people get on board. With the problems in the Internet and technologists argue the need for a new Internet, there are opportunities for virtual stores and technology like DMP. To challenge the lack of security found in the Internet we need to rethink our strategy. What if one could merge the traditional shopping experience with the availability and convenience of online shopping into one virtual store, situated at a physical location and utilizing 3D technology to provide users with a near-natural virtual reality? This idea will be further investigated in chapter 5.

## 2.5 Existing 'virtual' stores

The market for virtual stores have been studied and an overview of a few different solutions are presented in this section. Retailers of e-commerce are innovative and developing new experiences for their consumers, virtual stores have emerged for the convenience of the consumers.

There are examples of traditional e-commerce sites presented as 'malls', grocery stores utilizing smart phones, and virtual dressing rooms to ease everyday life for consumers. The use of these virtual stores will not only gain interest for their futuristic approach, but open up new possibilities for retailers and consumers.

### Traditional web virtual stores

The Virtual Mall[3] illustrated in figure 2.1 is an online marketplace where you can locate various stores through the website. This virtual mall is not much more than a collection of links to other known websites located in one place. Once you choose a 'Store' you are redirected to another e-commerce website. There are several types of these virtual malls, some where you can navigate around in a 3D environment, representing a store or mall. Enjoy3D[1] is an example of a 3D mall. It provides you with a simple 3D feeling inside a building, but the items are displayed in 2D. Figure 2.2 shows how consumers can navigate in a t-shirt store at Enjoy3D.



Figure 2.1: The Virtual Mall[3]



Figure 2.2: Enjoy3D store [1]

The most common e-commerce sites are such as hm.com, an online store for the world wide clothing chain H&M. These websites provide the customer with the availability of all their collections. In traditional stores, it is common that products are limited both in collection as well as size and color, but at the online stores you can find almost anything you need. hm.com is well structured and easy to navigate, available in several languages and regions. Figure 2.3 shows a snap shot of the online store.

### Virtual Stores utilizing smart phones

Tesco wanted to increase sales and their position in the South Korean market and placed out 'virtual stores' at the subway stations, to reach their busy consumers. Figure 2.4 shows the Virtual Grocery Store of Tesco in South Korea. The customers use their smart phones with QR-readers to shop items and they will be delivered to your home. A QR-reader reads a type of matrix barcode, and has been popular in advertising to store information about e.g. URL, discount



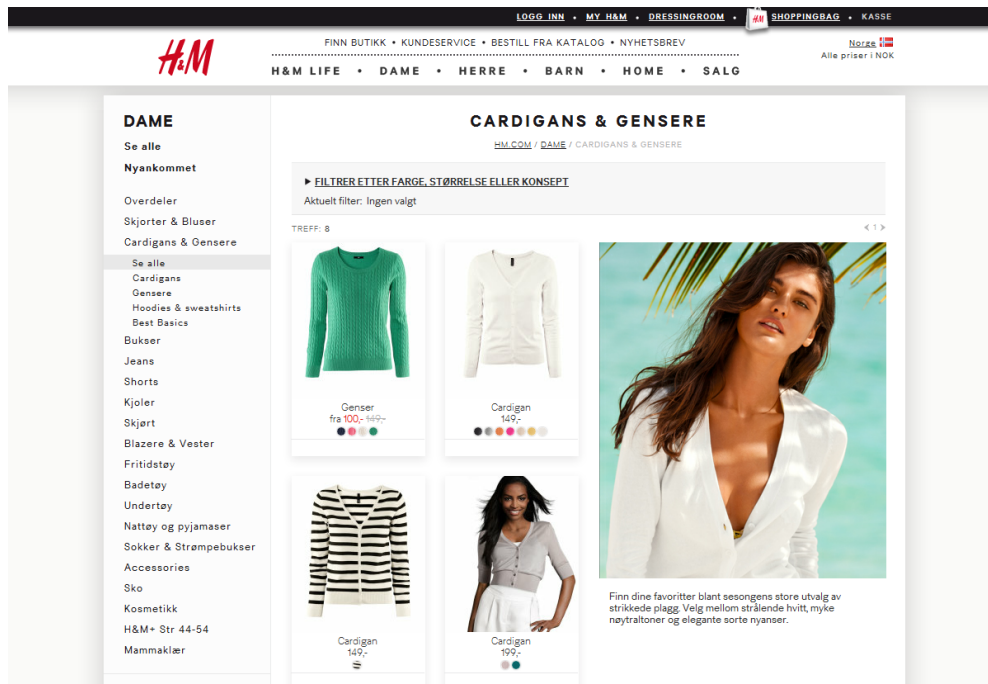


Figure 2.3: H&amp;M online store [14]

coupon[54].

Woolworths of Australia launched a virtual store, similar to Tesco, on two locations in Australia. Their motivation was to promote their new smart phone application to be used for virtual shopping[33]. Two virtual stores were placed out on subway stations in Sydney and Melbourne with images of products displaying barcodes. The difference with Woolworths was that they did this as a marketing campaign to raise awareness about their new application for smart phones, showing how consumers could use it to make shopping lists and place orders which would be delivered to their home.

### Sophisticated virtual stores

The Achilles heel of the apparel e-commerce has been the disadvantage of not being able to try on the clothes before you purchase or order them. If the item doesn't fit, it needs to be returned. Various options have popped up lately. An existing solution is present at Hurley.com. Their 'Online Try-On experience' in collaboration with embodee[13] allows the consumer to visualize how a piece of clothing will appear. The experience is only available for certain items. Jeans are eligible for the 'Try-on experience' and an example is shown in figure 2.5.



Figure 2.4: Tesco Virtual Grocery Store in South Korea [57]

The consumer needs to enter height and weight, and an image is created with an animation of how it will look on you. A comfort map is shown with various colors to illustrate how tight the jeans will feel. White is described as loose, red as tight etc.

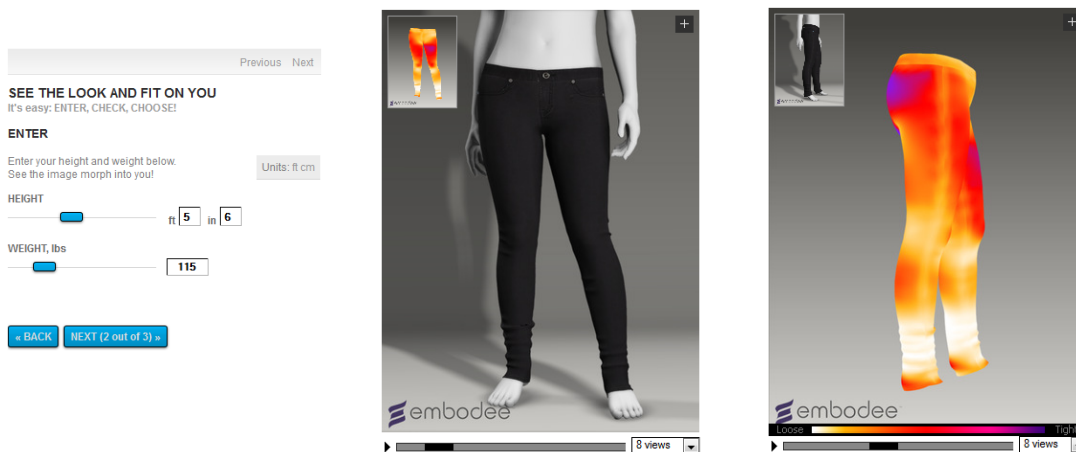


Figure 2.5: Illustration of the 'Online Try-On Experience' of Hurley.com[13]

Other examples of virtual stores are websites which uses a customer's web cam to illustrate how an outfit would look on, layering the item on top of an image of the consumer. Debenhams of UK launched an ipad/iphone application with

Augmented Reality (AR) Technology which superimposes outfits over an image, bringing together real and virtual worlds[8]. Macy's 'Try-me-on' mirror (Magic fitting room) is a type of virtual fitting room where customers step into a room with an iPad looking mirror (72 inches) in front which mirrors the customer's body with the chosen piece of clothing displayed on her[22].

## Discussion

The online environment changes faster than the offline environment, therefore it is difficult for a company to select a strategy and to stay the course. To create value of online stores one needs to be innovative[34]. From this brief overview of e-commerce and existing virtual stores it seems like retailers adopt the concept and consumers pay interest to it. There are different objectives to why retailers launch virtual stores. Some do it to increase sales and reduce cost, others do it to attract customers or to gain attention about a new product or consumer feature.

Most of the companies launching a virtual store have been reluctant in releasing information about sales statistics reflecting on the success of the virtual store. Several media outlets have reported that Tesco increased sales and traffic to their website significantly. The fact that these numbers are increasing might also be due to marketing effects, not only the advancements of the virtual store itself. The store has got publicity in media and is now seen at many public places. The trial boosted their online sales with an astounding 130% and 76% new members signed up with a shopping profile[11]. Woolworths reported that they launched the virtual store to gain attention to their new application for smart phones, which allows consumers to make shopping lists and order products[33]. Hurley.com launched the virtual Try-on experience to reduce the rate of consumers returning items and to satisfy their consumers. Hurley experienced a decrease in return rate in jeans of 34%. However, these solutions are not cheap to deploy and run, but several retailers report boosting conversion rates, reducing returns and making online shopping more fun[26]. In my opinion, the downside with the virtual malls, such as [virtualmall.co.uk](http://virtualmall.co.uk) and [enjoy3d.com](http://enjoy3d.com) are that the 3D quality is poor and it does not give the user an enhanced experience, so it is not much different from shopping from a regular website with content shown in 2D. The consumers want more.

## 2.6 Summary

Electronic commerce has evolved over the years, from simple flight-booking systems to virtual dressing rooms using augmented reality technology. Security of e-commerce is an increasing problem, hackers can alter price of items or steal private payment information. This chapter has introduced some existing virtual stores and the issues that e-commerce actors have to deal with. The market and technology is mature to take it to a new level, introducing an innovative solution to shopping utilizing 3D-technology and DMP. The following chapter will introduce 3D-technology.

# Chapter 3

## 3D Technology

Over the last years 3D technology has undergone improvements, which will allow for enhanced user experience. It is difficult to predict what the future might hold, but 3D technology's increase in popularity may lead to a more widespread use in everyday life applications. 3D technology can enhance the shopping experience in virtual stores and malls and will contribute to a convenient and futuristic shopping experience.

General principles of the human vision system and how we perceive depth is important in the process of designing quality 3D displays. This chapter will introduce general principles of 3D technology and the human depth perception.

### 3.1 Human Depth Perception

In order to better understand the technology behind 3D imaging, the human visual system and depth perception should be studied. How are digital stereoscopic images perceived by humans? The human visual system makes use of depth cues to interpret and to build mental 3D models of reality[12]. We can distinguish between monocular- and binocular depth cues. Binocular cues require information from both eyes in comparison to monocular cues which only receive information from one eye. Binocular cues include stereopsis, which is the process of reconstructing the mental depth dimension of the real world.

The human eyes are located at a small distance from each other, and their views of a 3D-scene is slightly disparate. The disparity of each point depends on the

distance between the fixation point of the two eyes. The brain can measure the disparity and use it to create a sensation of depth which is the subjective estimate of relative distance[30].

## 2D depth cues

2D depth cues can be found in purely monoscopic images and they can provide the feeling of depth. **Occlusion** lets the viewer sense depth ordering when objects are occluding each other. **Linear perspective** is experienced when same size object at different distances project a different image onto the retina. **Shading** are important in the perception of depth, in the way that light which is reflected from objects, provide cues to their depth relationship. Known object with smaller retinal image is judged further away than the same object with a larger retinal image and something of **Relative Size**, usually the larger object is closer. A texture of constant size objects, such as pebbles or grass, will vary in size on the retina with distance and is called **Texture gradient**. Our eyes perceive the atmosphere in different situations as the light traveling through it is affected by fog, dust or rain, and the colors loose saturation and sharp edges are diffused, this is called **Aerial distortion**. Figure 3.1 identifies 2D depth cues described above[12].

## 3D depth cues

3D cues are those that make humans perceive depth in the real world and have been identified as *motion parallax, accomodation and convergence*.

**Motion parallax** provides the brain with cues to 3D spatial relationships and helps the brain interpret the perception of a situation when the object in the scene moves, or the observer moves his or her head. **Accomodation** is a mechanism that lets the eye interpret depth based on the focus of the object. When an object of interest is fixated by the eye, accomodation is adjusted in a way that a sharp image is perceived onto the retina. **Convergence** happens when both eyes converge on the same object of interest[12, 36].

Figure 3.2 illustrates how depth is perceived behind and in front of a display plane. Perceived depth is denoted  $p$ ,  $z$  is the viewing distance,  $e$  is the eye separation, and  $d$  denotes screen disparity. Eye separation plays an important

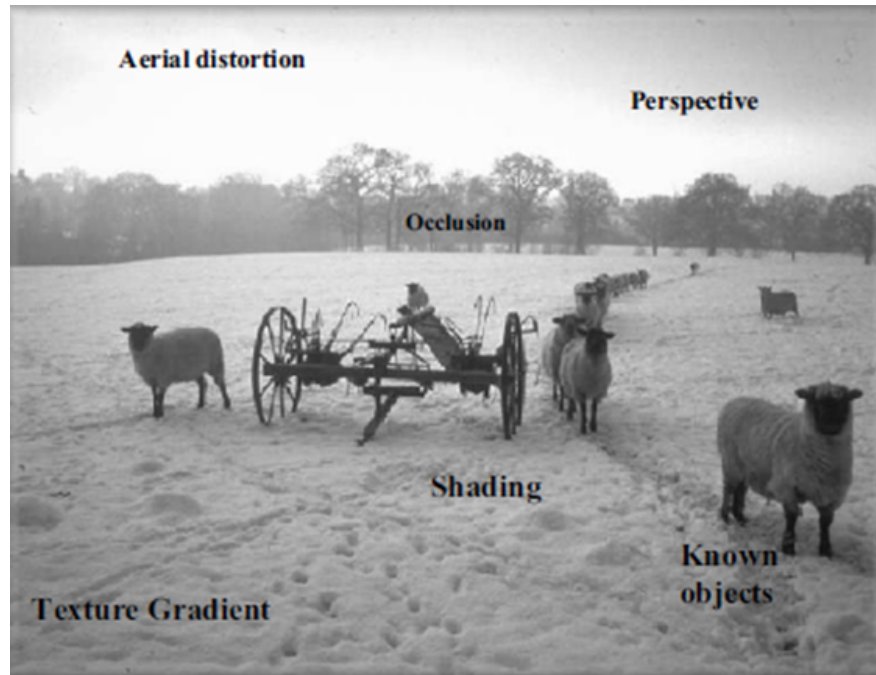


Figure 3.1: 2D depth cues [12]

role in the perception of depth, for example children who's eyes often are located closer to each other perceive more depth than adults, who have a larger separation between the eyes.

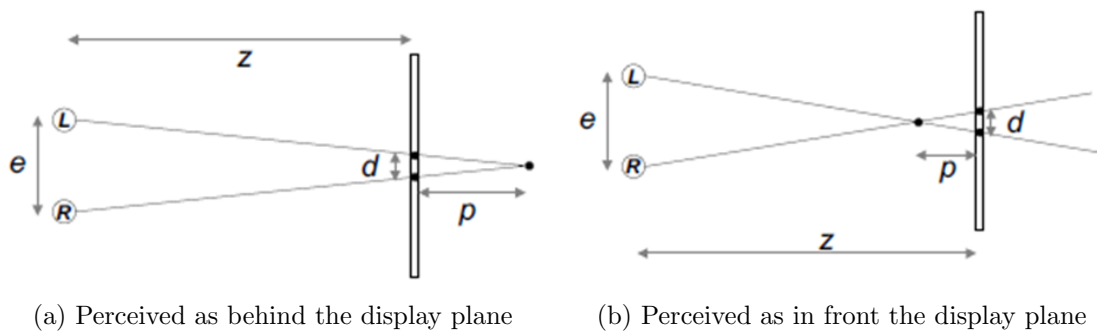


Figure 3.2: Geometry of depth perception [12]

## 3.2 3D Display Designs

It is important that 3D displays have at least as good image processing quality as 2D displays. 2D- and 3D depth cues mentioned are utilized in designing 3D

displays, some techniques in 3D display designs are described in the following section.

### 3.2.1 Stereoscopy

Stereoscopy is a technique where the viewers perceive depth through the use of specialized eye wear. The eye wear helps the right eye see the right view and the left eye see the left view. There are many 3D displays from different vendors on the market that use this technology, but they have suffered from drawback due to the disturbance of having to wear certain eye devices. An advantage of stereoscopic displays are that it is well suited to multiple observer applications such as cinema and group presentations. Providing the audience with eye wear is easier compared to directing individual images to each observer. The major types of technologies are polarized glasses, shutter glasses, and anaglyph glasses[12].

### 3.2.2 Auto-stereoscopy

With auto-stereoscopic displays the viewers are not required to wear eye wear to perceive depth. Left and right eye views are sent directly to the correct eye. The advantage of not requiring eye devices removes a barrier for acceptance in everyday life. Auto-stereoscopic displays uses micro-optics in combination with an LCD element, many designers have adopted this technology and some different combinations are out on the market. Parallax Barriers, Lenticular Optics, Micro-polarizers and Holographic elements. These elements are used in auto-stereoscopic 3D display designs including two-view and multi-view designs.[12]

## 3.3 3D for commercial use

3D has gone through waves of popularity, mostly due to the quality of the technology, the need for certain eye wear, and debates around peoples health when watching 3D. Over the last few years the popularity of 3D has increased and several movies are made in 3D. Avatar, the movie of 2009, gave 3D cinema a boost and now every Hollywood heavy-hitter is turning to the 3D act[27]. Utilization of





(a) Nintendo 3DS portable game device [15]    (b) LG Optimus 3D smart phone [23]

Figure 3.3: Consumer devices with 3D experience

3D in other applications have increased as well, TV sets for the home which can air 3D for 3D channels e.g. LG Cinema 3D TV, BBC has planned to air some of the Olympics 2012 program in 3D[44]. In addition, 3D for portable game devices e.g. Nintendo 3DS and smart phones can be delivered with 3D e.g. HTC evo 3D and LG Optimus 3D. Figure 3.3 shows the popular Nintendo 3DS and LG Optimus 3D smart phone.

It seems like 3D has regained its popularity through technology improvements, such as a wider selection of display technology and eye wear. The option of 3D will provide a more natural way of displaying clothing which may ease the trouble of deciding whether to buy a given item or not.

### 3.4 Summary

This chapter has introduced principles of 3D technology and techniques of 3D display design. 3D can provide users with an enhanced user experience and there are several areas where 3D can be utilized to make everyday life more convenient. In the near future, a patient might be able to get a medical consultancy or a chat with his psychologist from home, or shop from a virtual store in the futuristic Multimedia Home Space.

Distributed Multimedia Plays utilizes 3D to provide users with an enhanced user experience in collaborations and to give users a feeling of near natural virtual reality. DMP and its CS will be introduced in depth in the next chapter.



# Chapter 4

## Distributed Multimedia Plays

DMP is short for Distributed Multimedia Plays and is a networked multimedia system which provides near-natural virtual networked stereoscopic multi-view and multi-channel sound collaboration between users. The network can guarantee end-to-end time delay less than 20 ms, sequence of packets and handles security in a different way than the Internet to provide more privacy and reduced openness in the network. E-commerce has traditionally been performed over the Internet, but its security and quality are argued, DMP can offer what the Internet lacks. To set up a virtual store in 3D, with the demand for quality, control and privacy of such a virtual store, DMP is well suited. DMP is new to many readers and will be described throughly in this chapter.

### 4.1 Introduction to the DMP network

The concept of the DMP system was introduced by L.A. Rønningen as a proposal for an extension for the digital TV system and Multimedia Home Platform (MHP), in a Telenor project in 1996-1999. It has later moved into a long-term project with the philosophy and intention of the DMP architecture to present a system architecture that can handle Multimedia Home Space (MHS) distributed services and enterprise services using Collaboration Spaces[40]. Several projects have been performed over the years and resulted in various areas of use, it is well suited for use in music and gaming session, telepresence, and in the future shopping, only our mind can set the limit for what it can be used for. It is to be

noted that DMP is a futuristic network, and is not intended to be implemented in a ten years' time.

### 4.1.1 A virtual lunch

As an example we can imagine two colleagues discussing a project over lunch. One is located at her office in Oslo and the other is located at her home in Trondheim. They are both sitting at a table in their Collaboration Space, enjoying their lunch while discussing the theme for their new project. They are experiencing that they are in the same room due to the near-natural feeling of both video and audio provided by DMP. Figure 4.1 illustrates a virtual lunch.



Figure 4.1: A virtual lunch [40]

## 4.2 DMP architecture

This section presents the philosophy and principles of DMP, its network topology and three-level architecture.

### 4.2.1 DMP philosophy and goals

The philosophy of Distributed Multimedia Plays is to provide the users with a near-natural video and audio quality and to present a system that can handle

Multimedia Home Space (MHS) distributed services and public and enterprise services using Collaboration Spaces. By definition, the near-natural virtual scene has a quality that approaches the natural scene, making users not perceive the difference between a real and virtual scene[41]. With DMP one wants to reduce the open ness in the network, and leave more responsibility and control at the network providers side.

Four main goals of DMP are 'near-natural virtual collaborations', 'graceful degradation of quality', 'simple-to-use', and 'privacy'. Service is to be understood as the total service received by the users. The near-natural quality goals produce extremely high traffic, in addition traffic may be very variable during collaboration. The concept of QualityShaping enables 'graceful degradation of quality' and builds on concepts on controlled dropping of sub-objects from selected packets, and it also guarantees a maximum user-to-user delay.[40] The concept of QualityShaping will be explained further in the Quality section.

### 4.2.2 Network topology

The network structure is well planned. There are two different node types in the network, AccessNodes at the user side, and NetworkNodes in the network core. Several specialized servers are needed to support Collaboration establishment and management. The structure of the network is hierarchical with both star and mesh topologies. Its not important to find the most efficient topology, rather the best way of communicating with a guaranteed delay. Node levels are categorized in regions, not countries, in order to balance out network traffic according to population. The different node levels are GlobalNode (G), EuropeNode(N), DistrictNode (D), CityNode (C), VillageNode (V), and AccessNode(F). Fixed route is used as a basic rule to guarantee a maximum delay, alternatively, if a link or processing part fails to load sharing and hot standby of processing section of each section shall be used. The alternate routes will give the same number of hops and traffic is shared equally[40]. Figure 4.2 shows an example of a connection between three European cities. The network nodes are shown from EuropeNode at the top, to the AccessNode F, at the bottom, the three cities have links added between them due to the need for frequent interaction.

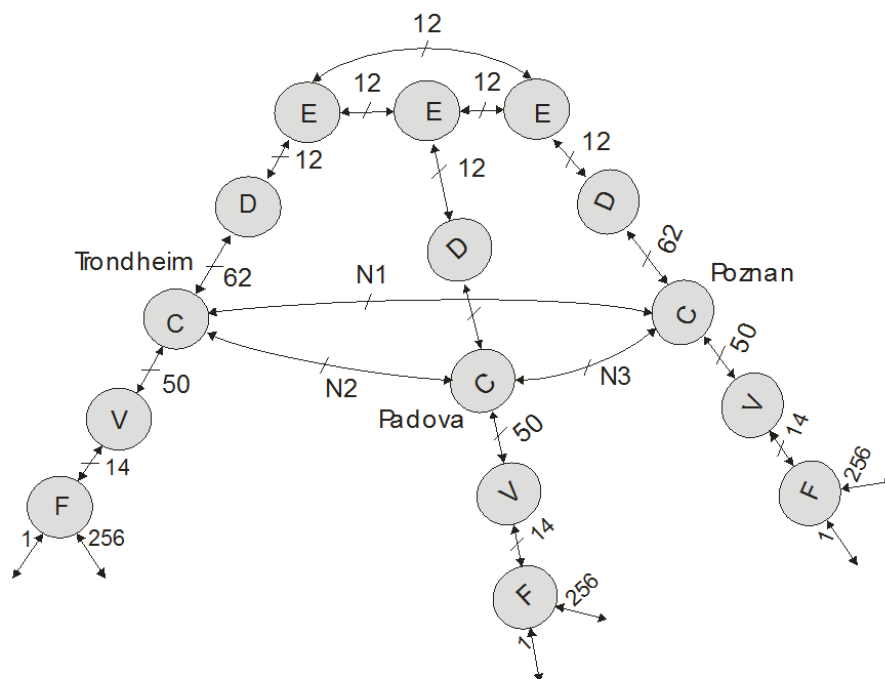


Figure 4.2: DMP network topology[40]

### 4.2.3 Three-level Architecture

DMP serves a three-layer network architecture with a combined layer of Application, Transport and Network called the AppTraNetLFC layer. Figure 4.3 shows the DMP architecture, the three layers from bottom-up consist of the Lincical layer, the AppTraNet layer and the Application layer. The Lincical layer is a combined layer reusing a sub-set of PCIe in transaction mode, it assumes optical fibers between network nodes, but wireless mobile connections are used as alternatives. The AppTraNetLFC layer is a combination of IPv6 functionality and functionality introduced specially for DMP, and it has a common protocol for applications, transport and network. This is where most of the security is handled and it implements IPsec.[40]

#### AppTraNetLFC protocol

The AppTraNetLFC protocol is built around IPv6 and IPsec and is the only protocol above the Lincical layer. Most of the security in DMP is implemented here. AppTraNetLFC is a typical request-response type of protocol and it holds

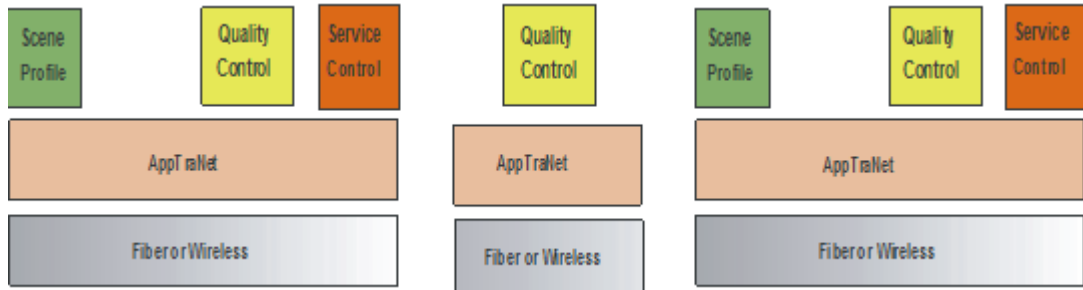


Figure 4.3: Three-layer architecture [40].

three types of messages, AppTraNet Key Exchange (AKE), control and multimedia content messages. The PT, Payload type, field in the packet defines the payload type. AKE is used in establishment of security associations (SAs) and exchange of keys for security. Control messages carry information about quality shaping, object move, viewer move, viewer focus sceneProfile, address, ack, and encryption. Multimedia content packets carry video, audio, graphics, and text. All AppTraNetLFC packets have the same header, only the payload change according to the packet type[40].

### 4.3 Collaboration Space

A Multimedia Home Space (MHS) or a Collaboration Space (CS) is the user interface, and where the user can interact with the system. It could be a room in a house, apartment or in an office building, for private use or for commercial use such as the virtual conference room introduced in M. Bøllhers master thesis[7]. The CS room can be any ordinary room or a specialized room designed with all the equipment needed for a near-natural collaboration, where the user can participate in a networked conference with other users and servers, or walk around, navigating their selves in a virtual store or a gaming session. The Collaboration Space is what would be used for a virtual store.

Projections of the players are projected differently, at different angles, in the different collaboration spaces and is illustrated in figure 4.5. The network consists of the room for collaborations space, with projection surfaces, cameras and projectors, hardware, routers and links. Collaboration spaces, cameras and projectors are located at the end user node, and the access nodes handle processing of quality and etc.[40]



Figure 4.4: All surfaces of the collaboration space are displays, giving a near natural feeling [40].

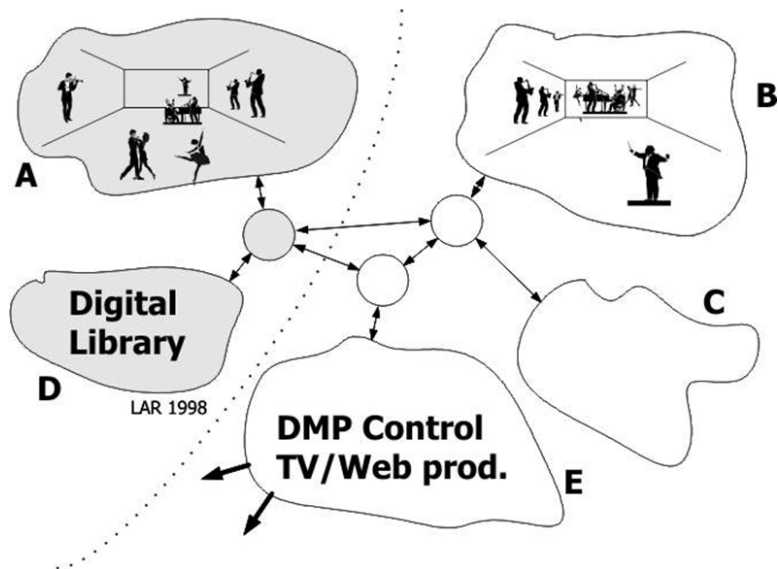


Figure 4.5: DMP collaboration between players in different collaboration spaces [40].

### Scenes and SceneProfiles

All possible services are described by SceneProfiles. The SceneProfile defines how to shoot videos and record sound, and how it shall be presented on the receiving user display. Scenes are composed of real or virtual sub-scenes. The SceneProfiles are chosen by the user during setup, but can also be changed during a session.[40]



## 4.4 Quality

The formal quality requirements of the system are to provide a 'near-natural virtual collaboration', 'auto-stereoscopic multi-view adaptive vision', 'guaranteed maximum user-to-user delay of multimedia content packets', 'quality of scene allowed to vary with time, but with quality limit guarantees', 'graceful degradation of quality when the network is overloaded or system components fail', 'guaranteed sequence of control packets', and 'node-to-node security provided by network- and/or service provider'. As previously mentioned, DMP is not intended to be implemented in a ten years' time, and it is believed that the quality requirements are becoming much higher than today, it is therefore justifiable to introduce audio and video quality to enable users to not experience the difference between a real- and a virtual collaboration. End-to-end time delay is critical in many collaborations e.g. in jazz jamming and gaming sessions and delay should be guaranteed less than 20ms. In order to guarantee this minimum delay, the quality of audio-visual content is allowed to vary with network traffic. To provide a near-natural feel the spatial and temporal resolution is critical, requiring Gbps data rates. Considering a conference meeting, where the high quality of the face of the person talking, Gbps is required for the face alone. Quality shaping and Service classing are schemes needed to allow DMP to meet its quality requirements.[40]

### 4.4.1 Quality Shaping

Quality shaping is a quality control scheme introduced in the DMP network to allow quality of schemes to vary with the traffic load in the network and to provide 'graceful degradation of quality'. It is related to the work on Traffic Shaping which was introduced by L.A. Rønningen in 1982. Quality Shaping helps guarantee a minimum quality of scenes, a maximum delay between end-users and a guaranteed sequence of packets when delay is not considered important.[40]

The main multimedia content of the system are collected in scenes (introduced in the previous section), which are composed of real and virtual sub-scenes. Objects in a scene can be divided into sub-objects which can be coded as independent streams and transferred in different packets. This scheme of independent streams provides graceful degradation of quality when the network is overloaded or a

network component fails.[40] An illustration of how object are divided in sub-objects are shown in figure 4.6.

The quality of a scene can be changed in many ways. A QualityShapingProfile holds parameters that can be varied, to maintain a guaranteed quality of the service. Dropping of packets and degradation of data rate is decided in the user terminal and performed by the access node. Measurements and feedback from nodes in the network are received at access node, and forwarded to the user terminal which decides based on QualityShapingProfiles to drop packets and decrease data rate for a period of time. The Access nodes perform controlled dropping of sub-objects. At the receiving side, objects are regenerated by interpolation.[40]

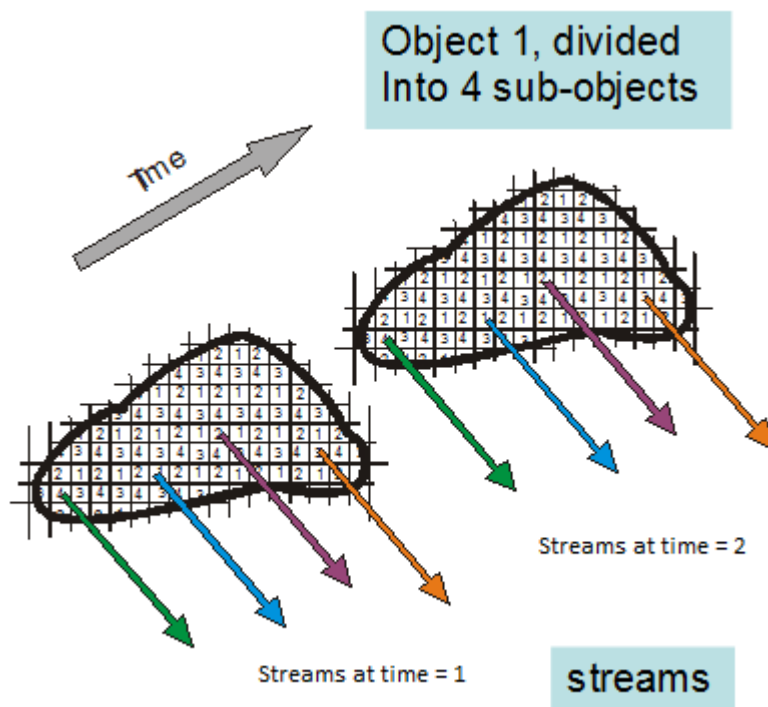


Figure 4.6: An object is divided into sub-objects, which is sent in independent streams[40]

#### 4.4.2 Service Classing

DMP divides their network services in classes. Service is to be understood as the total service received by users from one or more service providers. The classes are divided according to requirements and guarantees made to the network, and are

shown in the list below. The service classes are also used in queuing management, deciding where and how packets are handled and placed in queues[40].

- A** Guaranteed real-time requirements, the probability for loss shall be very low
- B** Moderate real-time requirements, shall be delivered in a correct sequence
- C** No real-time requirements, but shall be delivered in a correct sequence (TCP/IP supports similar service)
- D** No real-time requirements, can be delivered out of sequence, all packets shall be delivered
- E** No real-time requirements, can be delivered out of sequence, packets can be lost (similar to RTP/UDP/IP)

## 4.5 Security

DMP introduces a new and different approach to security. Its main philosophy is to reduce openness in the network and hand over more control to the network providers, at the same time making the network more intelligent and leaving the users without as much control and button-pushing. It serves as a point-to-point communication, either it being communication between host and a security gateway, security gateway to router, or router to router[40].

### 4.5.1 Security Services

Services that are important for DMP and the AppTraNetLFC protocol are access control, connectionless integrity, data origin authentication and confidentiality. Integrity is to ensure that data is the same data that was sent. Authentication is to make sure that the communicating end-point is the end-point it intended to communicate with. Confidentiality is keeping information secret from eavesdroppers and people not intended for the information. Confidentiality and authentication are the most critical parts and privacy is considered very important when implementing a tele-presence system, and it needs a security mechanism that ensures that multimedia content cannot be read by a third party, even if

that person has captured a packet. Authentication must provide security against attackers who tries to impersonate legal users and initiate connections.[40, 18]

### 4.5.2 DMP implements IPsec

The security mechanism for the DMP network focuses on implementing IPsec Authentication Header (AH)[19], and Encapsulation Security Payload (ESP)[20] on the AppTraNetLFC packets in the AppTraNet layer. IPsec[21] is introduced to provide confidentiality and integrity protection. IPsec implemented in the AppTraNetLFC protocol are in some extent modified and simplified to fit the requirements of DMP. Users and servers of the network such as access nodes, network nodes, hosts and user interfaces utilize certificates to identify themselves and the Certificates are allocated by Public Key Infrastructure (PKI). A Certificate Authority server on the DMP network assigns and maintains the certificates. It is assumed that all entities communicating have a valid certificate maintained by the DMP Certificate Authority. Further there are two phases in the AppTraNetLFC security scheme; the Key Exchange and Communication phase. The key security principle is to have all data regarding connection control and multimedia content encrypted and integrity protected before transferring.[40, 18]

In my specialization project[47] I evaluated the security in DMP and compared it with current security in the Internet. I found that there are key differences between the two network architectures which in turn affects decisions of security solutions. DMP with its implementation of IPsec and general strict rule of authentication before communication in addition to reduced openness provides more security to its network than the Internet. Resulting in DMP providing better security than the Internet. Over the years we have witnessed discussions about the security of the Internet, some even argue the need for a new Internet. With DMP the security has been in design plans from the beginning as opposed to the Internet, which has been thought of along the way, maybe when it was too late.[18, 47]

## 4.6 Establishment of a collaboration

To best understand the quality and security that Distributed Multimedia Plays can provide, study the establishment of a collaboration through the message sequence chart in figure 4.7.

## 4.7 Summary

DMP introduce new principles and a new approach to handle quality, delay and security. These principles answers many of the problems arising in the Internet today. How can DMP be utilized to form a solution of virtual shopping? The idea of a virtual store using DMP and potential scenarios are presented in the next chapter.

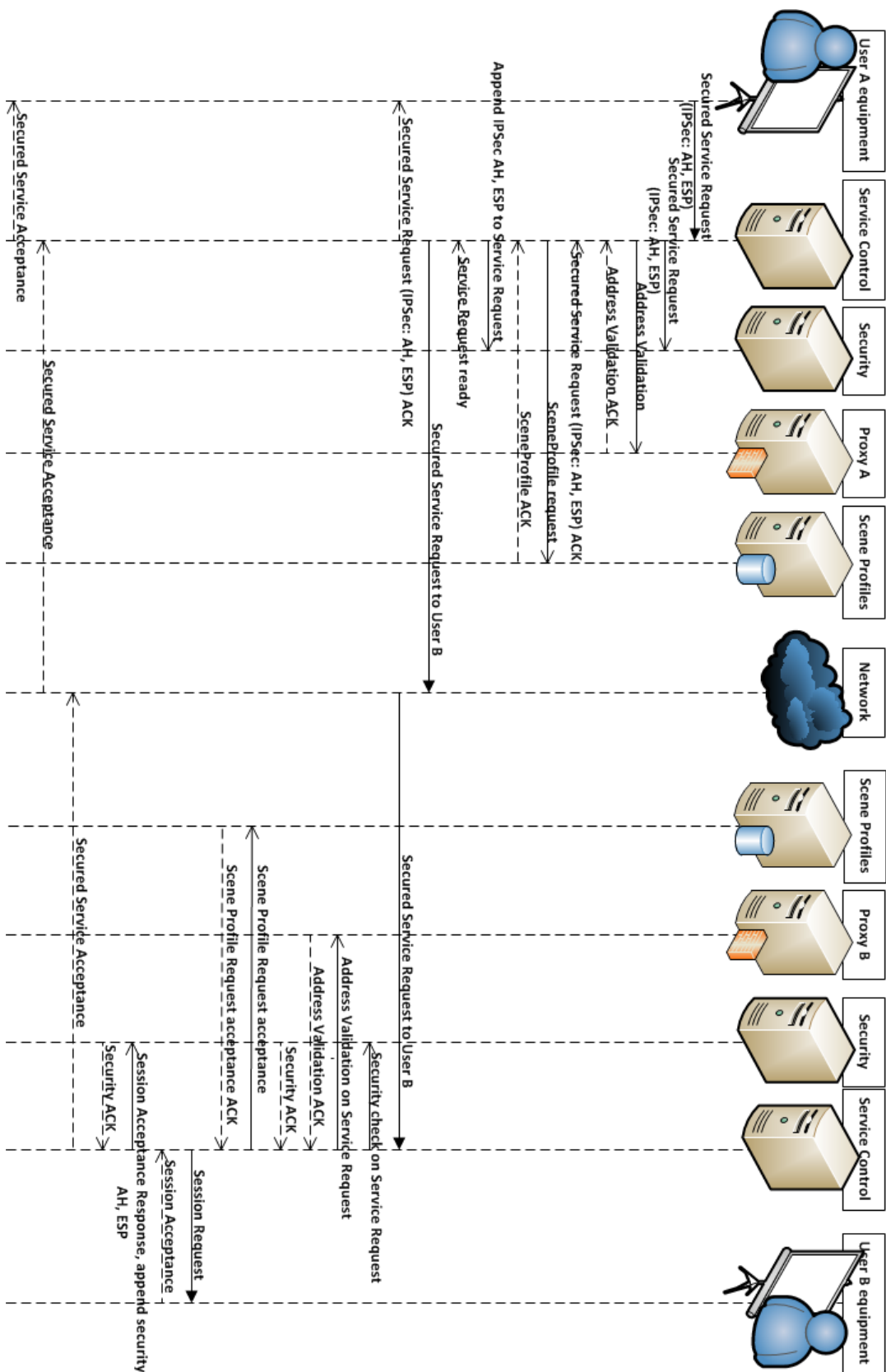


Figure 4.7: Message Sequence Chart of a DMP collaboration establishment

# Chapter 5

## A case study of 'The Virtual Store'

This chapter will present the idea of a virtual store utilizing DMP, as well as suggest potential scenarios for application. One of the proposed scenarios will be chosen for a solution, which will be developed in more detail regarding equipment and realization.

### 5.1 The idea

The idea of a virtual store comes from merging electronic commerce with a physical store on location. Getting the advantages from e-commerce such as availability and convenience, while still receiving the social value of visiting a traditional store (e.g. strolling around in the city when shopping). The consumers will still visit a physical store in the mall or city center, but it is equipped with a Collaboration Space which will provide the customers with a near-natural feeling of being in an actual store. A near-natural feeling, means that consumers shall not perceive the difference of walking into a regular clothing store and a virtual clothing store, when it comes to quality of imaging and etc. In order to provide the customers with a near natural experience, quality of image need to be very high, including projections on screens in 3D, which requires an extensive data rate. It is evident that the scenarios are futuristic, but as with the Distributed Multimedia Plays it is intended for realization in a five to ten years time. The infrastructure to

handle the quality and near-natural feeling is the Distributed Multimedia Plays. In times where information security is of big concerns this network can assure the customers of authentication and security. Pirate copies and fraud on the Internet is happening every day, and we need to approach it with new ideas. A solution of a virtual store utilizing DMP is a new approach. With the DMP network you would always know who you are shopping with, DMP can not cooperate with distributors who sell pirate copies, and you are not at risk of identity theft or someone stealing your payment information. People who in general are skeptical to online shopping, might feel more secure with this type of e-commerce, where security is of big concern. This case study is highlighting the possibilities of the technology we have at hand and what kind of applications it can be used for.

For a virtual store to appeal to the consumers it needs to give them more than what they get from online- or traditional brick-and-mortar shopping. The virtual store is a merging of the abilities and convenience of having everything accessed from one 'market place' and the social factor of going to a physical store in the city center or mall, illustrated in figure 5.1.

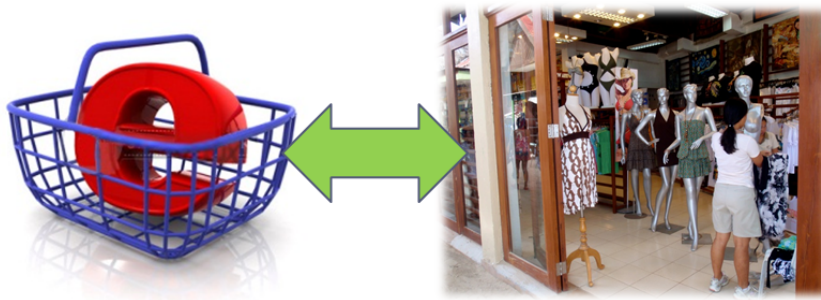


Figure 5.1: The idea of merging e-commerce with a physical store, pictures from [42, 17]

## 5.2 Scenarios

This section will introduce the reader to the possibilities utilizing DMP for the application of shopping, and identify what value are given to end-customers who will utilize the service. The company developing 'The Virtual Store' consists of a group of software developers with an entrepreneur idea of a virtual store. They have developed a standard software solution for 'The Virtual Store' and customize the solution to fit their customer, e.g. a clothing or furniture chain



store. The consumers of a specific store receives value from the store through visiting 'The Virtual Store'. A definition of scenarios helps the process of understanding customer needs and how those needs can be met in a business model. The innovation of new business models are about the need to meet unsatisfied, new or hidden customer needs[29]. In a way, the scenarios contribute with the same idea, but they can answer different needs for the customers and represent different customer segments. An illustration of the relationship between the solution provider, the customer of the application and the end-customer is shown in figure 5.2.

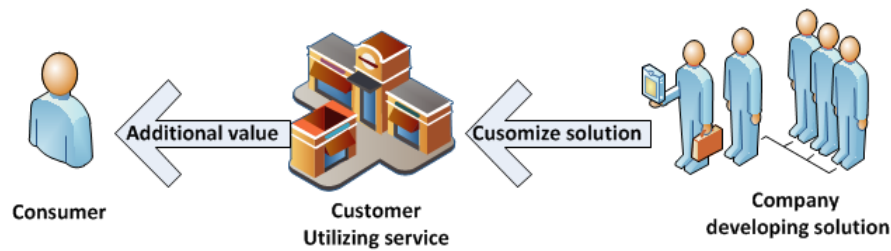


Figure 5.2: Relationship between the company who develop the solution for 'The virtual Store', its customer and consumer who receives value through the virtual store.

Several scenarios have been defined, and are presented in the following subsections.

### 5.2.1 Apparel shopping

Imagine a shopper, either a general shopper or a 'fashionista' who both may have different needs, but also have several similarities. They both like to shop, but they hate the time they have to spend in the dressing rooms. If they shop in a regular store and skip the dressing part, they might have to return the items that did not fit. The decision-making, either in-store or when shopping online consumes time and effort. An image of the customer or an avatar might be the solution that meets these customer needs. The 'Avatar', a graphical representation of the user[48], or in this case the customer, with the actual size and proportions is made for each customer. The 'Avatar' can help the customer find garment that most likely will fit their body and visualize how clothing will look like on. This might help the customer to take the right decisions, which can save time in the store, and diminishes the probability of returning the garment (e.g. didn't fit,

wrong color). The process of illustrated in figure 5.3, virtually trying on an item will consist of a camera recording the customer and representing her in 3D, while the garment she choses is layered over the image of the customer.

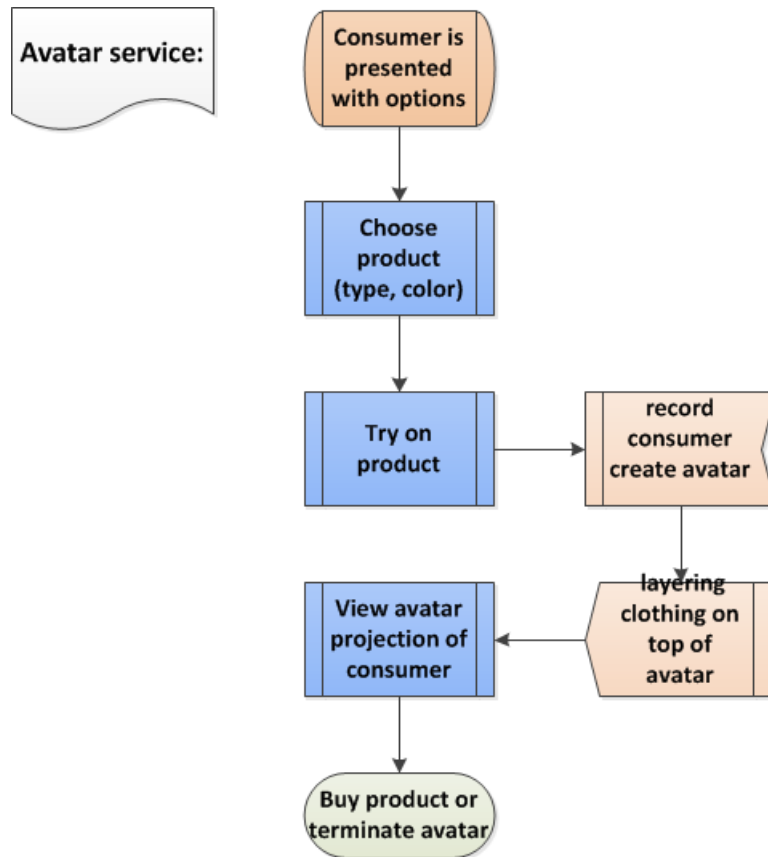


Figure 5.3: Process of trying on an item

'The Virtual Store' and the 'Avatar' service can enhance the customer experience, by making shopping easier. The availability of size and color are no longer a question, because everything is represented virtually. For example, if a customer finds a dress she likes, but not the right size or color, it would take time to get it delivered for her to try it on. In the virtual store that scenario is not possible, everything can be tried on virtually. 'The Virtual Store' will result in more satisfied customers, who while saving time on trying, buying and returning are having fun. Value added to end-customer through the services:

- **Authentication service:** The consumer reduces the risk of purchasing a pirate copy, and the threat of credit- and debit card fraud, through the use of the DMP network, which has a higher level of security than regular e-commerce on the Internet. DMP guarantees more security, authenticating

all entities who wish to collaborate in the network.

- **Availability service:** The Virtual Store can offer a wider product variety than a traditional brick-and-mortar store. Items are not limited to not having the size or color, they are all available virtually.
- **Avatar service:** The service of creating an avatar or projecting a 3D image of the customer, represented in a near natural way with the use of auto-stereoscopy. The system can help the end-customer to find the best fit in size and shape, based on the 'Avatar' created of the end-customer.

### 5.2.2 Furniture shopping

A virtual furniture store can ease the process for customers who are looking for new furniture to their home, by visualizing how a piece of furniture can look like in their living room. It can help customers to find the right color or size of a piece of furniture, and will enhance their shopping experience and reduce the time they have to spend on deciding. It saves the customer time on picking out the right product, enhances the shopping experience, gives the customer a better feeling of satisfaction. Value added to the end-customers through the service:

- **Availability service:** The virtual store has the availability of a large amount of furniture, to be viewed in 3D in its actual size.
- **Visualizing service:** The Virtual Store can offer the possibility of having the customers visualize how a new furniture would look like in their home, changing size and color. The furniture can be viewed in 3D, in its actual size, reducing the time needed to decide what to purchase.

### 5.2.3 Premium consumer

This scenario is intended to be offered to consumer who qualify as a premium consumer through for example annual amount spent in a specific store or mall, or willingness to pay for such a service. There are two versions of this scenario. The first version is a collaboration space integrated with a regular clothing or furniture store, where the store can charge the consumers an extra fee to use

the avatar service or the visualization service respectively. The second version is an independent collaboration space located at a high-end mall offering a 'virtual store' where all stores in the mall are presented at one market place, 'The Virtual Store', allowing the customer to try on the garment virtually and at their own pace. Value added to the end-customers through the service:

- **Availability service:** The Virtual Store has the 'availability' of all the stores in one market place, reducing the effort of the end-customer who only needs to visit one store to purchase it all. This offering creates value for the end-customer by reducing their effort on shopping, and giving them a premium treatment which makes them feel special.
- **Avatar service:** Projects a 3D image of the consumer, represented in a near natural way with the use of auto-stereoscopy. The system can help the end-customer to find the best fit in size and shape, based on the 'Avatar' created of the end-customer.
- **Exclusivity:** Since it is offered to premium customers, there might not be as many people using this service, and the customer can feel free to use the time she needs without being disturbed.

#### 5.2.4 Virtual Tailor

The scenario of customization describes a store, where customers can design and customize clothing, kind of like a virtual tailor. The idea is that the clothing is made after the order is placed, tailor made and one of a kind. A customer walks into the CS of 'The Virtual Store', she has been thinking of a special blouse she would like to have designed. In the store the Collaboration surfaces are of near natural quality, which displays fabric and color well. The customer is scanned by the camera equipment to generate an 'Avatar' of the end-customer with correct measurement. A store clerk helps the customer with the details. After order is placed, it is sent to the manufacturing factory. Measures along with, details of color and fabric are sent, in addition to delivery details. The customer can expect the blouse to be delivered within a week. This way the customer can get customized clothes and the clothing store can save money on distribution and storage of clothing as it is sent directly to the customer, without

and intermediary storage. Figure 5.4 illustrates the process of custom making clothing in 'The Virtual Store'.

- **Avatar service:** The service of creating an avatar or projecting a 3D image of the customer, represented in a near natural way with the use of auto-stereoscopy. Value is created for the customer when measurements for garment is performed virtually, and a service of tailoring can be performed without spending time getting measured manually.
- **Personalization:** The garment is custom made for the end-customer, and personalization such as placements of initials or logo are offered. Value is created for the end-customer who gets one of a kind clothing.

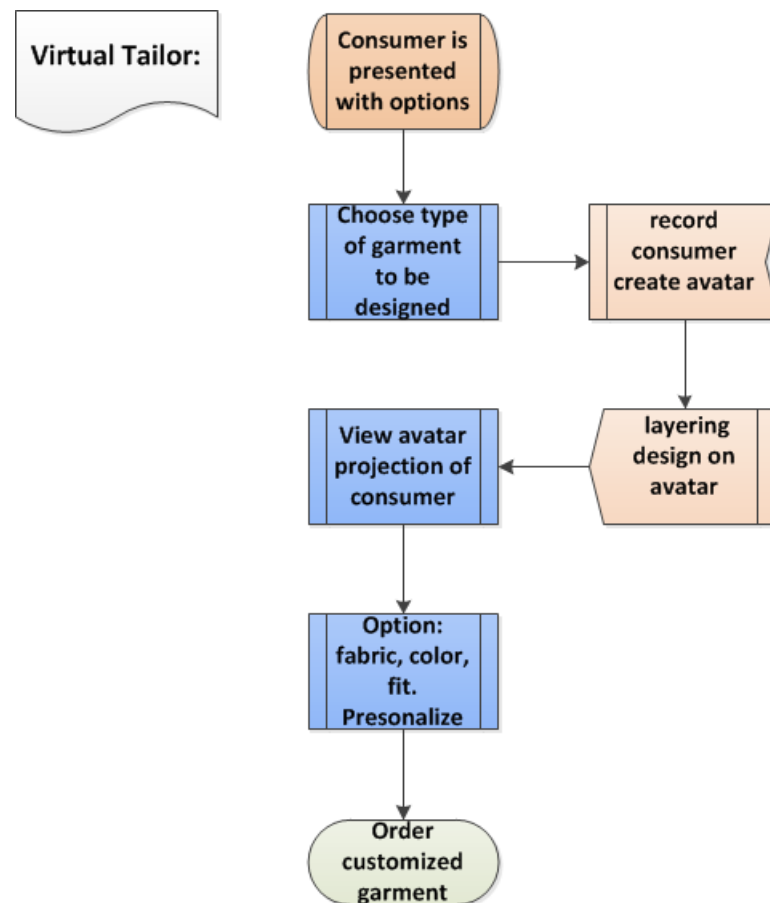


Figure 5.4: Process of Virtual tailor scenario

### 5.3 The Virtual Store - clothing store

The scenario for 'Apparel shopping' is chosen to be developed further. This section will present how a solution of a virtual clothing store can be realized with the utilization of DMP and its CS. A business model is developed for this scenario and will be presented in chapter 7 along with a financial analysis. The service is called 'The Virtual Store', and will be developed by a company experienced with DMP.

The virtual store will be constructed similar to a Collaboration Space of DMP. 'The Virtual Store', is a room where three walls or surfaces have back-projection displays and multi-view cameras. The arrangement provides the collaboration space with spatially true, multi view, auto-stereoscopic shooting of video, and single view, auto-stereoscopic presentation.

Even though we are using the DMP network with Collaboration Space for the virtual store, it may not require the same quality in audio and video as a teleconferencing system, nevertheless we base the requirements of bandwidth on known traffic in those systems. Traffic requirements of near-natural virtual scenes (as provided in DMP) is extremely high, up to  $10^3$  -  $10^5$  times larger than from today's videoconferencing systems and it is variable during the collaboration[40]. Hence, extremely high bandwidth is required. Some requirements of DMP are not available in technology today, but assumed to be in a five-ten years time, when the realization of the network is imagined, hence technology requirements and specifications are based on SOTA.

#### 5.3.1 Requirements to 'The Virtual Store' CS

The Collaboration Space of the virtual store is based on requirements for 'the Hems lab and Collaboration Surface project' presented in [40], further specifications and details on equipment are based on studies in [38, 39], but is modified to work with the scenario of 'The Virtual Store'. 'The Virtual Store' will be hosted in the Collaboration Space of DMP. As mentioned earlier, the quality of the scenes intend to approach 'near-natural quality' in the long run, but to start with state-of-the-art equipment will be installed. A DMP CS consists of cameras, projectors, surface/screens, processing equipment, and servers.

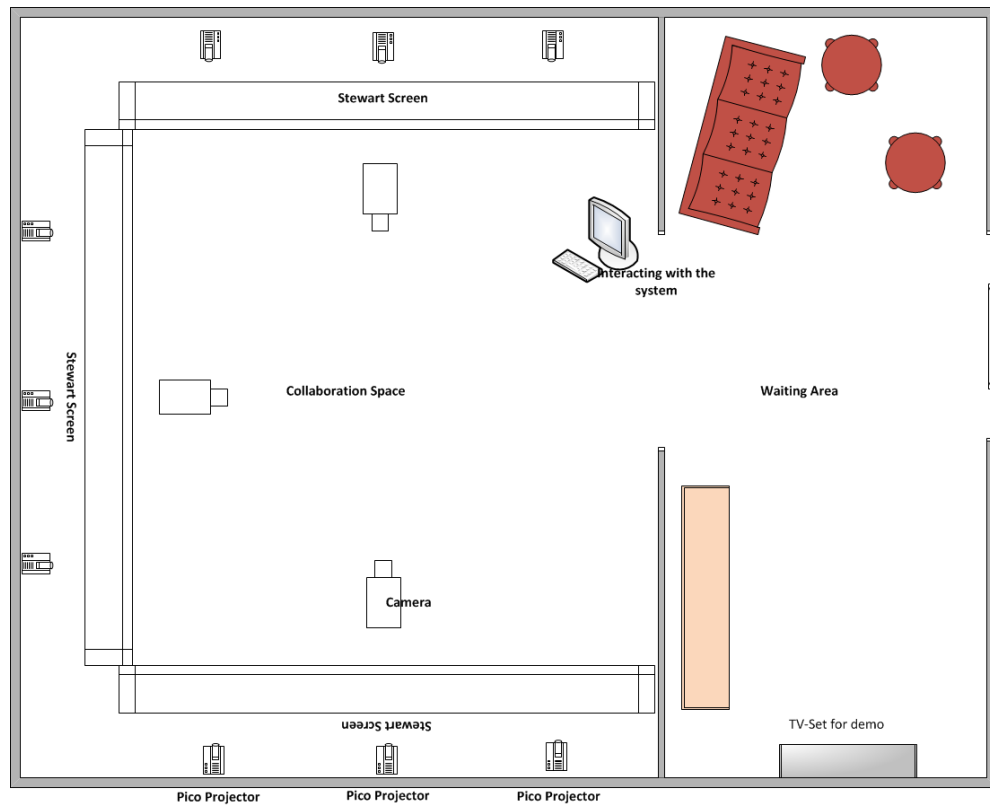


Figure 5.5: Illustration of The Virtual Store

The DMP architecture shall provide near-natural virtual networked auto-stereoscopic continuous view video and multichannel sound collaboration between users and users and servers. With the futuristic approach in mind, technical requirements and cost of equipment and hardware are limited to the cost of state-of-the-art technology.[40]

### Collaboration surface

The Collaboration surface is a technical interface including camera arrays, projector arrays, displays and other built-in devices. In 'The Virtual Store' three collaboration surfaces with projector and camera equipment and people constitute the collaboration surface.[39, 38]

Three collaboration surfaces which have back-projection displays and one camera in front of each display to record the customer. This arrangement provides spatially true multi-view, auto-stereoscopic shooting of video and single view stereoscopic presentations.[40] The Stewart AeroView screens are 2.4 m wide and

will be arranged on 3 meter wide walls. Because we use back-projection there will need to be space behind the displays to arrange the projectors. One camera is placed in front of each AeroView screen to record the customer for the 'avatar or virtual dressing service'. Between the entrance of the store and the CS there will be a waiting area where customers can wait, find information about 'The Virtual Store' or watch a demonstration video on how it works.

The virtual store will have a database with data of different categories of stores, and this stored data will be projected in the virtual store after what the customer wishes to see.

### **End-user requirements**

Some requirements are set to obtain the best possible solution and perceived experience to end-users. These requirements have been made after discussion with professor Rønningen. Maximum number of users in the virtual store are set to three, in order to receive multi-view and auto-stereoscopic imaging, which is the value of the collaboration space. With the installation chosen for 'the virtual store' users must be located at least 1 meter away from the displays to receive best possible quality and sharpening of the picture. Three projectors are placed behind each display and are preferably generating adaptive views. 1 camera per view, it can generate a depth map in order to generate 3 views. In a traditional collaboration space there would be more cameras placed out, but in the case of the virtual store, much of the information/data are recorded and stored in a database. Only one camera is needed to film the end-user in 3D and present it in a way to use a photo shop technique with layering to display a chosen garment on top of the image of the customer, virtually dressing up the customer. To best capture the near-natural feeling, a small size camera have been chose. It may reduce the image quality, in comparison to using a big studio camera, but which will not give an awkward feeling of a big camera in a dressing room. Preferably the camera should have been embedded into the display, but we leave that for the future.



### The Virtual Store equipment

Equipment needed for a set up of the virtual store is presented in table 5.1 and is for visualization and streaming of the DMP content for three collaboration surfaces in the same collaboration space. In the original collaboration space, loudspeakers and microphones are used for interacting with the system, but in the realization of 'the virtual store' they are left out. Equipment are based on equipment used at the Caruso lab at Department of Telematics (Test Lab) and described in [40] by professor Rønning and some camera and codecs used in 'The Virtual Conference Room' described by M. Bøhler in [7]. The DMP network is intended for implementation in a five-ten year time, all the requirements to quality and performance does not exist in todays technology and for an example of realization of a system assumptions on state-of-the-art technology must be made. The equipment and prices are based on an assumption that the cost of SOTA technology today is consistent with the cost of SOTA technology in the future.

<b>Equipment</b>		
<i>Item</i>	<i>Description</i>	<i>Price (NOK)</i>
Stewart AeroView screen	AeroView 100 1200mm x 2400mm. Three screens of 20 000 NOK each[2].	60 000
Pico projektor	3*3 projectors, three projectors are placed behind each screen[2]. Three projectors to create three views.	151 000
Camera equipment	The virtual store needs small but good quality cameras, in order to provide the three views it is needed three cameras. One camera cost 25 000 NOK[7]	75 000
Codecs	The system needs codecs that can handle 3D signals with minimum latency. Encoder 220 000 NOK and decoder 130 000 NOK [7]	350 000
PC	High performing PC	25 000
Miscellaneous	'The virtual store' have a waiting area in front of the Collaboration Space with lounge furniture, and a TV-set for a demonstration video. Estimated costs based on sog.no and komplett.no	20 000

Table 5.1: Equipment needed for 'the virtual store', based on the CS[40]

## 5.4 Virtual Shopping scenario

Message Sequence Charts are used to illustrate some important processes of The Virtual Store. The first MSC will illustrate when a customer chooses an item shown in figure 5.6. A request is sent from The Virtual Store, appended by IPSec security to the database which stores the product items. A successful establishment has been performed and the set up part is omitted in the illustration, only shown by the first three lines of 'Secured Service Acceptance'. A successful establishment of a collaboration was presented in the last section of chapter 4.

### Payment solution

Running a traditional brick-and-mortar store or an online store you need a payment solution. The Virtual Store is a merging of the two worlds, and offers a payment solution with the analogy of an online store. In this solution the payment gateway plays the lead role, and provides the store with a real-time authorization of credit- and debit cards. A payment gateway process the payment and is an important part of the payment transaction. Security must be considered here, the transmission of payment information must be confidential, utilizing DMP it is secured with IPSec AH and ESP.[34]

In the virtual store, when a customer has found an item of interest and wants to purchase it, the customer must enter his or her credit(or debit) card details to be sent to the payment gateway which processes the payment. The purchase needs to be verified for payment to 'The Virtual Store'. The payment gateway routes, verifies, processes and accepts (or declines) credit card transactions on behalf of 'The Virtual Store' over a secure encrypted connection provided by the DMP network[53]. The payment solution is implemented with the Virtual Store and managed as a merchant Interface, integrated with The Virtual Store server. The customer will see the payment solution as a interface displayed on the computer running in the virtual store (later extended to a portable device, such as a tablet PC. The MSC in figure 5.7 illustrates the process when the customer enters the payment information and waits for confirmation, the processes of the payment solution is illustrated in more detail in figure 5.8.

## 5.5 Summary

There are several scenarios where DMP and its CS could provide enhanced user experience. Apparel and accessories online stores has had a tremendous increase in sales, and are estimated to increase further. This product category had a slow start at e-commerce up until now, because many shoppers would like to touch and view items before they purchase them[9]. The clothing store scenario was chosen to be developed further, details regarding equipment and important processes have been presented. A business model is developed for the chosen solution and is presented in chapter 7.

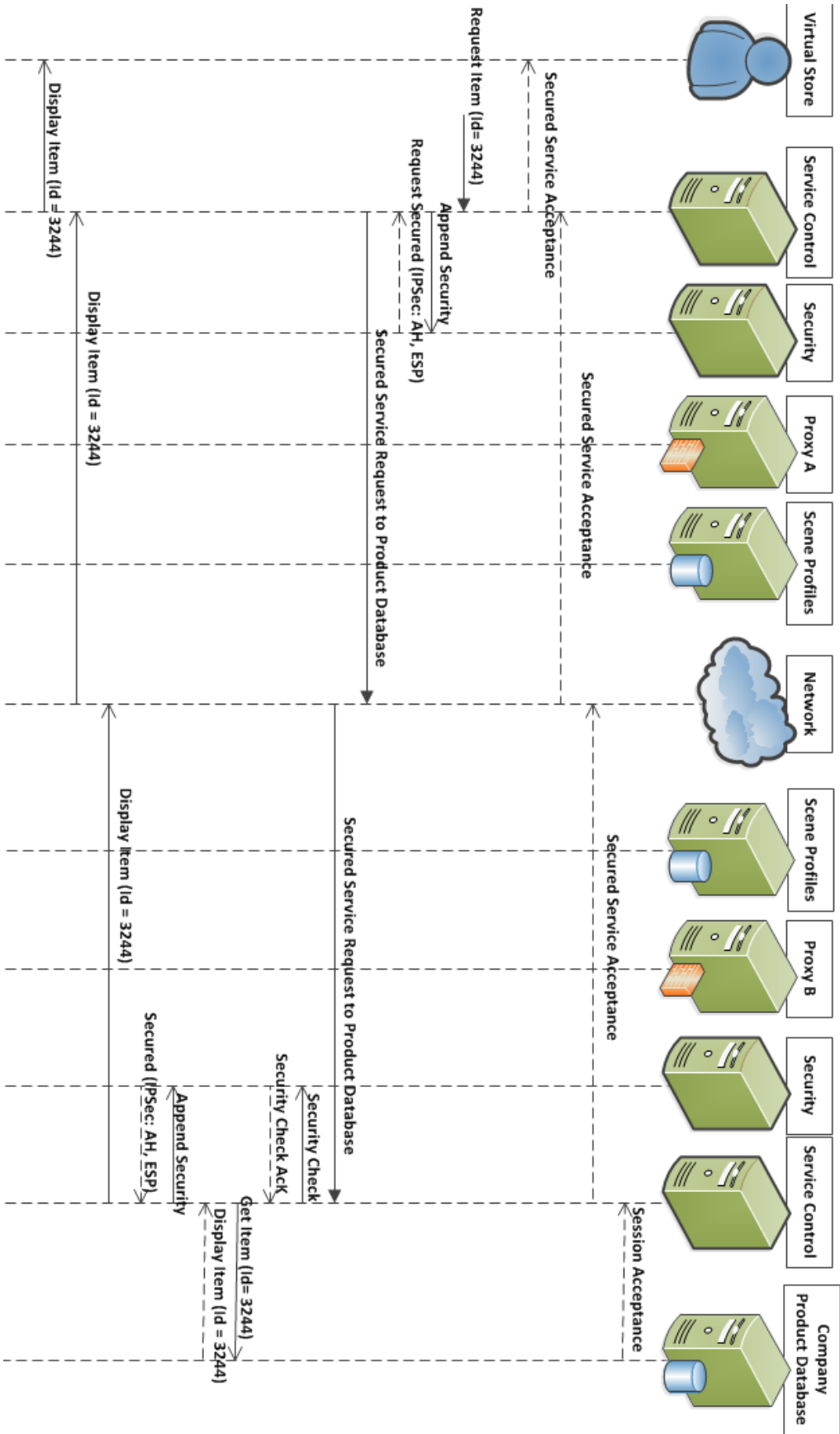


Figure 5.6: Message Sequence Chart of requesting and displaying an item in The Virtual Store

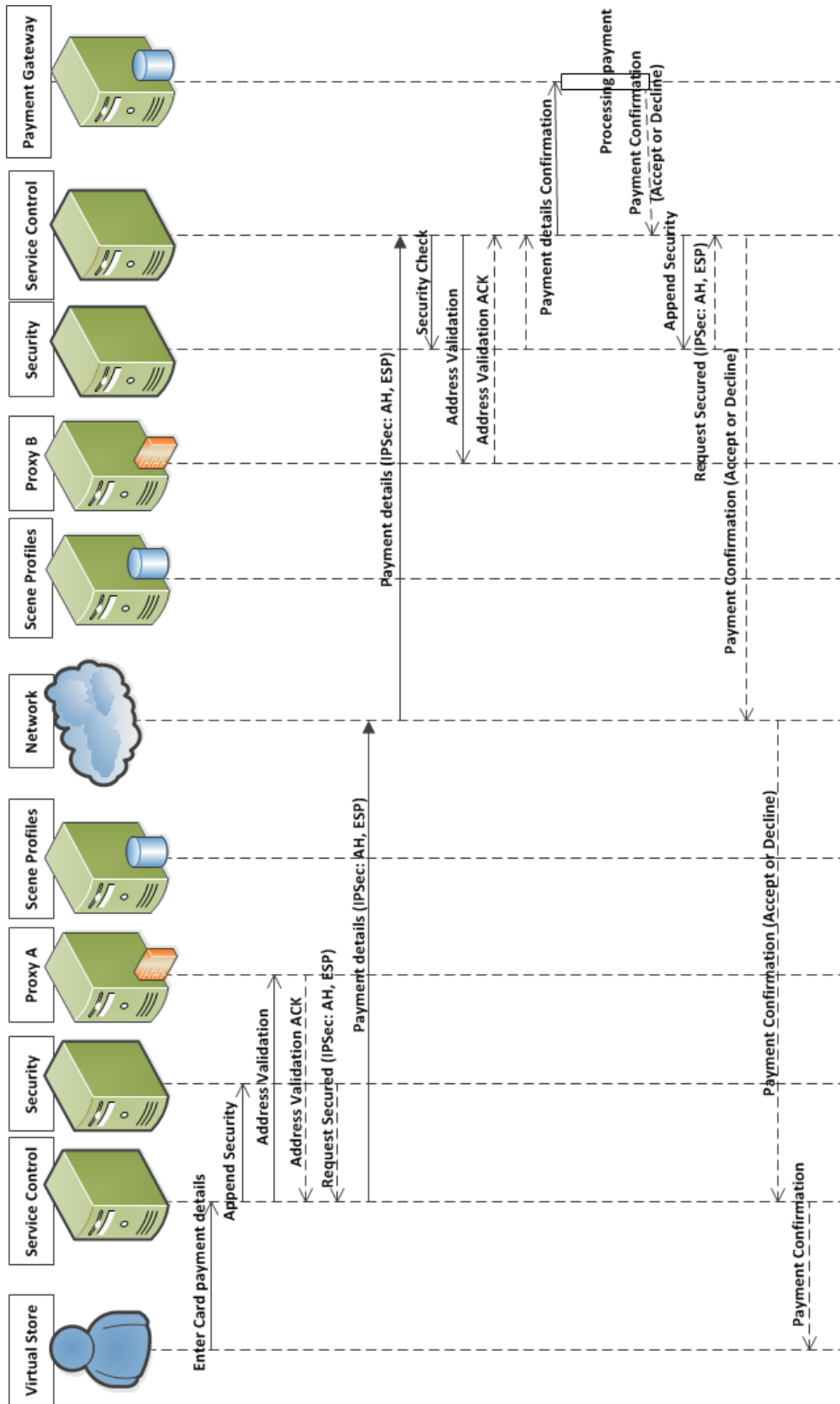


Figure 5.7: Message Sequence Chart of a purchase in 'The Virtual Store'

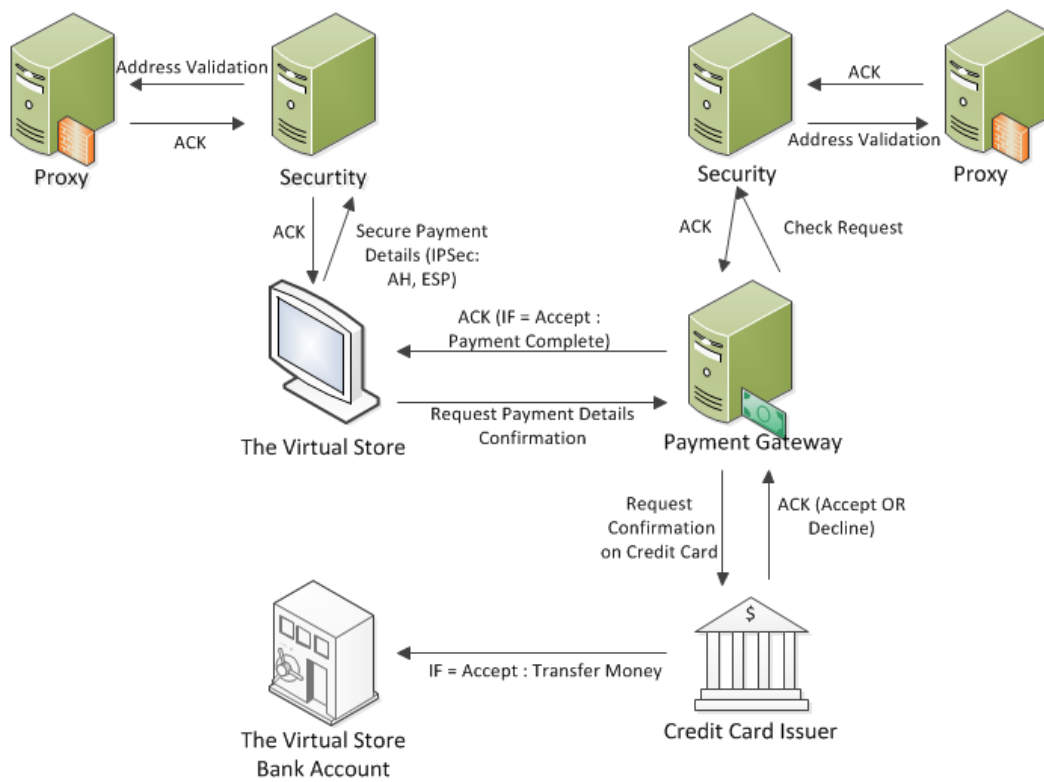


Figure 5.8: The payment solution in the virtual store

# Chapter 6

## Osterwalder's Business Model Ontology

Alexander Osterwalder has developed a business model ontology, based on his PhD thesis. He has studied and identified areas important in several business- and strategy models, and made a business model ontology which suites the world of online markets[28]. In order to evaluate the business potential of 'The Virtual Store' I have chosen Osterwalder as a framework, and it will be presented in detail in this chapter.

### 6.1 Business Model structure

Osterwalder provides an ontology to accurately describe the business model of a firm. Four main pillars are identified and describe the essential business model issues of a company. The four pillars are[28]:

- **Product** - Describes what kind of business the company is in, and what the products and value propositions offered to the market are.
- **Customer Interface** - Describes who the company's target customers are, how the company deliver their products and services, and how it builds a strong relationship with its customers.

- **Infrastructure Management** - Describes how the company efficiently performs infrastructural or logistical issues, with whom, and as what kind of network enterprise.
- **Financial Aspects** - Describes what the revenue is like for the company, the cost structure, and the business model sustainability.

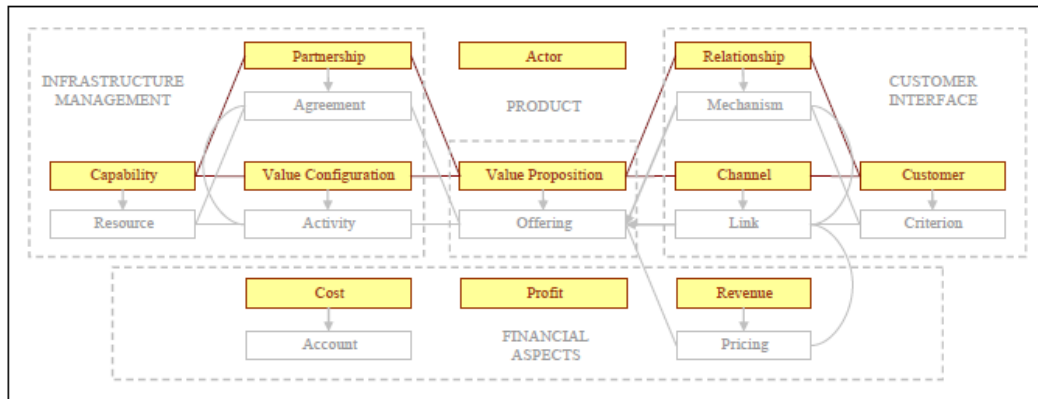


Figure 6.1: The relationship between the four main pillars and the nine elements of the business model [28].

To receive a more detailed plan of the business model, Osterwalder split the four pillars into nine interrelated business model elements which make up the core of the Business Model Ontology. Figure 6.1 illustrates the Business Model structure and how the four main pillars, and the nine elements relate to each other. Every element can be decomposed into a set of defined sub-elements, which allow us to study the business model on different levels of granularity. Each pillar will be described by an illustration which shows how elements are decomposed into sub-elements and how elements related to each other within each pillar and with the elements of other pillars.

## 6.2 The Product pillar

New technology and rapidly changing markets are reasons why companies increasingly organize in networks and offer bundles of products and services. Product innovation has had a major impact on the separation of physical goods and information. The product pillar covers all aspects of what a firm offers its customers and it is composed of the Value Proposition element which can be decomposed



into a set of Offering(s). Figure 6.2 illustrate the relationship between the VP and its sub-set of Offering(s) and how the VP is related to elements of other pillars.[28]

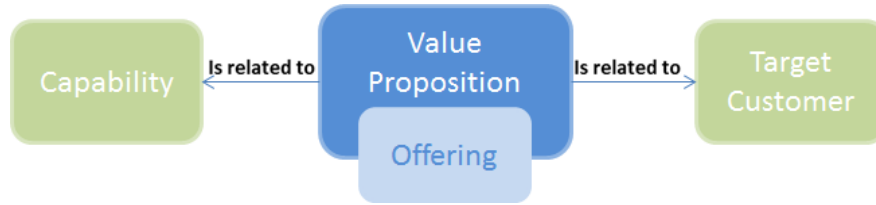


Figure 6.2: The product pillar

A **Value Proposition** of a service seeks to solve customer problems or satisfy new, hidden or unknown customer needs, and is the reason why customers choose a company over another. Each customer segment, and each product or service can have different value propositions. For example, a pharmaceutical company creates value for doctors, patients, and insurances, but they are all different propositions. An Offering is characterized by its attributes; *Description*, *Reasoning*, *Value level*, *Price level* and *Life cycle*. An element should be studied over its entire life cycle in order to find out what phase it creates value in[28, 29].

The *Reasoning* attribute describes why and how a firm thinks its Value Proposition or Offering will create value or satisfy a certain need for a target customer. Added value is described through the attributes[28].:

**{use}**: through the use of a certain product or service.

**{risk}**: the reduction of risk when using the product.

**{effort}**: making a customers life easier through a reduction in {effort} by using the product or service

The *Value level* attribute allows the company to compare itself to its competitors by measuring the value level of a company's offer. Value is measured as [28]:

**{me-too}**: a product or service does not differentiate itself from its competitors.

**{innovative imitation}**: a company imitates an existing product or service and adds innovative features.

**{excellence}**: value is pushed to its extremes and comes with a hefty fee.

**{innovation}**: a company introduces a completely new product or service or a revolutionary combination.

The *Price level* attribute compares the value proposition's price level with the one of its competitors. Price level is distinguished by [28]:

**{free}**: some companies offer a value proposition to a customer without asking for financial compensation, e.g. when the business model is based on income from advertising.

**{economy}**: the low-end of the price scale where the company can offer a more attractive price than the one of the bulk of its competitors, streamlining other elements of its business model.

**{market}**: pricing at little demarcation from the rest of the market, attractive when a product or service signal additional value.

**{high-end}**: upper boundary of the price scale, in which often involve luxury goods, or new and innovative value proposition that allow charging a premium.

The *Life cycle* attribute has the goal of capturing in what stage of an Offerings life cycle it creates value. The five stages are [28]:

**{value creation}**: e.g. customization, customer receives something special or unique.

**{value purchase}**: e.g. Amazon's one-click shop, where process is smooth and streamlined.

**{value use}**: e.g. maximized when use match the customer needs.

**{value transfer}**: e.g. user loses interest in the product and gets help with transferring to someone else.

## 6.3 The Customer Interface pillar

The Customer Interface describes *how* and to *whom* a company delivers its Value Proposition. The relationship with customers is essential for companies and this pillar helps a company identify and cover all customer related aspects, it is illustrated in figure 6.3. It describes who are the most important customers, how the company reach their customer and what kind of relationship they want to establish with their customers.

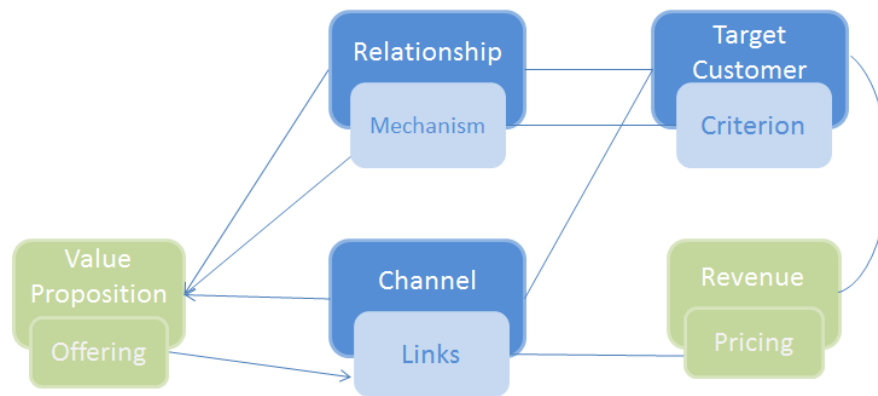


Figure 6.3: The Customer Interface pillar

The **Target customer** is the heart of a business model and is who the company creates the product for. A company needs to thoroughly identify who their target customers are, in order to best create a VP that will satisfy certain needs. TC had sub-element Criterion(s) which defines the characteristics of a customer[28, 29].

The **Channel** element describes how a company gets in touch with its customers, and channels are the connection between a Value Proposition and a Target Customer. The identification and description of the Target Customer may indicate through which channels they can reach potential customers. For example, the computer manufacturer HP mostly sells its products through third-party vendors, while Dell focus on selling through direct channels, through the Internet. Certain market tasks can be identified through Links, and a channel should be studied through its entire buying cycle. The attribute *Customer Buying Cycle*, CBC identifies what function the customers buying cycle a Channel Link fulfills. Nokia, the cell phone manufacturer, has the national cell phone network operators as their primary channel, but other channels such as Nokia.com, Club Nokia, or Nokia Academy are all part of fulfilling different aspects of the CBC. The Cus-

customer Buying Cycle is divided into four phases; the customer's *awareness*, the *evaluation* of the customer's needs, the moment of *purchase*, and the *after sales*, it is best illustrated in figure 6.4 [28].

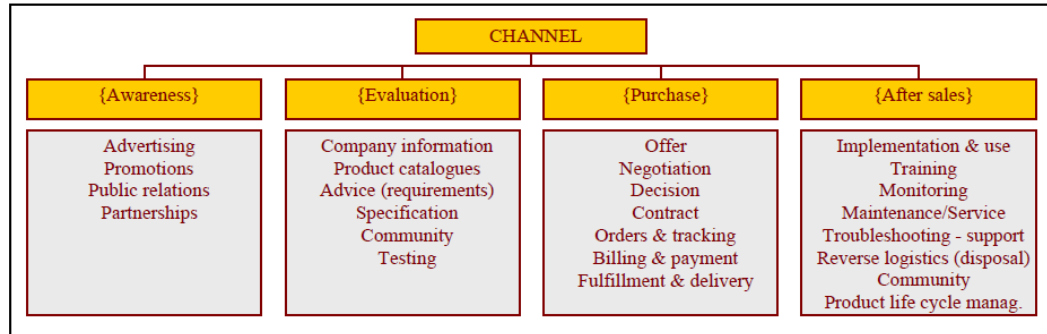


Figure 6.4: Customer Buying Cycle [28]

The **Relationship** a company builds with its customers is described by the Relationship element. The Relationship a company establishes with a target customer segment is based on equity. A company should clarify the type of relationship it wants to establish with each customer. The company can analyze who are worth spending retention effort on, if they are subject to add-on selling and who are most profitable. {Acquisition}, {Retention}, and {Add-on selling} are all part of the relationship attribute *Customer Equity*[28, 29].

## 6.4 The Infrastructure Management pillar

The Infrastructure Management specifies the capabilities and resources found in the business model, the relationship among these elements are illustrated in figure 6.5. It specifies owners, providers and who executes what activities. The company abilities and key resources necessary to provide a VP to a customer must be identified. The Value configuration of the company consists of activities to create and deliver value, their relationship between the activities and the Capabilities and Resources found in the business model. Capabilities and Resources can be acquired in-house or through the firm's Partnership network. A company can enter Partnerships with hardware suppliers, software developers etc[28].

**Resource** is a sub-element of Capability and can be classified through the attribute *Resource type* and distinguishes between {tangible} and {intangible} assets as well as {human} or people-based skills. Examples of tangible assets are

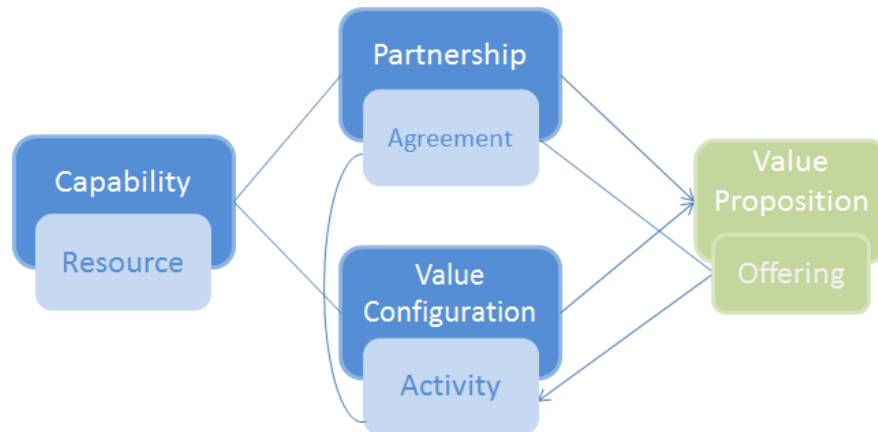


Figure 6.5: The Infrastructure Management pillar

plants, equipment, and cash reserves. Intangible assets are patents, copyrights, reputation, brands and trade secrets. In order for the firm to create value with its assets, human resource are needed, and are based on peoples skills. The company will enter a Partnership and sign an Agreement to provide a specific business service, which can not be found in-house. An Actor is an outside organization that can be involved in the business model through a Partnership[28].

The Value configuration element relies on the Capabilities and Resources in the business model, and describes the arrangement of one or several Activities needed to provide the Value Proposition. To define the value creation process and the main activities Osterwalder makes use of Porters Value Chain framework[32] and its extension of Value Network and Value Shop defined by Stabell and Fjelstad in [43].

*The Value Chain* can be viewed as the transformation of inputs into products and the method identifies and analyze the main activities important to a company in order to create value. The activities that are vital to a given company is industry dependent, but the primary activity categories are inbound logistics, operations, outbound logistics, marketing and service. *The Value Chain* model applies well to companies in the manufacturing and distribution industry, e.g. an assembly line is designed to produce standard products at low cost per unit.[28, 32]

*The Value Shop* are resolving customer problems and concentrates on discovering what the clients wants. The company delivers a customized product or ser-

vice. The primary activities are problem-finding and acquisition, problem-solving, choice, execution, and control/evaluation.[28, 43] *The Value Shop* applies well to most 'body shop' organizations, companies directed at a unique and delineated class of problems, such as building contractors, consultancies, legal firms, and organizations whose primary purpose is to find new market opportunities to exploit. For example developing a new drug or designing new technology.

*The Value Network* creates value by linking customers together. The firm itself is not a network, but it provides a networking service and act as an intermediary such as a broker, or a market maker. The primary activities are network promotion and contract management, service provisioning, and infrastructure operation. The Value Network model applies well to telecommunication companies linking their customers together, as well as banking and insurance companies[28, 32, 43].

A **Partnership** is a voluntary initiated cooperative agreement between two or more companies established in order to create value for a customer through the Value Proposition, and it concerns a Value configuration.

## 6.5 The Financial Aspects pillar

The Financial aspects of a business model is influenced by the other pillars and elements illustrated in figure 6.6. It is composed of the company's Revenue model and the Cost structure.

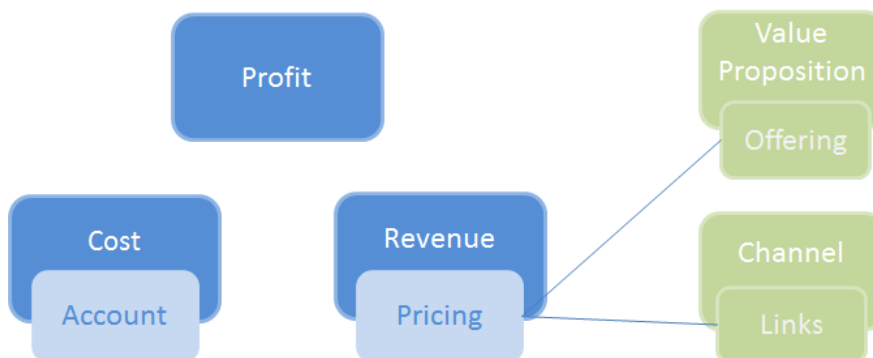


Figure 6.6: The financial aspects pillar

The **Revenue model** element describes the way a company makes money through a variety of revenue flows and depends on the firm's Value Proposition. The revenue model can be decomposed into different pricing mechanisms. A firm may have one or several different revenue streams, each associated with different pricing mechanisms. ICT has been part of helping companies diversifying their revenue streams and improve revenue maximization. In addition, the Internet has had an impact on pricing mechanisms, as it has made it easy to compare prices on web sites, which may help the customers getting the best possible price. Pricing is characterized by *Stream type* and *Pricing method*[28].

**Stream-type** consists of {selling}; giving away a good or service in exchange for money, {lending}; the object lent generates an income while it is given away, but cannot generate more money while it is away, {licensing}; giving someone official permission to do or have something in exchange for a licensing fee, {transaction cut}; the fee that is paid to the party that has organized or performed the deal, and {advertising}; to tell something publicly through media as to influence the choice or behavior to a target audience.

**Pricing Method** range from {fixed pricing}; price do not differentiate in function of customer characteristics, {differential}; prices that differentiate according to product or customer characteristics, and {market}; dynamic prices that change based on real-time market conditions. Pricing of the service in the Revenue model are based on what the company thinks the customer is willing to pay. If the product or service is a substitute, it should offer a better price than the existing product

The **Cost structure** is the representation in monetary value of all the means found in the business model. The Cost element is decomposed into Account(s) with description of what costs are associated with the business. The costs are distinguished between direct costs and indirect costs. The direct costs are cost associated with starting up a business and indirect costs are cost associated with running the business. An account is described by four attributes: {name}, {description}, {sum}; the monetary value of an account, and {percentage}; how much the account contributes to the total Cost structure.[28, 29].

At last the company can calculate their **Profit**. The profit results from subtracting the cost from the revenue, and is used to evaluate if a business is worth

starting up, and an indicator to when and how much profit it is possible to produce. Financial analysis should be conducted to evaluate the potential of a business model.[28]

## 6.6 Summary

The framework of Alexander Osterwalder is a collection of several business and strategy models, developed to best create a business model ontology to serve the world of online markets. The framework is used to create a business model for a virtual store utilizing DMP, and is presented in the next chapter.



# Chapter 7

## Business Model for The Virtual Store

Theory presented in the previous chapter is adopted to develop a business model for 'The Virtual Store'. A business model describes the rationale of how an organization or firm creates, delivers, and captures value. 'Business Model Canvas' in Business Model Generation[29] by A. Osterwalder and Yves Pigneur is a helpful tool to identify different elements.

The company developing 'The Virtual Store' service has experience with the DMP network and has innovative ideas on how to utilize Collaboration technology for a futuristic shopping solution. The service is targeted to clients in the apparel industry who want to utilize it as a part of their business and interaction with the end-customers.

### 7.1 Actors

Several actors take part in a business model. They are needed to structure how value is created. The actors of the business model for 'The Virtual Store' are identified as:

- **The Company developing 'The Virtual Store'** are the owner of the product. They are developer and entrepreneurs and have experience with the DMP network and establishment of collaboration spaces. The company is the main actor of the business model and whom the business model is developed for.
- **The Network Provider.** DMP and the Collaboration Space hosting 'The Virtual Store' have high requirements for quality and control in the network which can be handled by a partnering network provider. 'The virtual store' implemented with DMP might open up a new market for network providers due to requirements in the DMP network. DMP guarantees quality and control, security, and a guaranteed maximum delay, which needs to be controlled and handled by a network provider.
- **The Hardware supplier.** The collaboration space of DMP has a set of requirements to equipment etc. the company can partner with a hardware supplier to get specialized equipment and a possible reduction in price. who supply the system with infrastructure of the network, cameras and screens for the collaboration spaces and user equipment.
- **The Target Clothing Store.** The apparel chain buying the service can offer added value to its end-customers and reduce cost associated with running a regular store e.g. H&M, BikBok. They may want new ways of interacting with their consumers.

## 7.2 Product

### 7.2.1 Value Proposition

The idea of the service, 'The Virtual Store' was presented in chapter 5 and is a merging of a physical store and electronic commerce, merging the social value of actually going into a store with the availability and convenience of the web shop. The Value proposition of the virtual store, is a bundle of services described by two Offerings. The Offerings illustrate the different features of the service, and identify how it is assumed to create value for the target customers.

The Value Proposition of 'The Virtual Store' is to provide clients in the apparel

industry with a solution where they can offer an enhanced shopping experience in a 'near-natural' virtual store to their consumers. The solution is an innovative and futuristic approach to attract consumers to the client stores and a way in which clients may reduce their costs. The Service of 'The Virtual Store' offered to target customers will be customized for each customer. The offerings of 'The Virtual Store' are each described in tables 7.1 and 7.2, and together they form the Value proposition to the Target customers.

<b>Offering - Short-term leasing: Marketing service</b>	
<i>Attribute</i>	<i>Description</i>
<i>Description</i>	Short term leasing of 'The Virtual Store' can be part of a clothing chain wanting to raise awareness and interest for the store chain (e.g. general branding), release of a new collection, or a new store profile. It can be used in marketing campaigns to raise awareness and attract attention and increase traffic to the store, and possibly attract new customers.
<i>Reasoning</i>	{use} This offering creates value for the customer through the use of 'The Virtual Store'. A clothing store utilizing a virtual store for a marketing campaign can increase the interest and attention for a store, attract new users or increase sales because end-customers want to try something fun and futuristic. A Virtual Store related to marketing, is new and will provide attention and curious consumers to the store. It can develop to a 'buzz' on social media or blogs, which result in free advertising and interest to their company.
<i>Value Level</i>	{Innovation } is characterizing this offering because it is has innovative elements.
<i>Price Level</i>	{Market} should be the price level. Some simpler versions exist and have been used in marketing campaigns (e.g. Wollworths of Australia(cite)). The cost of this service does not allow us to put a low price.
<i>Life Cycle</i>	{Value use} Value is created to the customer through the use of this service. When the service of 'The Virtual store' is put in effect, value is created for the customer by people visiting the store and showing interest to their e.g. marketing campaign. The attention created through the use of The Virtual Store Short-term service can lead to more sales, attention in media and even more visits to their websites.

Table 7.1: Offering of the value proposition - Short-term Marketing service

<b>Offering - Long-term leasing: Substitute store service</b>	
<i>Attribute</i>	<i>Description</i>
<i>Description</i>	Long-term leasing of 'The Virtual Store' can reduce cost of running a clothing store by substituting it with a virtual store. The Virtual Store can provide the customer with a green profile as futuristic and environmental friendly company. In addition they can attract more customers because the service can enhance the user experience through the near natural virtual reality that 'The Virtual Store' provides. The end-customer will experience an easier way of shopping by virtually trying on clothes and viewing items in 3D in a near natural way. The utilization of a virtual store can provide security (e-commerce). The customer can be sure to be shopping with a trustworthy vendor, through the use of the DMP network, which authenticates all entities who wants collaborate in the network. With reduction in cost of running a brick-and-mortar store, the clothing stores may reduce price on items sold, attracting more end-customers and generating more revenue by increased sales. Retailers who can offer a wider variety of products attract more end-customers.
<i>Reasoning</i>	{use}, {effort}. The offering creates value to the customer through the use of this service. The customer who leases utilizes the service can attract more end-customers who wants to save time with shopping, needs help with fitting, or in general have been skeptical to e-commerce for security reasons. The customer can promote the virtual store as a futuristic and environmental friendly approach to shopping and attract curious and environmentally concerned customers. The store chain can reduce store clerks through use of 'The Virtual Store', and may save time on un-packing of delivered goods to the store, resulting in effort reduction.
<i>Value Level</i>	{Innovation}: It is a revolutionary combination of the virtual store (e.g. grocery stores) we have witnessed and the 'virtual fitting rooms' found (e.g. hurley.com).
<i>Price Level</i>	{Market}: The service offers an new and innovative solution that will give additional value to a company and the cost of this service does not allow for a lower pricing.
<i>Life Cycle</i>	{Value use}: This service creates value to the customer when it is in use, and possibly creates additional value for their company when offering the service through increased sale and attention.

Table 7.2: Offering of the value proposition - Long-term leasing

## 7.3 Customer Interface

The Customer Interface covers all customer related aspects. The company need to identify who the target customers are, how to attract and get in touch with them as well as establish a relationship.[28]

### 7.3.1 Target Customer

When the Target customers are identified, one can define through which channels one may reach those customers. In the case of 'The Virtual Store' the target customers will be apparel chain stores, or independent store owners, which relates the type *B2C - Business to Consumer*. The Target customer is decomposed into a set of characterizations called Criterion listed below. They belong to the same segment, but they have different needs to be satisfied by the Value Proposition and its Offerings.

#### Target Customer - decomposed into Criterion:

**Clothing chain store:** Chain stores can be interested in reducing cost or have alternative ways of marketing and attracting new customers. The need to reduce cost can be satisfied by substituting one of several traditional stores with a virtual store, and the alternative way of marketing can be met by leasing a virtual store for a few months marketing campaign, through a futuristic solution, show casing how the customers can shop in the future. Potential customers: H&M, Cubus, BikBok etc.

**Independent Apparel store:** Independent run clothing stores which are looking for ways to reduce cost, reducing cost by only having items kept in storage and represented virtually in the store. A store owner who does not have sufficient capital to run a brick-and-mortar store. e.g. independent private owned store

**Clothing web site:** Website who are basing their business on website shopping, collecting all brands in one place, price comparing etc. The business may

want grow bigger and attract a different customer segment, for example people who are not familiar with shopping online. Potential customer: amazon.com who serve several brands such as levi's, calvin klein, hurley, may want to attract consumers who are unfamiliar with e-commerce through a more visible store.

### 7.3.2 Channel

The channel element is the connection between the Value proposition and the Target customer. The Customer Buying Cycle identifies what function in the customers buying cycle a channel Link fulfills. The company wants to introduce the customer into the first cycle again when finishing the last cycle. 'The Virtual Store' needs to create value to the customer through purchase, after sales or evaluation. A customer might be aware of a new product called 'The Virtual Store', but not be sure of what it is and how it works, the company needs to inform the potential customer. The customer can then evaluate the service by visiting the store's informational web site or visit the store.

Customer retention is important and customer acquisition are expensive, the company needs to spend time on retain the customer they have acquired for example through the after-sales cycle. Figure 7.1 illustrate and identify tasks the company should fulfill for the customer.

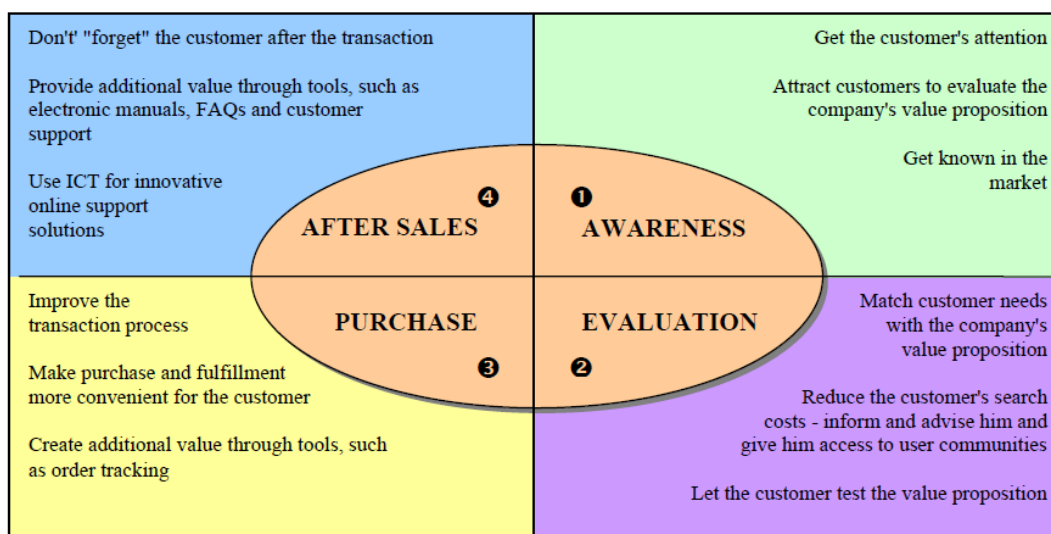


Figure 7.1: Customer Buying Cycle [28]

Channels where the 'The Virtual Store' company should be visible and promote their product are defined, the phase of the Customer Buying Cycle is also identified:

- **Fashion & Retail Exhibitions:** Where people in the clothing and retail industry can be introduced to the concept find interest in new and innovative approaches. Representatives of the target customer may be at the event and introduce it to their teams. **CBC:** *{Awareness}- Get known in the market*
- **Ads on web sites:** Ads on web sites can attract new customers and direct them to the official website where they can learn more about the service. **CBC:** *{Awareness}- Get known in the market and attention from customers.*
- **Ads in magazines:** Ads in branch magazines possibly read by the target customers can attract new and interested customers. **CBC:** *{Awareness}- Customer attention and to get known in the market.*
- **Company website:** Describes the concept of 'The Virtual Store', how the shopping experience works, and lists locations where it is possible to lease a virtual store. Potential customers can view a demo video to understand the concept and how it can create value. **CBC:** *{Evaluation}- Match customer needs, reduce search cost and customers evaluate the solution by watching a demo.*
- **User profile on web site:** Client can monitor its sale statistics and customer feedback and in that way be motivated to open up more virtual stores on other locations or extend their leasing period. **CBC:** *{After-sales} - Use ICT for innovative support, provide additional value through customer profiles with statistics on sales etc, new functionality can be designed after evaluation and feedback from customer.*
- **Promotional Videos:** Videos demonstrating how the process of shopping in the virtual store can be placed on social media e.g. youtube.com and other hubs for advertising  
**CBC:** *{Awareness & Evaluation} - Attract customer attention and get customers to evaluate the value proposition .*

- **Direct Contact:** Contact directly with a clothing chain. Explain marketing value and provide studies or evaluation by other customers. **CBC:** {*Awareness*} - *Get known in the market and get the customers attention.*

### 7.3.3 Relationship

'The Virtual Store' company depend on people wanting to continue using their service in order to have a continuous revenue stream. The Acquisition phase is costly, when customers are acquired they must get the feeling that they want to continue using this service instead of trying a competitive solution. Acquisition cost more than retention, but the company must choose retention strategy wisely. Customers evaluate their expectations versus delivered quality, customer service, the quality of the product, and the ease of service, and will affect the retention decision[28]. The Relationships are classified according to their *Customer Equity Goals* which are {*Acquisition*},{*Retention*}, and {*Add-on Selling*}. The company's relationships with the target customers are described below.

#### Apparel Chain Store

- *Acquisition:* Build a valuable relationship with a major chain store may lead to new acquisition of several stores which are part of the chain on other locations. It is important that the company spends time on establishing a good relationship and introduce the customers with a reduction if they start up with the long term leasing etc.
- *Retention:* Follow-up customers with sales data, or marketing analysis about the store and position in the market after the use of their service.
- *Add-on Selling:* Focus on a strategy of how they can get the most out of their service and create additional value to the customer, by developing additional features that can work in parallel with the Value Proposition (e.g. smart phone application).

#### Independent Store

- *Acquisition:* The strategy of acquiring this type of customer must be



to introduce them into an easier way of running a store, where you save time and costs.

- *Retention:* An independent store owner are likely to be concerned with costs, and they can be offered a discount depending on their leasing period.
- *Add-on Selling:* If the customer is satisfied with the service, the DMP team can develop new features that can be sold. Application for smart phones and additional features.

#### **Apparel & Accessories web site promoting various brands**

- *Acquisition:* Through adds on websites and demonstration video of the avatar service. Introduce the customer to how to receive more attention to the store by being visible to people unfamiliar with e-commerce.
- *Retention:* The popularity and marketing value as well as satisfied customers. Provide customers with statistics of sales.
- *Add-on Selling:* Develop additional features.

## 7.4 Infrastructure Management

In order to put the idea of 'The Virtual Store' into life, Resources and Capabilities need to be structured. This pillar specifies the capabilities and resources found in the business model, and present owners and providers as well as identifying who executes what tasks, and is about how 'The Virtual Store' and the company can turn value out of their product.

### 7.4.1 Capability

The Capabilities depend on assets and resources of the firm. A Capability or its sub-element Resource can be acquired in-house or through a Partnership. Resources for 'The Virtual Store' are classified by its *Resource-type* which can be tangible or intangible as well as a people-based skill, presented in table 7.3.

Capability - decomposed into Resource(s)		
<i>Resource</i>	<i>Resource-type</i>	<i>Acquired through</i>
Cameras	{Tangible}	Partnership with hw-supplier
Projectors	{Tangible}	Partnership with hw-supplier
Collaboration Surface	{Tangible}	Partnership with hw-supplier
Servers	{Tangible}	Partnership with hw-supplier
Other equipment	{Tangible}	Partnership with hw-supplier
Standard for 'The Virtual Store' Software	{Intangible}	In-house
Software developers	{Human}	In-house
Administrative personnel	{Human}	In-house
Marketing and sale	{Human}	In-house
Store space	{Tangible}	Partnership with room-supplier
Network access	{Tangible}	Partnership with network provider
Office space	{Tangible}	Partnership with room-supplier
Reputation	{Intangible}	In-house

Table 7.3: Classifying Resources by its attribute *Resource-type*

### 7.4.2 Value Configuration

The Value configuration makes the Value proposition possible and describes the main Activities of the company and how these relate to each other. A Value configuration is explained by its attribute *Configuration-type* and are distinguished

by {Value chain}, {Value network}, and {Value shop}.

A company can have configurations consistent with all three *Configuration-types*, but there is usually one value configuration that dominates. According to Stabell and Fjeldstad[43]: Important functions performed by the company can have a value creation logic best understood as a value shop, even though the primary activities of the overall firm have a value creation logic that is consistent with the product and transformational logic of the value chain.

In the case of the product 'The virtual store' {Value Shop} is the dominating value configuration, because it is a customized service for a customer, even though many of the primary activities performed by the company apply to the value chain model (e.g. software development, marketing, maintenance etc.). The company can be viewed as a consultancy firm providing specialized services for the customer, in which the customer can create more value and reduce costs. While the value chain performs a fixed set of activities that enables it to produce a standard product in large numbers, the shop schedules activities and applies resources in a fashion that is dimensioned and appropriate to the needs of the client's problem[43]. There are five categories of primary activities for the value shop; *problem-finding and acquisition, problem-solving, choice, execution, and control and evaluation*. Problem-finding and acquisition have much in common with marketing of the value chain. The client owns the problem, here they want to provide customers with a customized virtual store to add additional value. Human Resource management are support activities and are co-performed with the primary activities. These functions are crucial to competitive advantage.

'The Virtual Store' service is a standard application or service created by the company. When a customer leases the service of 'The Virtual Store' it is customized to that customer, with their profile and products etc. The value chain is present in the first phase of the company. It starts with a company idea of a 'new way of shopping', resulting in a description and design of a system as input. Further, software for the system is developed and implemented, resulting in the Value Proposition 'The Virtual Store'. When the value proposition is ready, the value shop configuration starts by marketing its proposition, finding customers, customizing the proposition to a customer before executing the solution for an agreed time. After the leasing period is over, the customer evaluates the solution and gives feedback to the company who can improve the solution or add new functionality. The evaluation is fed back into the value shop, and a new leasing cycle can start over. [43].

'The Virtual Store' service is not sold as a shelf service, and needs to be customized for each customer with product databases, store profiles to be displayed inside the Collaboration Space etc. which resembles a Value Shop with its intensive problem solving technology. The main activities of the company are performed here, and a list is presented in table 7.4.

After the first phase of developing the Value Proposition is completed, the activities of the value shop begins. To attract customers, the activity of marketing and advertising is performed. Through successful marketing, customers will show interest to the Value proposition and lease the service. When an agreement of leasing is made, the company will customize the Value proposition to that particular customer. These are primary activities which result in an increase in revenue. Support activities are performed by the company to withhold the quality of the product and have the company operating. These activities are updating the software for Value Proposition, hardware maintenance on 'The Virtual Store' equipment and collaboration space. Administrative tasks needs to be performed to keep the company in operation. Evaluation and feedback from customers can help the company improve, through suggestions of improvements or wanted functionality. The activities performed in the Value Shop are illustrated in figure 7.2

<b>Activities</b>	
<i>Activity</i>	<i>Level</i>
Marketing & sale	Primary
Customize solution	Primary
Software update	Support
Standby support	Primary
Hardware maintenance	Support
Administrative task	Support
Evaluation & feedback	Primary
Partnership	Support

Table 7.4: Main activities performed in the company

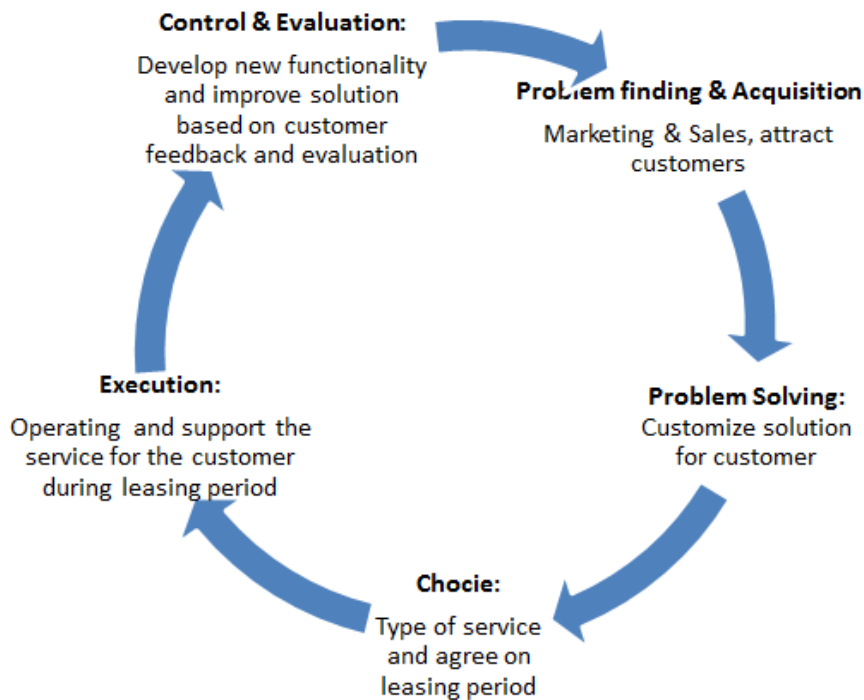


Figure 7.2: Activities performed in a Value Shop [43]

### 7.4.3 Partnership

The company can enter a partnership with other actors to share cost and risk as well as generating a competitive advantage. Partners sign an agreement. Partners of the company are:

**Network Provider** 'The Virtual Store' service are dependent on reliability and control in the network in terms of guaranteed quality, minimum delay and security control. The company can sign an agreement with a network provider to ensure high stable bandwidth and reliability, due to the high requirements in DMP. An agreement may open up new potential for value creation for the network provider, who can differentiate pricing according to quality and control agreements. The potential for the network provider will be discussed later.

**Hardware Supplier** 'The Virtual Store' and the Collaboration Space requires specialized hardware. A partnership may give the company an opportunity to receive customized equipment, creating value for both the hardware supplier and the company.

**Room owner** The company need to lease rooms to host the Collaboration Space and 'The Virtual Store', the rooms should be leased for an annual period and a fixed price can be bargained if the company are signing an agreement for a number of rooms. The room supplier will then be ensured income for a number of rooms for a set period of time.

## 7.5 Financial Aspect

'The Virtual Store' is considered a customized service, sold as a whole package to the customer. The revenue of the virtual store is based on estimates of what a target customer would be willing to pay for such a service. The estimate is based on what value 'The Virtual Store' as a product creates for its customers. The cost structure is associated with what it will cost the firm to establish their service 'The Virtual Store'. There are costs that are direct costs associated with setting up the virtual store and annual payments associated with running the store. These costs are present regardless of vacancy.

### 7.5.1 Revenue Model

The company needs to look at the different offerings provided by the value proposition and how they can create a revenue stream. In the virtual store its main revenue will be from leasing the service to their customer. It needs to be a fixed price and cover the cost the company have for running the store, and cover costs of setting it up. However, the revenue model is an estimate on what a customer is willing to pay. Revenue stream and Pricing sub-elements describes the incoming money stream for the value offered by the company.

The *Stream type* is {lending}, the activity of giving something away expecting to receiving it back after an agreed period of time. The company generates income from lending and the pricing is characterized by the *Pricing Method*. The *Pricing Method* is {differential} because it will depend on customer characterization and preferences in addition to type of offering they decide on lending, offering 1 - the Long-term service or offering 2 - the Short-term service. Customers are presented to different prices according to what type of service they will be leasing.

Leasing over a short-time period should have a higher first monthly cost than when contract for a longer period is signed. The company can consider price reduction or a buy more get more discount type of deal, where the company is assured sales over a long period of time. Prices may be negotiated and may result in partnership where the customer invest in the company in return of innovating new features etc.

### Price of services

What are the value for the customer and what are they willing to pay for such a service? It is difficult to predict what a target customer would be willing to pay, and certain assumptions are made to be able to estimate the price accepted by a target customer. Estimations have been used for what it costs to run an average size traditional brick-and-mortar store. Estimations are based on rent costs, operational costs and staff salary[37, 35, 4]. For a customer to be interested in the service, they need to see numbers on how much money they can save in comparison to running a regular store, with more staff etc. A target customer wanting to substitute a store is interested in the service if it reduces cost. The various prices for the two services are presented in table 7.5

- **Long term - substitute for the regular store:** The price of the leasing of a virtual store should be less than the price of running a regular store which requires more staff to handle transactions, unpacking delivery of clothing and tidy the store. Based on numbers estimated to run an average size store it would be reasonable to propose a price per month of the service to be 200 000 NOK. One can operate with three different prices, high, medium and low, which respectively will be 225 000, 200 000, and 175 000. Prices are in NOK per month and without VAT.
- **Short term - marketing service:** Marketing vary a lot from company to company, ranging from 10 000 to 1 000 000 NOK monthly. Using the virtual store for marketing may create a wow effect and attract more customers to check out their website etc. Since this service is meant for a shorter leasing period, the monthly price has to be larger than the monthly price for long term leasing in order to guarantee a stable income flow for the company, and a reasonable price for such a service should be high = 325 000 NOK,

medium = 300 000 NOK, and low = 275 000 NOK, prices are estimated without VAT.

	Price of Service	
	<i>Long-term</i>	<i>Short-term</i>
High	225 000	325 000
Medium	200 000	300 000
Low	175 000	275 000

Table 7.5: Price of 'The Virtual Store' services

## 7.5.2 Cost Structure

Costs structure can be differentiated by two categories, direct costs- associated with the costs that are one-time payments for setting up the store and indirect costs associated with running the store. The Cost element is decomposed into Account sub-elements. Costs for equipment for the virtual store are based on specification on equipment presented in the case study of the virtual store in chapter 5. It is assumed that SOTA technology have the same cost today, as state-of-the-art in five years, hence products and cost analysis will be based on prices of today.

### Equipment cost

The cost for setting up one virtual store is based on requirements to the DMP Collaboration Space, and the equipment presented in table 7.6 is estimated for three collaboration surfaces in one collaboration space, which constitutes one virtual store. The total cost of equipment is estimated to be 681 000 NOK and it is a one-time expense.

### Hardware maintenance and replacement

This type of equipment usually has a five years lifespan, the straight line depreciation rate equals to 20% per year (100%/5yrs)[50]. Depreciating cost is calculated as 20% of the total cost of equipment and will be an annual cost instead of assuming that the equipment value is zero after a five year period.



<b>EQUIPMENT cost</b>	
<i>Item</i>	<i>Price</i>
Stewart AeroView screen:	60 000 NOK
Pico projektor:	151 000 NOK
Camera equipment:	75 000 NOK
Codecs:	350 000NOK
High performing PC:	25 000 NOK
Miscellaneous:	20 000 NOK
<b>Total:</b>	<b>681 000 NOK</b>

Table 7.6: Equipment needed for the collaboration space/the virtual store [40]

### Network access

The virtual store is dependent on a high bandwidth and Telenor's fiber solution with bandwidth up to 1000Mbit/s is a decent state-of-the-art solution[45]. The set up is a one-time expense of 17 500NOK and the annual cost is 470 400 NOK[46].

### Software

Development of the specialized software needed in 'The Virtual Store'. The company of 'The virtual store' needs to develop software customized for the collaboration space and the virtual store. It is assumed that it will take 3 software developers one year to develop the software. An experienced software developer has an average annual salary of 450 000 NOK [24]. I have estimated the cost of an employee to 25% of yearly salary[35]. This accounts total cost is 1 687 500 NOK. This is a one-time expense for developing the software for the virtual store.

### Software customization & maintenance

The standard software for the virtual store needs to be customized for each customer. The team that developed the software share the tasks of customization, updating the software and develop new features. The team consist of three software developers and the annual cost is 1 687 500 NOK, annual salary plus a 25% expense of having employees.

### Administration & other staff

The administration consist of 4 people, the company chief, a secretary, a person in charge of sales and marketing and a operational support person. 'The Virtual Store' shall be easy to operate, but there should be one person stand-by for support if system problems arise. The leader has a modest salary in the start up phase 500 000 NOK, secretary 350 000NOK, marketing

and sales person 400 000 NOK, Support personnel 400 000NOK. Plus the cost of having employees the account adds up to 2 062 500 NOK, and it is an annual expense.

### **Room rent**

The company needs a physical store, preferably in the city center or at a mall. The estimated cost of renting a store space in Oslo would be 120,000 NOK annually, based on estimates from [37].

### **Office Space**

The company needs office space for their employees, and is where they run their business from. The annual cost for office space is estimated to be 800NOK per  $m^2$ , with a  $100m^2$  office the annual cost for the office is 80 000 NOK, estimates based on [37]. When starting up the company, all employees need office furniture, lap tops and other work related items. One-time expense of 100 000 NOK.

### **Marketing & sales**

The marketing budget is estimated to be 1 000 000 NOK when starting up the business and is a one-time expense. It will consist of making a demonstration video, traveling to exhibitions, having advertisement on web sites and creating their company website. After starting up the marketing budget is reduced to 500 000 NOK annually, and will be spent on advertisement, traveling to exhibitions and keeping the company website updated.

### **Value Added Tax**

25% VAT (Value Added Tax) need to be payed for sold products and services. The tax is calculated from revenue after cost is subtracted. For simplification reasons, tax is not calculated in the examples of calculation.

### **Half of Annual Cost**

When starting up a business, it needs to be running before revenue will be generated. An assumptions is made that the company will be running 6 months prior to the service is ready for leasing, and an estimation on cost is reasonable to be half on annual cost of running the business.

The total cost of starting up business and setting up one Collaboration Space to host 'The Virtual Store' is estimated to be 6 014 300 NOK and is a one-time expense shown in table 7.7.

<b>COSTS decomposed into ACCOUNT(s)</b>		
<i>Name</i>	<i>Description</i>	<i>Sum NOK</i>
Equipment	Equipment for the Collaboration Space hosting 'The virtual store'.	681 000
SW Development	Specialized software developed to run 'The Virtual Store' with DMP.	1 687 500
Network access	Network access establishment cost, high speed fiber.	17 500
Marketing budget	Marketing and sale expenses.	1 000 000
Office set-up	Establishment of an office for the company. Consists of office furniture, computers etc. for the employees.	100 000
Half of annual cost	The company needs to be running before the first service is sold.	2 528 300
<b>Total:</b>		<b>6 014 300</b>

Table 7.7: Direct costs associated with starting up business

Annual cost associated with running the business operating one virtual store is 5 056 600 NOK and is shown in table 7.8.

<b>COST - decomposed into ACCOUNT(s)</b>		
<i>Name</i>	<i>Description</i>	<i>Sum NOK</i>
Store rent	Annual rent for the room hosting 'The Virtual Store'.	120 000
SW developers	Salary for a team of three full-time employees.	1 687 500
Administration	Salary for administration staff. Company leader, handles sales together with a sales staff, secretary and one standby support person.	2 062 500
Network access	High-speed network access that meets the requirements of DMP. Partner agreement.	470 400
M & R cost	Instead of assuming zero value after five years maintenance and replacement of the equipment is 20% of total cost of equipment.	136 200
Office Space	Renting office space for the developer team and administrative staff.	80 000
Marketing task	Marketing budget for advertisement and traveling to exhibitions and fairs.	500 000
<b>Total:</b>		<b>5 056 600</b>

Table 7.8: Indirect Costs associated with running the business

The percentage distribution reveals that the largest account of the direct costs are associated with software development and the cost of running the business (half of annual cost). Indirect cost distribution also reveals that the largest accounts are salary to the employees of the company. The distribution is shown in figure 7.3

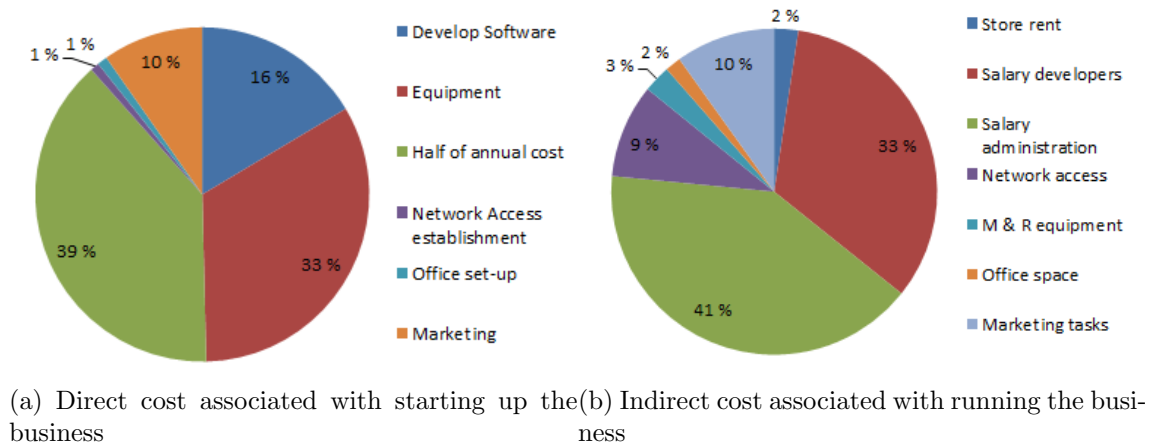


Figure 7.3: Percentage distribution of cost found in the business model

## 7.6 Financial Analysis

To evaluate the potential of the business model expected revenue and costs have been evaluated. A financial analysis can provide insight to what it will cost to start up the business, annual cost associated with running the business in addition to evaluate if the business model is profitable or not. Investors would also like to know if their money are secure, and what returns they can expect and at what rate.

### 7.6.1 Revenue generated from the Long-term leasing service

The long-term leasing service can act as a substitute for a store. To calculate the revenue, we can operate with three different prices, high, medium and low. A calculation of expected revenue operating one virtual store is shown in table 7.9. The long-term leasing service is based on annual contracts with customers.

It is therefore reasonable to assume that the store will suffer no vacancy through a year in the case of long-term contract.

<b>Annual revenue</b>		
	<i>Price/month</i>	<i>Revenue</i>
High	225 000	2 700 000
Medium	200 000	2 400 000
Low	175 000	2 100 000

Table 7.9: Annual revenue of Long-term service with high, medium, and low pricing

From table 7.9 it is evident that the company need more than one store when they start up the business. The investment cost will increase, but overall the investment cost per store will decrease with the number of established stores. Assumptions are made for how the two services, Long-term and Short-term, will be distributed among the stores when number of stores increases. The distribution are shown in table 7.10.

<b>Service distribution among stores</b>		
<i>Stores</i>	<i>Long-term</i>	<i>Short-term</i>
1	1	
2	2	
3	2	1
4	3	1
5	3	2

Table 7.10: Distribution of service based on number of virtual stores

Figure 7.4 shows how the annual revenue increases in comparison to the annual cost of running the stores. The revenue is estimated with stores being reserved for a certain service, distributed according to assumptions made in table 7.10. From these calculations the company should at least start up with five stores.

### 7.6.2 Example calculation

An example calculation is performed to let us investigate cash flow and ROI factors, and to be able to evaluate the profitability of the service. Some assumptions are made to perform the calculation. The company starts up with five virtual

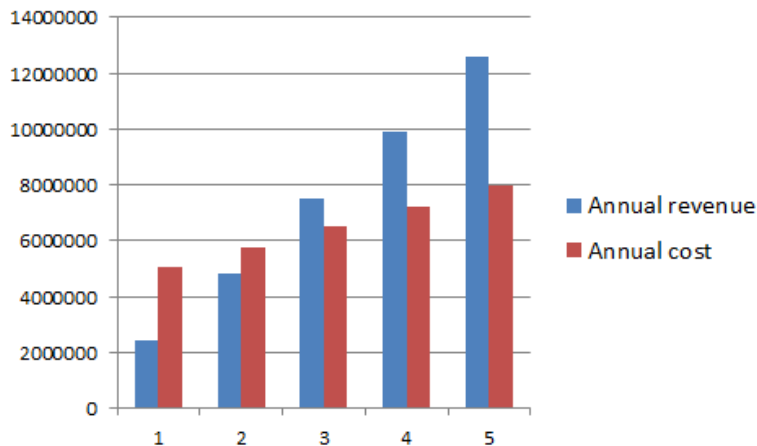


Figure 7.4: Revenue and Cost associated with number of stores

stores, where service is distributed as presented in table 7.10. Revenue is calculated with medium pricing strategy for both services and it is assumed that only Short-term service suffers vacancy of six months annually (e.g. three months per store reserved for the Short-term service). Long-term service is based on annual leasing and it is reasonable to assume that there will be no vacancy. VAT are left out of the calculation for simplicity. The costs are distinguished between investment costs needed to start up the business, and the annual costs needed to run the business. The Investment cost result in 10 261 500 NOK for five Virtual Stores and is shown in table 7.11. The distribution of cost is illustrated in figure 7.5.

<b>Investment Cost</b>	
<i>Account</i>	<i>Sum NOK</i>
Office set-up:	100 000
Develop Software:	1 687 500
Equipment*5:	3 405 000
Nw access est.:	87 500
Half of annual cost:	3 981 500
Marketing:	1 000 000
<b>Total:</b>	<b>10 261 500</b>

Table 7.11: Investment cost of The Virtual Store

Revenue are based on income from both services, according to the assumed distribution of service among stores. If the company starts up with five stores, it is assumed that two stores should be reserved for marketing purposes. Three stores are available to rent out on a yearly basis. The price of the service and

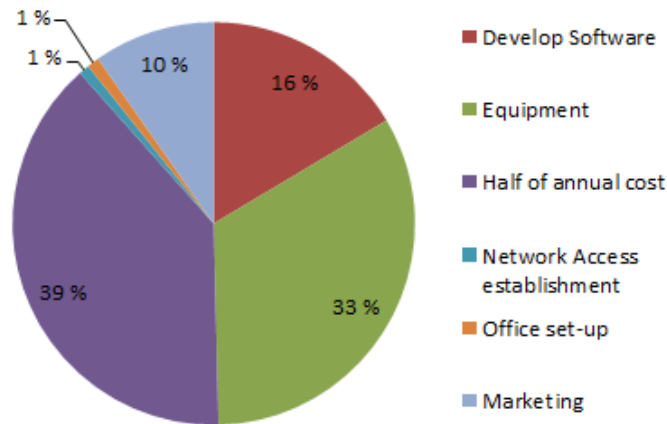


Figure 7.5: Percentage distribution of investment cost associated with starting up with five virtual stores.

the expected estimated revenue is shown in table 7.12. The estimated revenue for one year is 12 600 000, with full occupancy in the long term store and marketing service with six months vacancy per year. The annual profit, when the company is leasing out five stores are 4 637 000 NOK, the company key figures are presented in table 7.13.

Annual revenue of five Virtual Stores		
<i>Service</i>	<i>Calculation</i>	<i>Revenue NOK</i>
Long-term:	3 VS x 200 000/month x 12	7 200 000
Short-term:	2 VS x 300 000/month x 9	5 400 000
Total Revenue:		12 600 000

Table 7.12: Estimated revenue generated from five Virtual Stores(VS) with medium pricing

### Lifetime of service and Risk

The lifetime of the service is difficult to estimate, based on rapid improvements in technology and little knowledge about how the 3D and collaboration technology market will evolve, a lifetime of 5-10 years is assumed[5]. With an expected lifetime of 5-10 years, the company should generate a good returns of investment within a five year period.

Considering this is an innovative and futuristic solution and there are scarce information about competitors and their solutions, this project should be considered

a medium- to high-risk project.

### Cash flow and Payback period

The cash flow of a company tells us something about the difference between incoming revenue and outgoing cost. Discounted cash flow indicates the value of the money at a given time and is used to calculate NPV, Net Present Value [49]. Table 7.14 illustrates the difference between the cash flow and the discounted cash flow of the company. The discount rate is 10%.

A cash flow forecast can be an indicator to investors who speculate on investing in the company. The payback period tells investors something about how long it takes to recover the amount invested in a project and is an indicator of risk. The smaller the payback period is, the better[31]. In The Virtual Store company they will in year 0 invest in the company, which will give the company a cumulative negative cash flow. After year 3 the company generates a positive cash flow. The payback period of an investment made in year 0, with medium pricing mechanism will give a payback period in three years. The cash flow is illustrated in a diagram in figure 7.6.

### IRR and NPV

NPV is the sum of all cash flows discounted back to its present value and 10% discount rate is chosen[10]. The IRR is defined at any discount rate that results in NPV equals zero and interpreted as the expected return generated by an investment. The NPV after five years is equal to 8 249 240 NOK and gives the most accurate reflection of the business. Nevertheless, the IRR is easier to evalu-

<b>Company key figures</b>	
Investment cost:	9 261 500NOK
Annual cost:	7 963 000 NOK
Total Revenue:	12 600 000NOK
Profit:	4 637 000NOK

Table 7.13: Company key figures from running five Virtual Stores with medium pricing



Cash flow						
	year 0	year 1	year 2	year 3	year 4	year 5
Net Cash flow:	-10261500	4637000	4637000	4637000	4637000	4637000
Discounted Cash flow:	-9328636	4215450	3832231	3483846	3167133	2879212

Table 7.14: Net- and Discounted cash flow

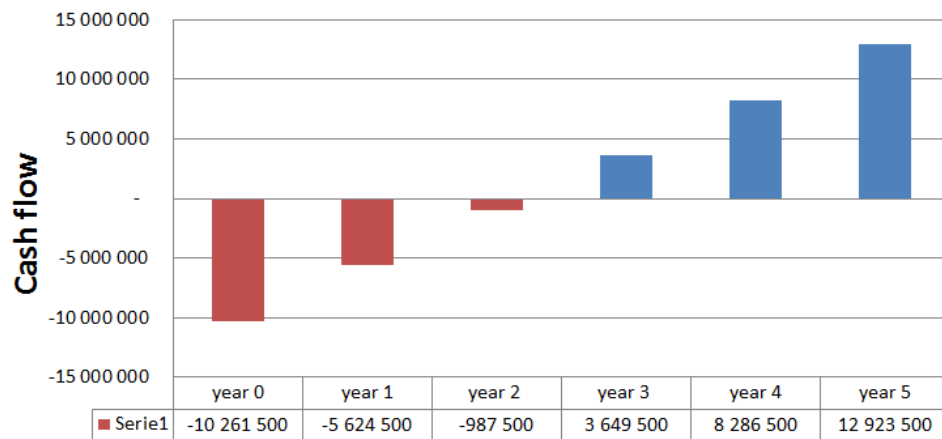


Figure 7.6: Cumulative Cash flow for a five year period running five Virtual Stores.

ate than NPV, because it illustrates percentage value instead of monetary value and it is what I have used for this analysis, illustrated in graphs[52]. IRR is an important Rate of Interest factor most investors emphasize on when looking for projects to invest in. IRR is calculated from the net cash flow provided in table 7.14. In year 0 the cash flow is -10 261 500 NOK and the following years has a positive cash flow of 4 637 000 NOK.

Return of Interest factors such as Payback period, NPV and IRR all affect the decision on whether to invest or not. IRR are commonly used to evaluate the desirability of investments in projects. Usually, the project with the highest IRR is chosen to invest in. Risks can affect the choices of investment, and when a project serves a high risk it is desirable for the IRR to be at least 20%. 'The Virtual Store' is considered a medium- to high-risk project due to its futuristic approach, and state-of-the-art technology, as well as scarce knowledge about competitors. NPV with a positive value is acceptable to invest in, a decision criterion for IRR

is usually that if IRR is greater than cost of capital, project is accepted. Invest in a project with low payback period, the larger the payback period is the larger the risk[31, 52].

Due to the fact, that calculations are made based on assumptions on pricing and vacancy further analysis is performed on the IRR when changing factors. Calculations are made for the IRR with high, medium and low pricing, and changing the vacancy to see what happens to the IRR. Changing pricing strategy and vacancy gives us an sense of how the company would do in certain market periods (e.g. low interest from customers to lease the service, financial instability).[10, 52]

**IRR on different pricing** Figure 7.7 illustrates how the IRR is affected by different prices for the service. Revenue is based on medium pricing and the assumption that the company is running five stores, where three stores are reserved for the Long-term service and two stores for the Short-term service. Long-term service has no vacancy and short-term service is vacant 6 months annually. Regarding that the project is considered a medium- to high-risk project, there should be generated a high IRR within a five year period. Both High and Medium pricing generates IRR between 25-35% in year 3. Low pricing generates 20% IRR after year 5, which is considered not acceptable for investment.

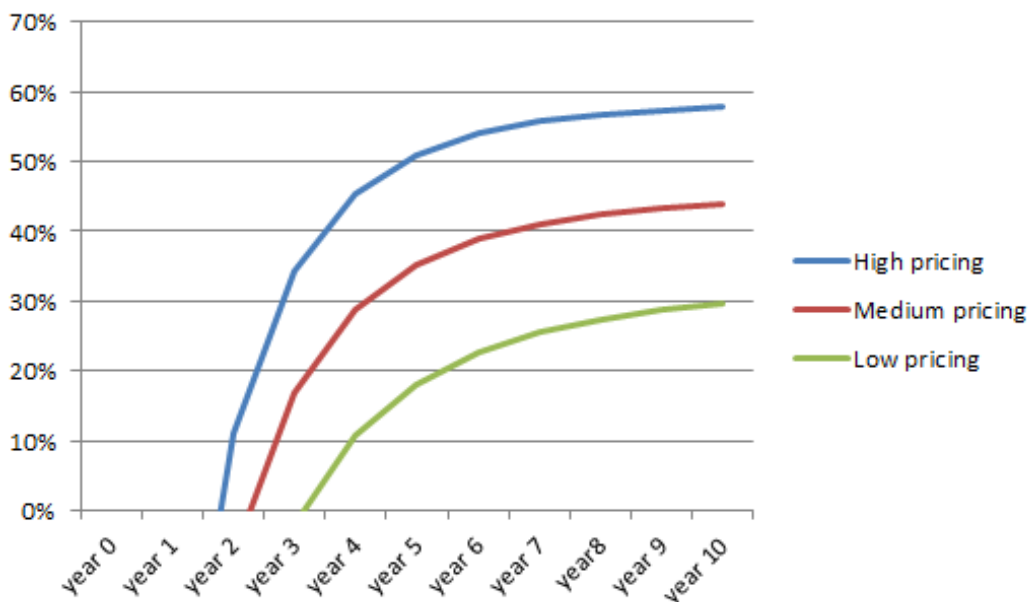


Figure 7.7: IRR based on different pricing.

**IRR on change in vacancy** Figure 7.8 illustrates how the IRR is affected when vacancy changes. Five categories of vacancy are tested. No vacancy illustrates a case where the company has accomplished to lease out all five stores for a whole year. 6 months Short-term vacancy is the estimated vacancy used in the financial analysis, it represents two stores reserved for short-term service being vacant in total 6 months each per year. 6 months Long-term service represents a total of 6 months vacancy per store reserved for the Long-term service and 6 months vacancy for the Short-term service. 9 months Long-term service vacancy and 8 months Short-term vacancy. 12 months long-term vacancy and 12 months short term vacancy. This distribution illustrates time where the company can have problems leasing out the service, for example due to financial instability.

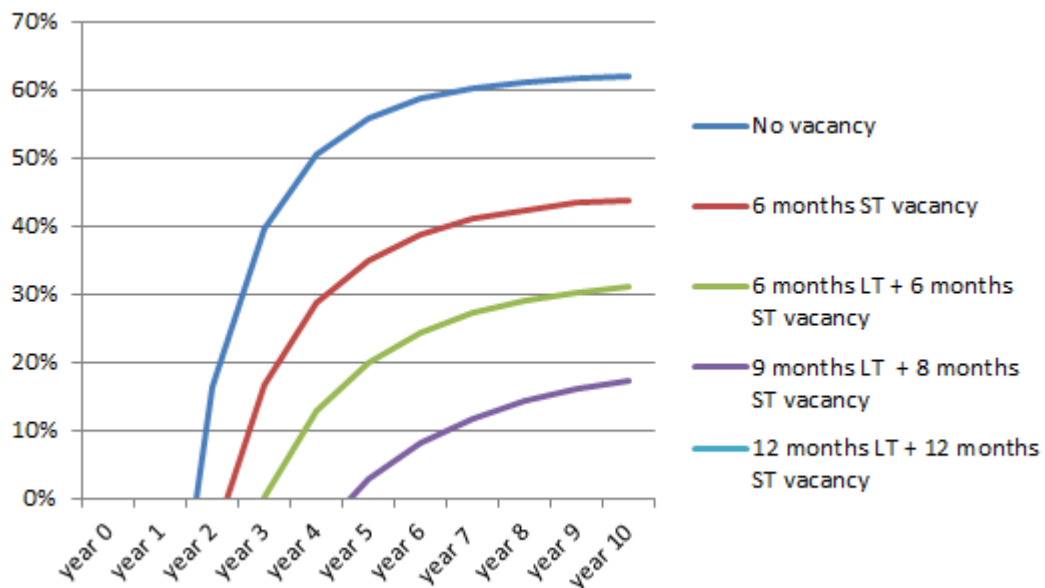


Figure 7.8: IRR affected by vacancy.

Only when 'The Virtual Store' service is operating without more than 6 months vacancy in Short-term service the IRR is acceptable within the five year period. This illustrates that the solution and pricing strategy is sensitive to changes in vacancy and can make the project unprofitable.

## 7.7 Summary

I have modified and used the Business Model Canvas[29] to illustrate the relationship between the elements that form the business model for the Virtual Store in figure 7.9.

The Virtual Store creates value for the customers who utilize the service in addition to the end-customers. Customers may reduce cost of substituting a regular store with the virtual store. The Short-term service which can be utilized in a marketing campaign may create value to the customers through attracting consumers to their store and gaining attention for their brand name.

There are several variables affecting profit and sustainability. Investment, costs, and market all play a part. A market analysis should be created to establish the attractiveness and matureness of a such a futuristic service as 'The Virtual Store'. A market analysis will help the company better estimate the minimum of virtual stores to be set up. The number of stores is related to investments and influence the cost of establishing the business.



Figure 7.9: Summary of the business model for 'The Virtual Store', modified from the business model canvas[29]



# Chapter 8

## Discussion

### 8.1 In general

By studying the electronic commerce market and existing virtual stores it can be stated that there are potential for a virtual store utilizing Distributed Multimedia Plays and its Collaboration Spaces. E-commerce, especially the apparel and accessories category has had a large increase in sales over the last years, and it is estimated to grown even further[9]. The overview of existing virtual stores in chapter 2 presents simple virtual stores presented on a traditional web site, innovative solutions using smart phones and QR-codes such as Tesco and Woolworths, and sophisticated virtual dressing rooms utilized to help online shoppers like Hurley.com's 'Try-me-on experience' or dressing rooms utilizing AR-technology like Debenhams and Macy's. There are different objectives to why virtual stores are utilized, some utilize it to create attention for a new product or attract customers to download their new 'app' for smart phones, others do it because they want to increase sales without having to set up traditional stores, which require more space.

With the technology improvements, presenting better quality images and more detailed product description, shoppers seems less skeptical to purchase items they cannot touch, and it opens up opportunities for 'The Virtual Store'. A virtual store utilizing DMP will improve user experience even more, projecting items in 3D in a near natural way. Security which is regarded an issue in traditional e-

commerce will be improved and ensured in a virtual stores utilizing DMP. With technology continuously improving, and utilization of smart phones and tablets increase, it will be even easier to launch these self helping futuristic services.

## 8.2 Proposed solution

For a target customer, such as a clothing store part of a store chain, 'The Virtual Store' can act as a substitute for a traditional store. It can create value through the saving of cost on store clerks and unpacking and tidying of products in the store and increase sales through the use of the Avatar service. It can also be used in a marketing campaign to draw attention to the store chain. They might want attention for a new collection or the release of an application for smart phones which can be used to enhance user experience. The substitute store can be leased on Long-term basis and the marketing store can be leased on short-term basis. The customer store can save cost on reducing staff, they offer value to their end-customers who might help them attract new customers or retain old ones.

Existing virtual stores have been proven successful. Tesco, the virtual grocery store reported an increase in sales of 130% and increase in traffic to their web site [11]. Hurley.com reduced their return on jeans by 34% when introducing the virtual 'Try-On experience'[26]. Companies have to think in new and innovative ways to attract and retain its customers. They have to be innovative and futuristic.

The solution generates some requirements which may make the solution less attractive. The presented solution has a limits the number of users to the system to be able to provide the users with a near natural feeling, generating views in the CS. If the limitation of users is considered to low, it might be an idea to simplify the solution of requirements to quality of image and auto-stereoscopic displays to allow more users into the virtual store which will make the solution more attractive. A more attractive solution will increase demand and generate more profit.



### **Lifetime of the service**

As the market and technology keep evolving, one need to keep in mind the lifetime of a service such as 'The Virtual Store'. Conventional wisdom holds that product life-cycles are getting shorter over time, and this perception is considered particularly in technological dynamic industries such as computing[5]. The technological advancements we have seen the past decade are a signal in that direction. Some products enjoy long lifetime, while others suffer a quick decrease in interest, e.g. the MiniDisk overlapping the change between the Tape-cassette and the CD, never grew popular. There are several implications to why some product enjoy stable lifetime and others don't. Much have to do with correct timing and 'going-into-market' strategy.

It is difficult to predict the lifetime of such a service. Based on analysis of lifetime for technology products[5] and some knowledge about the e-commerce retail market studied in chapter 2 and valuing the futuristic and 'green' profile a virtual store can provide it is reasonable to assume a lifetime of a virtual store to be five-ten years. The environmental friendly focus of a virtual store may lead to increase in popularity as we strive to be environmental friendly citizens of the world. The lifetime of the service affects how potential investors will view the project.

### **Security**

The problems with e-commerce security can be met by requirements to security in 'The Virtual Store' if DMP is utilized. Several threats to e-commerce mentioned in chapter 2 are application layer security. In DMP security is handled at network layer implementing IPSec AH and ESP which has been shown more secure than application layer security (e.g. SSL) in the Internet. I have performed a comparison between Internet and DMP security in [47]. Security in the network layer secures the transmission of payment details when authentication, integrity and confidentiality are protected, by authenticating and encapsulating transactions. In addition, the principle of reducing the openness in the network with more control relying in the network provider, can guarantee a better security.

## **Business model**

Osterwalders ontology[29, 28] was chosen as framework for creating a business model, it is a collection of several frameworks melted together to form a wider understanding of online markets. A detailed business model is created for 'The Virtual Store' and identifies all elements in the company and the solution, which provides a solid foundation on further analysis or extension of the solution.

## **Potential for partners**

With a high demanding network such as DMP it should be an advantage for the company to partner with a Network Provider and enter into an agreement to ensure reliable and dependable network access and content. Such an agreement would benefit both parties, the network provider can change their pricing mechanism to ensure quality and control at all times and the company can be sure to receive a dependable network connection from the network provider, which its quality, security and delay guarantees requires. A change in the pricing mechanism for the network provider may challenge the principle of 'Network neutrality', which fundamentally states that interactions over the Internet should be between end-users and web sites or content providers, not involving middle men such as a network provider[16]. With the increase in streaming audio and video, the network providers are facing a choice. The last decade, network capacity and dependability have increased and the prices have dropped. In addition, the migration of IP networks will eventually drive fundamental changes in the telecom industry. Should there be a different pricing mechanism? The philosophy of DMP with a more open network and more responsibility at network provides support a different pricing mechanisms attractive to network providers, and may be an incentive for the network provider to cooperate with a company utilizing a network such as DMP.

The Virtual Store requires innovative SOTA equipment and the company should partner with a hardware supplier and enter an agreement which may lead to the possibility of receiving customized equipment at a better price. The hardware supplier may receive advantages from entering a partnership through network externalities or allowing them to test new equipment and ensuring a fixed revenue, as the equipment needs updates and replacements annually to ensure the life time

of the equipment not to be depreciated after five years.

### **8.3 Financial aspects**

A financial analysis can be conducted to interpret various signs of instability regarding the economic aspects of the business. A financial analysis was performed on the business model developed for 'The Virtual Store' in chapter 7. The analysis was based on the Revenue model and Cost structure identified in the business model. The pricing mechanism for 'The Virtual Store' is based on what it is assumed that a target customer would be willing to pay for the service offered. For a product which value proposition is to create a substitute for a traditional store, the price offered needs to be lower than what it cost the potential customer to run the regular store. The assumed price is based on a price lower than the estimated cost of running a traditional clothing store of average size. These assumptions can therefore be somewhat uncertain. It is difficult to predict what a target customer would be willing to pay without knowing more about the customer segment and competitive solutions. However, a reasonable price for the Long-term and Short-term service were assumed and used in the calculation example.

#### **Start-up**

From early calculations it was evident that there is no point of starting up the business with only one location to be leased out. Even though investment cost are high, the cost per established store decreases when the number of stores increases. With the pricing strategy set at medium pricing, the annual profit generated over a five year period increases respectively to the increase in number of stores. It is reasonable for the company to at least start up with five locations for 'The Virtual Store' to be able to generate a decent revenue.

#### **Return On Investment factors**

The payback period can tell us something about the risk of investing, how many years does it take before the invested capital is earned. The payback period for

'The Virtual Store' was estimated through a cash flow forecast. Invested capital is used in the start up of the business in year 0, the cash flow is cumulated per year and the invested capital can be expected to be returned in year 3. A payback period of three years is good, and will make a good investment. However, the payback period is not the only factor in which should be studied when evaluating the profitability of a future project.

The IRR indicates the rate of return on investment. An investment whose IRR exceeds its cost of capital adds value for the company (i.e., it is economically profitable)[52]. However we also need to consider the risk of investment. As mentioned previously, an futuristic SOTA service as this is is considered a medium- to high-risk project, and the IRR should at least be 20%. To evaluate the stability of the investment changing factors such as price and vacancy was done. When the revenue decreased with the variation in pricing and vacancy the IRR decreased as well. Assuming the lifetime of the service to be five-ten years, the IRR should appear high before a five year period is over.

The IRR for the calculation example, results in an acceptable IRR within a five year period, which is a profitable investment. However, when changes were made to the price and vacancy it is clear that the pricing strategy low is not acceptable for making investment in the project. The company is also sensitive to changes in vacancy, and only the case of no vacancy and the case of no Long-term vacancy and 6 months Short-term vacancy have acceptable IRR within a five year period.

The uncertainties related to the financial analysis, due to assumptions made in the revenue model and the scarce knowledge about competitors it is not advisable to start up the business without further examinations and analysis. If we can state that the market will accept the pricing strategy presented here and customers are attracted to the service it is acceptable to start up the business.

## 8.4 SWOT-analysis

A SWOT-analysis can state something about the company's position in the market and identify opportunities. It evaluate a company's internal and external factors through strength, weaknesses, opportunities and threats involved in a business venture[6]. Strengths are characteristics for the business that gives ad-

vantage over others. Weaknesses are characteristics that give the company disadvantage over others. Opportunities are external chances to improve performance (generate more profit) in the environment. Threats can be identified as external elements in the environment that could cause trouble for the company and project.

A SWOT-analysis for 'The Virtual Store' company is presented in table 8.1. The company has several strengths they can exploit through having experience with a novel technology and their focus on security, which is applicable for concerns in e-commerce and network security. They should take advantage of their opportunities in the market and be first to enter the market with their innovative technology. The threats present in the market can be explored in a market and competitive analysis and translate it into a strength.

<b>SWOT-analysis</b>	
<b>Strengths</b> Innovative and futuristic technology Customization for customers Latest technology Focus on security and quality of networks	<b>Weaknesses</b> Unknown company Marketing, attracting customers Expensive equipment Lifetime of service
<b>Opportunities</b> Unexplored, new market The interest for new ways of marketing and shopping by retailers Environmental friendly focus in the world	<b>Threats</b> Competitors with simpler solutions Challenge to produce less expensive solution with same requirements

Table 8.1: SWOT-analysis

## 8.5 Contribution

Throughout the work on the master thesis a new area of application for the Distributed Multimedia Plays architecture has been studied and a potential solution has been proposed. The proposed solution is developed into a business model and evaluated in the light of financial potential. The case study of various scenarios can be further studied and extended, as well as the business model can be used for further analysis. The business model is developed in detail and it can be extended or changed to fit another application or service similar to The Virtual Store.



# Chapter 9

## Conclusion

The market of e-commerce and how we can utilize collaboration technology, such as the DMP collaboration network to create an innovative and futuristic way of shopping has been studied. A business model for 'The Virtual Store' has been developed to identify value provided by the solution, who the target customer is, what resources are needed, what costs are related to the solution and how it can create revenue. Due to the revenue model being based on an estimation of what the customers would be willing to pay for the service there are some uncertainties regarding the economic aspects of the business model and its profitability. If we can state through a market and competitor analysis that the market will accept the pricing strategy presented here and that the customers are attracted to the service it is acceptable to start up the business. The solution generates some requirements which may affect the interest in the service in a negative manner, because the solution has a limited number of users who can use the system at the same time. For the solution to be more attractive to customers, changes to the solution can be made, simplifying the solution to decrease cost and increase profitability.

### 9.1 Important findings

1. Retailers and consumers seems mature and open to a futuristic service such as a 'The Virtual Store' as described here. Technology is rapidly improv-

ing and consumers adapt to innovative solutions fast, especially when it provides them with convenience or improvement of existing solutions.

2. Distributed Multimedia Plays and its Collaboration Space can be utilized in the idea of virtual networked shopping, created in this thesis are several scenarios and areas of application where DMP can be a possible solution. DMP will provide more security to the shopping environment through the use of IPSec and a more controlled network by leaving more responsibility with the network provider.
3. Through the financial analysis it was established that a minimum of five stores should be established in order to generate a solid revenue. With a medium pricing strategy the payback period to investors will be decent, three years. A market and competitor analysis should be performed, to establish better pricing strategy and estimate how many stores to start up with.
4. The analysis of the IRR showed that the project generates acceptable IRR when the pricing strategy was medium and high. Low pricing strategy generated a too low IRR for a company with medium- high risk. Changing vacancy, the IRR was acceptable for the cases where the company suffers no vacancy and the case where there was six months vacancy in the Short-term service. The other cases of vacancy generated a too low IRR to be acceptable for such a project. Investing in this project requires more research on the market to more accurately identify a correct price for the service.
5. Distributed Multimedia Plays require control of quality and delay in the network as well as security, which gives a network provider the opportunity to enter an agreement with the company of 'The Virtual Store'. Agreement on control in network can lead to new business potential for the network providers who can consider charging customers with content, not access alone, generating a new way of income.



## 9.2 Future Work

A number of areas interesting for future work are:

- A market analysis can be performed to identify the attractiveness of the industry of 'The Virtual Store'. With knowledge of the market and its potential it would be easier to estimate the numbers of stores to be established when starting up the business.
- In the chapter of e-commerce I found some competitive solutions of existing virtual stores. A competitor analysis can be performed to learn more about the strength and weaknesses of the competitors and to establish a more solid pricing strategy.
- Design and Implementation of 'The Virtual Store' in the DMP Collaboration Space can be performed, and evaluate usability and performance of the solution.



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