NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF INFORMATION TECHNOLOGY, MATHEMATICS AND ELECTRICAL ENGINEERING

PROJECT ASSIGNMENT

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Course: ICT Economics, Specialization TTM 4725

Title: Business Models for Shared WLAN Access Providers

Text: This project assignment studies business models for access providers that do not also provide services, more specifically providers of WLAN capacity. It does this through studying areas such as product, customers, market segments, business relations and value creation. The areas are discussed and specified for shared WLAN access providers.

The different aspects are structured into a specific business model. This model is then applied to the case of Trådløse Trondheim. Scenarios for the cost structure and revenue model of Trådløse Trondheim are evaluated.

Deadline:	December 20th, 2006
Handed in:	
Carried out at:	Department of Telematics
Supervisor:	Thomas Jelle

Trondheim, ……2006

Steinar Andresen
Professor

I. Preface

This report is the result of a four month project carried out as a part of my Master of Science degree at the Norwegian University of Science and Technology (NTNU). The work was carried out in the period from August to December 2006.

I would like to thank Professor Steinar H. Andresen of NTNU for valuable input throughout the project. My supervisor, the general manager of Wireless Trondheim, also deserves my gratitude for helpful insight and guidance. Furthermore, I am indebted to associate professor Josip Zoric for our discussions and his input in the field of business modeling. The people at my lab, Henrik Ljøgodt Moen, Petter Stray and Øystein Bøhn-Hagen, also deserve my thanks for fruitful discussions and motivation.

Trondheim, December 20th 2006

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Tormod Ree

II. Abstract

The widespread adoption of wireless networking technology has been one of the main developments in the communications industry over the later years. Initial wireless data networks were small scale personal and business networks. However, there has been a development towards larger scale networks. Some of these span entire cities and are run by shared WLAN access providers. Such providers operate the network and cooperate with service providers to sell services. The shared WLAN access providers face a novel business situation.

The goal of this report has been to understand the business situation facing these providers. This report contributes to this by developing a generic business model based on a business model ontology. The business model describes the architecture of the business; the money earning logic. After developing a generic model, the model is adapted to Wireless Trondheim. Wireless Trondheim is a shared WLAN access provider in the Norwegian city of Trondheim. To investigate the profitability of this project, a cash flow analysis is conducted.

This report discusses the technological situation facing shared WLAN access providers, and provides an introduction to business modeling theory. By examining the technological situation, main services and resources are identified. These services are used to identify the business actors cooperating in offering services to customers in return for revenue. This understanding and business modeling theory provide the basis for the business model developed. The business model discusses and specifies important areas such as the product, the customer interface, the infrastructure management and the financial aspects. To analyze the money earning logic of Wireless Trondheim and to test the feasibility of the model, it is adapted to Wireless Trondheim. Three scenarios are developed to investigate the profitability. The main drivers of revenue are identified and estimated. All three scenarios yield a positive net present value for the project.

The main contribution of this report is the business model developed for shared WLAN access providers. This model helps in understanding the business architecture of such providers.

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V. List of Abbreviations

ADSL	Asymmetric Digital Subscriber Line
AP	Access Provider
B2C	Business to Consumer
CDMA	Code Division Multiple Access
GPS	Global Positioning System
GSM	Global System for Mobile Communication
ICT	Information and Communication Technology
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
ISO	International Standards Organization
ISP	Internet Service Provider
LAN	Local Access Network
LOS	Line of Sight
MAC	Media Access Control
MNO	Mobile Network Operator
MVNO	Mobile Virtual Network Operator
NIC	Network Interface Card
NLOS	Non Line of Sight
NOK	Norwegian Kroner
NPT	Norwegian Post and Telecommunications Authority
NPV	Net Present Value
NTNU	Norwegian University of Science and Technology
OSI	Open Systems Interconnection
QoS	Quality of Service
SE	Service Enabler
SSB	Statistics Norway
SSID	Service Set Identifier
TCP	Transport Control Protocol
TEV	Trondheim Electric Utility

UML	Universal Modeling Language
UMTS	Universal Mobile Telecommunications System
USA	United States of America
VWISP	Virtual Wireless Internet Service Provider
WAN	Wide Area Network
WLAN	Wireless Local Area Network

1 Introduction

1.1 Background

The last decade in the computer and telecommunications arena has been influenced by a widespread adoption of novel wireless technologies. Several new technologies have been adopted on a large scale, such as Bluetooth and Wi-Fi. These new technologies have given greater flexibility for the users, and have made feasible a new way of working. Many computer users now view wireless communication as a part of their every day life.

Various ways of deploying wireless networks have been introduced. Some networks operate on a very small scale, such as a Bluetooth connection between a personal computer and a cellular phone. The scale then ranges from small 802.11 home networks, to nation wide cellular networks based on technologies such as GSM, CDMA and UMTS. Most of the medium to large scale networks are operated by entities on a for-profit basis. These entities employ a variety of business models [18].

In the later years, a new approach to deploying wireless networks in urban areas has emerged. Several cities, such as Philadelphia (USA) [12] and San Francisco (USA) [35], are in the process of developing city-wide wireless networks based primarily on IEEE standard 802.11 [14][15][19]. This is also the case in the city of Trondheim (Norway) [13], where a wireless network has been rolled out in the city center. The owners of these networks have chosen a wide variety of business models. Some are based on a shared WLAN solution, where the network operator sells access on a wholesale basis to service providers. No business model has emerged as the most preferred and there has been some debate surrounding the detail to which the business models have been specified [18].

1.2 Problem Statement

This report seeks to study the business model for providers of shared WLAN solutions. A business model describes a firm’s money earning logic. More specifically, this report investigates the model for access providers in a vertically disintegrated business situation.

Such providers mainly provide access on a wholesale basis, and do not themselves act as a service provider. For the end users these access providers are hardly visibly, they provide a transparent link between the user and the service provider.

The goal of this report has been to develop a sound and well specified model of the technological situation and the business. The model is applied to the case of Wireless Trondheim, where three different scenarios are evaluated. The scenario analysis is meant to test the feasibility of the model developed, and to gain insight into the profitability of Wireless Trondheim.

1.3 Scope

This report develops a business model and evaluates it through applying it to Wireless Trondheim. There are many interesting areas related to the business models of shared WLAN access providers, and the scope has had to be narrowed to provide an interesting and in-depth analysis. Osterwalder defined three main business layers in [20]; these are illustrated in Figure 1-1. This report focuses on the business model layer. The business model layer focuses on the money earning logic of the business. As can be seen from the figure, the visions, goals and objectives are part of the strategic layer, and these are not an area of focus of this report. They are, however, briefly dealt with to explain the background for the business model. The process layer dealing with organization and workflow, the implementation of the business model, is not studied in this report. Furthermore, regulatory and competition issues that arise when public entities sponsor the deployment of a wireless infrastructure are not addressed. These aspects are addressed by Balhoff & Rowe [18] and ongoing legal disputes in the United States [1].

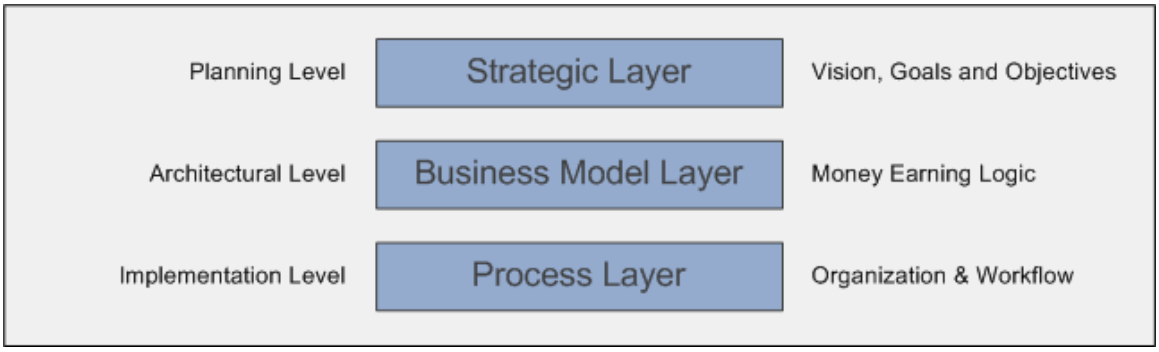

Figure 1-1. Business layers, as defined by Osterwalder in [20].

To properly describe the business model of shared WLAN access providers, this report looks further into the technological challenges. The consumer behavior is also briefly examined to get a proper understanding of the challenges facing the access providers. A more detailed description of a business model, and what aspects that will be considered in this report, is provided in section 2.1.

1.4 Methodology

This report solves the problem at hand by first evaluating the technology enabling shared WLAN solutions. The underlying technology is what supports the business idea. Without the wireless technology, there would be no WLAN to share, and no business model to research. Relevant technologies are briefly described in section 3.1. In addition to looking at the purely technical aspects, the service enablers and business actors are described using the UML [31] modeling language. To understand the business environment in which the access providers operate, vertical disintegration is also studied.

After providing an understanding of the underlying technology, the goal of the report is to develop and thoroughly evaluate the business model. This is done using a framework similar to that proposed by Osterwalder in [20]. The different parts of the business model are described using the proposed business model ontology and relevant business theory. To evaluate the business model developed, the model is applied to Wireless Trondheim.

1.5 Project Outline

This report starts out by explaining relevant theory for business modeling and value systems in Section 2. The section provides an introduction to business modeling and presents the business model ontology that is used in this report. Furthermore, the theory of value systems and networks is introduced. Section 3 discusses the technology and background information for shared WLAN networks. The first part of the section describes the technologies necessary to support shared WLAN solutions. Vertical disintegration is explained to understand the business situation and vertical co-production of value facing shared WLAN access providers. Finally, the main services necessary in the service composition are discussed to identify business actors.

Section 4 goes on to develop the business model for shared WLAN access providers. The main business model elements are specified. Section 5 continues by adapting the business model to Wireless Trondheim. The adaptation tests the feasibility of the generic business model, and specifies the money earning logic of Wireless Trondheim. A scenario analysis is conducted to investigate the profitability of the project through a cash flow analysis. Finally, the work is concluded in Section 6.

2 Theory

This section provides an explanation of the theories and models used in this report. Models are used for providing and abstract representation of the technical concepts or business at hand.

2.1 Business Model Theory

2.1.1 What is a business model?

There are many conceptions, and misconceptions, regarding what a business model really is. Linder and Cantrell find that executives have problems articulating their business models, and that 99% of them have no clear framework for describing their model [32]. Strictly speaking, the business model is the organization's core logic for creating value. In other words it is the company's money earning logic.

To elaborate on this crisp definition, Osterwalder [20] suggested the following working definition of a business model:

> *A business model is a conceptual tool that contains a set of elements and their relationships and allows expressing a company's logic of earning money. It is a description of the value a company offers to one or several segments of customers and the architecture of the firm and its network of partners for creating, marketing and delivering this value and relationships capital, in order to generate profitable and sustainable revenue streams.*

Osterwalder bases his definition of a business model on an extensive literature review, where important contributors include: Stähler [33], Gordijn [34], and Linder and Cantrell [32].

It is important to note that the business model is just what the term suggests, a model of the business of a firm. A model is an abstract representation of the object that is being

modeled, and business is the activity of buying and selling goods and services [52]. Hence, the business model presents an abstract representation of the company's way of earning money.

There are many aspects that influence the way a company operates and how it earns money; Figure 2-1 provides an illustration of these. The business model functions as glue between the business strategy, the business organization, and Information and Communication Technology (ICT). This is important because there often is a considerable gap between these. The three concepts often talk about similar issues, but address them from different angles. Further, there are important external factors that influence a firm, shown as arrows in Figure 2-1. A company's business model should be able to react to these external factors.

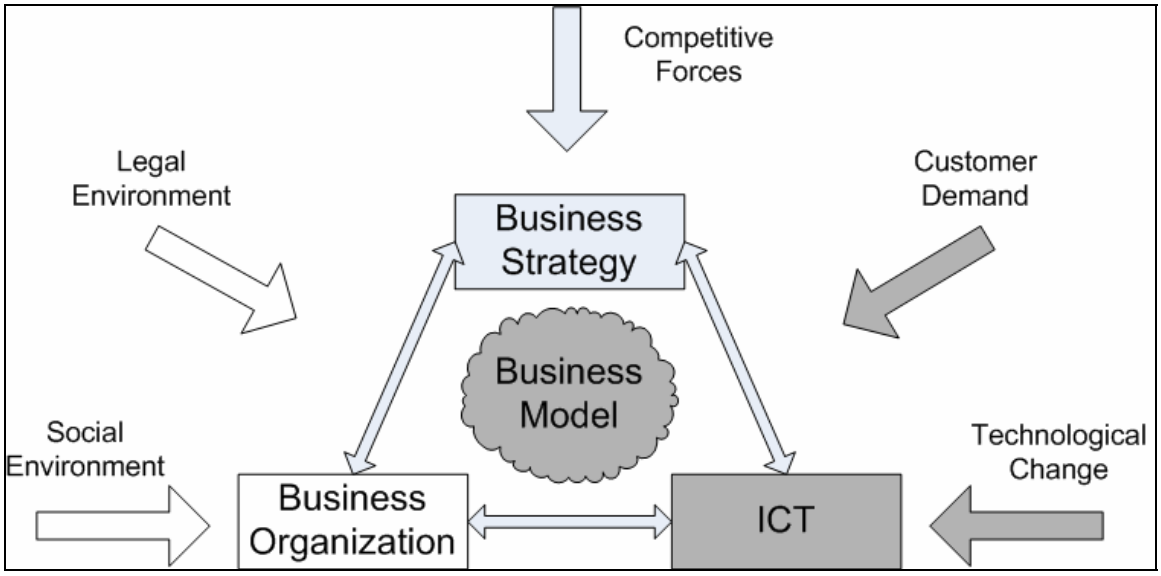

Figure 2-1. Business model environment, based on [20].

To be able to thoroughly study the business model, this report focuses on some of these aspects. The main area of focus is the business model itself. Moreover, ICT is studied in depth, and the ICT equipment used in the shared WLAN infrastructure is included in this element. Customer demand and technological change substantially influence the aforementioned aspects, and are also studied. The customer demand is critical to the future revenue and for the cash flow analysis that is conducted in the scenario analysis of

Wireless Trondheim. The areas of focus in this report are shaded in dark grey in Figure 2-1.

It should also be mentioned that there is an ongoing discussion on the difference between strategy and business models [33], but it is not the goal of this report to contribute to this discussion. See section 4.2 for an elaboration. The parts of Figure 2-1 dealing with strategy are shaded in light grey. The business organization of a shared WLAN provider is out of scope for this report. Furthermore, the legal and social environments will not be studied.

A firm has a number of approaches to choose from when developing a sound business model. Linder and Cantrell [32] suggest that one option is to define certain fundamental questions that the model should answer. They suggest that Figure 2-2 can be used as a starting point for this approach. The figure provides a number of questions that illustrate important parts of a business model.

This report will try to answer the questions posed in Figure 2-2, but it will use a different framework for the model itself. The framework and approach chosen is described in section 2.1.3.

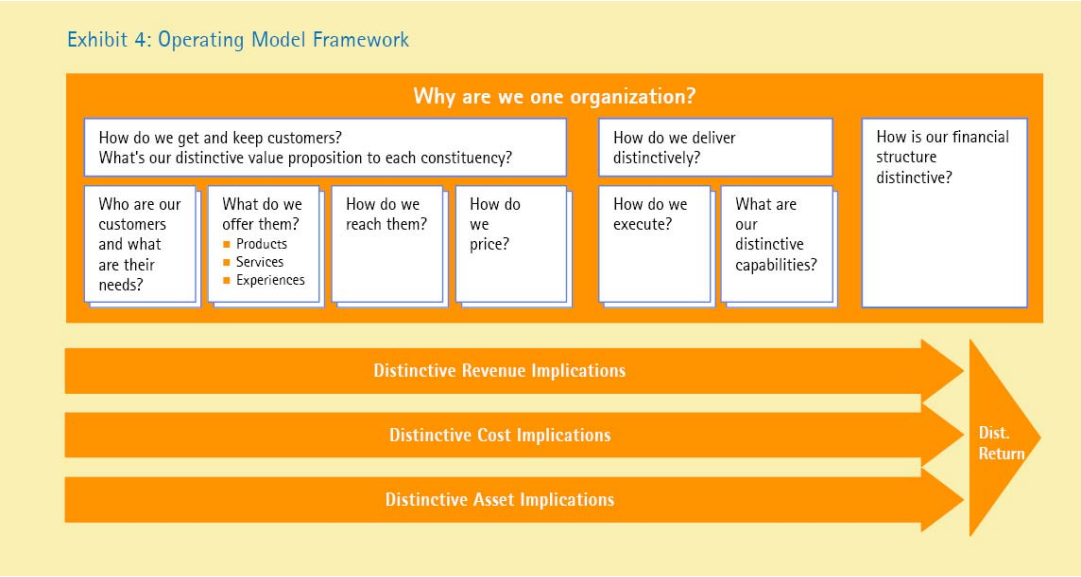

Figure 2-2. Company operating framework, from [32].

2.1.2 Why a Business Model?

As mentioned previously, the business model acts as glue between the business strategy, the business organization, and ICT. But why is a business model needed? Business models are a relatively new area of research, and they have perhaps yet to prove their importance. However, this report provides reasons for the importance of a good business model in a company.

General Benefits

Companies that succeed know how to make money. They do this through effectively implementing a good strategy to achieve a sustainable competitive advantage. A good business model can help a company achieve this. Linder and Cantrell [32] believe that companies succeed because they choose an effective business model and execute it superbly. Furthermore, they renew their distinctiveness as competitors threaten and master the ability to change the business model.

Understand and Share

The business model is an important tool for understanding the business logic, and sharing this understanding throughout the organization. Employees and departments may have different viewpoints and angles from which they look at the business situation. Some may be concerned with the internal organization, some with the market situation, and others with the way the company uses ICT. They all face the same situation, but look at it from different angles.

By specifying a business model, a company first has to capture the business logic. It has to do this by combining the different viewpoints, which is in itself a useful process. The model is an abstract visualization of the complex business logic, and this can be easier to comprehend when described with a business model ontology. A business model captures

more logic than a standard and coarse three-point strategy framework, which in many situations is not comprehensive enough.

When the model is specified, it is useful for communicating the business logic throughout the company and to other stakeholders. This communication facilitates a common understanding of the money earning logic, unquestionably important to effectively run the company.

Analyze

Another way in which a good business model contributes is through analyzing the business logic of a company. By performing this analysis a company can observe change, improve performance measurement and compare their business model to that of others [20].

To be able to observe changes in the company, how it behaves, reacts to external forces, and how it performs, a detailed analysis is needed. A well specified business model is a useful tool when conducting these observations. The model provides a platform for measuring different parameters at different points in time. Performance measurement makes possible quantifying progress and future goals.

Manage

A business model also contributes by improving management of the business logic of a firm. Osterwalder [20] points out three different areas where the business model concept contributes to the business logic management:

- By improving the design, planning, change, and implementation of business models
- By helping companies react faster to changes in the business environment
- By improving the alignment of strategy, business organization and technology

Having specified the business model, managers obtain a better understanding of the situation and through this they are able to make more informed and better decisions.

2.1.3 Business Model Framework in this Report

This report will use the ontology framework proposed by Osterwalder [20] when developing the business model for a shared WLAN access provider. The framework and its nine building blocks are presented in Table 2-1. This framework is chosen because it is based on an extensive review of previous business model ontology literature, and because it combines the findings and experience from previous work. At the same time, it provides a more detailed and formal framework than most of the other papers dealing with this area. The model suggested by Osterwalder includes all business model building blocks that are mentioned by at least two other authors in the literature review conducted. These building blocks are also called elements.

Furthermore, the characteristics of each business model element are described using a table and a graphical illustration. Certain elements also have sub-elements. The table template is shown in Table 2-2. The full description of all ontology elements is provided in *Appendix A: Business Model Ontology.*

Pillar	Building Block of Business Model	Description
Product	Value Proposition	A value proposition is an overall view of a company's bundle of products that are of value to the customer
Customer Interface	Target Customer	The target customer is a segment of customers a company wants to offer value to
	Distribution Channel	A distribution channel is a means of getting in touch with the customer
	Relationship	The relationship describes the kind of link a company establishes between itself and the customer
Infrastructure Management	Value Configuration	The value configuration describes the arrangement of activities and resources that are necessary to create value for the customer
	Capability	A capability is the ability to execute a repeatable pattern of actions that is necessary in order to create value for the customer
	Partnership	A partnership is a voluntarily initiated cooperative agreement between two or more companies in order to create value for the customer
Financial Aspects	Cost Structure	The cost structure is the representation in money of all the means employed in the business model
	Revenue Model	The revenue model describes the way a company makes money through a variety of revenue flows

Table 2-1. The nine business model building blocks proposed by Osterwalder in [20].

In addition to specifying the nine building blocks presented in the above table, the report also discusses two other important areas; risk and competition. The risks for a shared WLAN access provider can be decomposed into technological and business risk. When considering the technological risk, the external factor of technological change is investigated. The competitive situation is assessed to enable a realistic evaluation of demand when applying the business model to the case of Wireless Trondheim.

Name of BM-Element	NAME
Definition	Gives a precise description of the business model element
Part of	Defines to which pillar of the ontology the element belongs to or of which element it is a sub-element
Related to	Describes to which other elements of the ontology an element is related to
Set of	Indicates into which sub-elements an element can be decomposed
Cardinality	Defines the number of allowed occurrences of an element or sub-element inside the ontology
Attributes	Lists the attributes of the element or sub-element. Each element and sub-element has two standard attributes which are NAME and DESCRIPTION that contain a chain of characters {abc}
References[1]	Indicates the main references related to the business model element

Table 2-2. Business model element description template. One of these is defined for each element or sub-element of the business model [20].

2.2 Value Systems

To express and explore how firms differ in a competitive sense, Porter's value chain [38] has been widely adopted to represent and analyze value creation on the firm-level [37]. While Porter's representation is well suited for describing a traditional manufacturing company, Fjeldstad, Stabell and Andresen argue that it is less suited for service-oriented oriented industries, such as telecommunications [39][37][40]. They propose an alternative value system for firms in such industries, namely value networks.

2.2.1 Value Networks

The value network system will be used in this report to explore the value configuration in the business model. The value network is well suited for describing value creation in industries where firms exchange information, and use a mediating technology to link customers. Telecommunications is a good example of an industry where firms use a mediating value-creation technology [40]. Moreover, the value network is applicable to a

[1] This report will not list references directly in the element descriptions.

situation where mediators co-produce services in a layered system where services of one mediator are provided over the network over another mediator. This is exactly the situation in a shared WLAN.

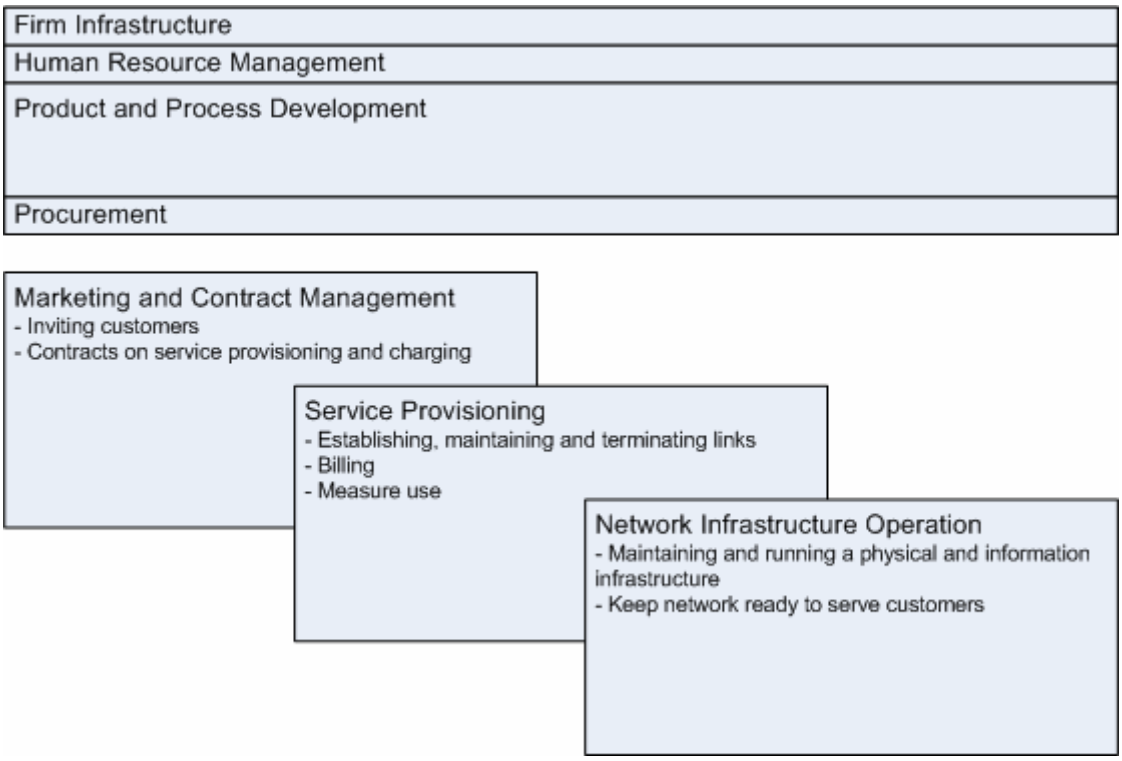

Figure 2-3. General Value Network Diagram, based on [37].

Figure 2-3 shows the main building blocks of a value network diagram. The value configuration diagram distinguishes between primary and support activities. Since this report is not considering the business organization, the support activities will not be investigated. The primary activities consist of marketing and contract management, service provisioning, and network infrastructure operation. For more details on value networks, [40] and [37] are good references.

3 Technology and Background

The goal of this section is to provide an understanding of the technologies used in wireless networks, and more specifically in large scale shared WLAN solutions. This is necessary to understand the business model for access providers, discussed later in this report. To understand the challenges facing access providers in shared WLAN, the trend towards vertical disintegration is also investigated. Furthermore, the service enablers offered by access providers and the interaction with other business actors is described in section 0.

3.1 Technology

3.1.1 Wireless Technologies

The main wireless technology used in shared WLAN networks is the 802.11 (Wi-Fi) standard specified by the Institute of Electrical and Electronics Engineers (IEEE) [14][15][19]. Another IEEE standard that has been suggested as a future candidate for such networks is 802.16 (WiMAX) [16][30]. This section will provide a brief introduction to the technologies.

IEEE 802.11 (Wi-Fi)

802.11a/b/g are standards from IEEE specifying wireless local area networks (WLANs). The first standards, 802.11a [14] and 802.11b [15], were introduced in 1999. 802.11g [19] is a later development, introduced in 2003. A common name for these technologies is Wi-Fi [7]. 802.11a operates on the 5.xGHz band with data rates up to 54Mb/s, while 802.11b and 802.11g operate on 2.4GHz with data rates of up to 11Mb/s and 54Mb/s, respectively. These are unlicensed spectrums over most of the world, and do not require any licenses. The fact that the standards operate on an open spectrum has lead to a widespread adoption of the technology [24]. 802.11 network interface cards have become customary equipment on new laptops. An important decision when specifying 802.11 was to make it compatible with Ethernet above the data link layer, which means it is

possible for computers to send IP packets over the wireless LAN the same way they send packets over Ethernet.

One way of measuring the use of 802.11 is to look at the number of hotspots available. A hotspot is an area covered by an 802.11 network, providing WLAN access to users for free or at a certain rate. Numerous commercial providers provide access through such hotspots, often at locations such as cafés, hotels and airports. Table 3-1 provides an overview of the registered hotspots in various countries and regions. The numbers for jiwire.com are significantly higher than for the two others because jiwire also shows commercial hotspots. By studying the numbers in Table 3-1, it becomes clear that a large number of hotspots have been deployed. Furthermore, the number of registered hotspots in Europe increased with 17% in the fourth quarter of 2005 [25].

	Source		
Country/Region	free-hotspot.com	hotspot-locations.com	jiwire.com
Europe	NA	16520	NA
USA	6948	11320	41758
UK	285	181	15801
France	434	78	10691
Germany	142	396	12721
Norway	7	125	345

Table 3-1. Registered hotspots in various countries/regions[2].

Some 802.11 access points have the possibility of broadcasting several Service Set Identifiers (SSIDs). The SSID is a sequence of up to 32 letters or numbers that is the ID, or name, of a WLAN. Cisco now offers routers with the option of broadcasting as many as 16 SSIDs simultaneously [26]. This enables access providers to announce SSIDs from multiple service providers, enabling Virtual Wireless Internet Service Providers (VWISPs). The situation can be compared to that of the mobile telecommunications industry, where Mobile Virtual Network Operators (MVNOs) buy capacity from the Mobile Network Operators (MNOs) owning and operating the network.

[2] Collected from respective websites on October 15th, 2006

IEEE 802.16 (WiMAX)

Another IEEE standard for wireless communication is 802.16, more commonly known as WiMAX (Worldwide Interoperability for Microwave Access) [27]. 802.16 is a newer standard than 802.11, and it is currently not adopted on the same scale. 802.16 can operate on a variety of frequency bands, both licensed and unlicensed. The first 802.16 standard was approved by the IEEE in 2001 [16]. Numerous vendors see great future potential for the 802.16 technology, and Intel has called it "the most important thing since the Internet itself" [29]. However, few vendors have started producing equipment based on the standard, and a revision was approved in 2004 [16]. Equipment based on this revision has seen testing and deployment in 2006 [28].

802.16 provides specifications for both line of sight (LOS) and non-line of sight (NLOS) communication. The first version of the standard specifies communication for fixed broadband, and support for mobility was not added until 2005 [30].

802.16 is primarily a technology for Wide Area Networks (WANs), and the first specifications did not allow for mobility. More specifically, the technology is in an early phase and current deployment has been limited to fixed links. There is hope for future mobile use of this technology, but to which extent and when is uncertain.

Technology Focus

As presented in the previous sections, 802.11 is primarily a LAN technology, while 802.16 is designed for WAN use. The shared WLAN networks that are the areas of focus for this report are somewhat of a hybrid between WAN and LAN networks. On one hand they provide local access to users in the city and can with respect to this be called LANs. On the other hand they span large areas of a city, sometimes interconnecting several LANs, and could also be classified as WANs. Considering this, both 802.11 and 802.16 are relevant technologies. However, since the report specifies a business model and evaluates this by doing a scenario analysis on a current shared WLAN based on 802.11, this technology will be the one on which the business model is based.

3.1.2 Technologies for Shared WLAN

Shared WLAN

A number of cities have deployed, or are planning to deploy, wireless networks in large areas of the city. In contrast to the numerous hotspots in many major cities, these new networks cover larger areas and appear as one network to the end user. Being a new development, these networks are still called by many names, such as Municipal Wi-Fi [18], Public Wi-Fi [21], and Community Wi-Fi [22]. Furthermore, some actors have decided to deploy the network and act as an access provider without providing any services to the end users. Instead, they have chosen to sell capacity and access to service providers, and themselves only act as access providers. Since several service providers can provide services through the same wireless network, this is called shared WLAN. It is an example of vertical disintegration, a concept discussed in section 3.2.

Of the two previously mentioned technologies, Wi-Fi is the one most commonly used in shared WLAN solutions. Because Wi-Fi capable laptops and handsets are now increasingly common, Wi-Fi is considered to be a suitable technology for the connection between the access provider and the users. Moreover, Wi-Fi can also be used to interconnect different access points in a shared WLAN.

Wireless Mesh

Some shared WLANs use wireless technologies for more than the user connection. To reduce deployment and maintenance costs, parts of the wired backbone in a network can be replaced with a wireless mesh [6]. With wireless mesh network architecture, not all access points need be connected with a wired backbone, rather they are interconnected with wireless links. Eventually, data reaches a node in the network connected to the wired backbone. Several of the cities deploying public WLAN in the US are using this approach [12][18].

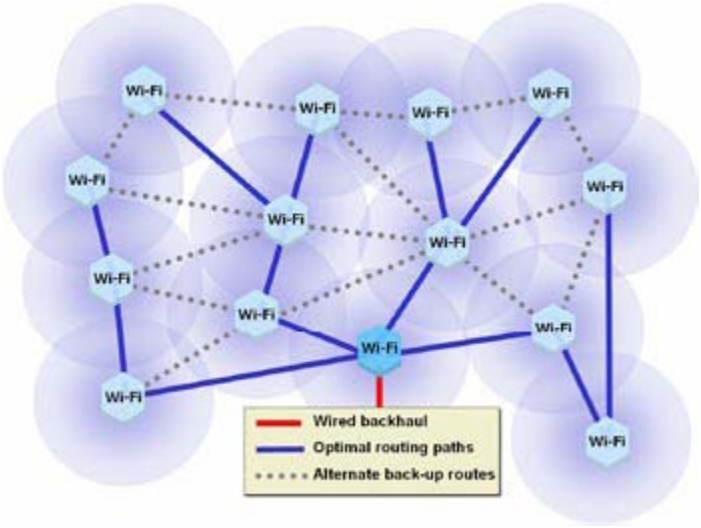

Figure 3-1: Wireless mesh architecture. From [7].

Figure 3-1 illustrates the wireless mesh architecture. As can be seen from the illustration, a minority of the Wi-Fi access points are connected to the wired backbone. This gives the advantage of not having to deploy wires to all access points, which can mean significant cost savings for the access provider. Another advantage is a more rapid deployment [6].

On the other hand, in a mesh architecture network the backhaul traffic will compete with the traffic between the users and the access points if the traffic is transmitted over the same frequency band. Without doubt, this will lead to increased contention in the network. Another aspect that should be considered is that current state of the art wireless technologies [14][15] have considerably lower capacity than wired fiber technologies [17]. Nevertheless, Wireless Philadelphia [12], EarthLink [36], and Tropos [6] have the mesh solution as their technology of choice.

Fiber Backbone

The alternative to the mesh architecture described in the previous section is a wired backhaul, which can be either copper or fiber-based. By using a fiber backhaul instead of the wireless mesh, the network operator can reduce the level of contention and increase the capacity of the network. The downside to a wired backhaul is the up front investment cost in wired links to all access points.

3.2 Vertical Disintegration

3.2.1 The OSI model

The OSI (Open Systems Interconnection) model was created hoping to standardize the protocols used in the various layers of a network [7]. It was developed based on a proposal from the International Standards Organization (ISO) [5]. The OSI model is important for this project because it can be used to illustrate the interaction between the service- and access providers. By following the specified interface between two layers, the responsibilities are divided between the cooperating firms.

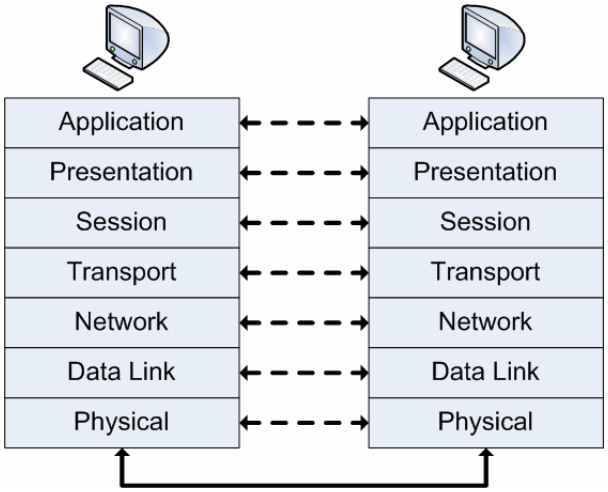

Figure 3-2: Illustration of seven layer OSI model.

Three layers of the OSI model are important to the shared WLAN setting studied in this report, namely the physical, data link and network layers. The physical layer is concerned with transmitting raw bits over a communication channel, while the data link layer transforms the raw bits into a connection and often corrects basic errors. The network layer is the first end-to-end layer, and controls the operation of the network. With TCP/IP internet communication, the network layer transmits IP packets. For more details on the layers and the OSI model, [7] is a good reference.

3.2.2 History of Vertical Disintegration

Historically, the telecommunication companies in most countries were publicly owned companies in a position of monopoly [23]. They controlled the physical copper wires connecting the users to the network, and all the rest of the network infrastructure. These companies are called incumbents. In addition to controlling the infrastructure, they were the only service providers in the network. Although the number of services offered in the early days of telecommunications was limited, all were controlled by the incumbents and there was no competition in any parts of the network. Because of the monopoly situation with lack of competition, the industry was heavily regulated [23]. Translating this situation to the OSI model, the incumbents controlled all layers of the protocol stack.

Throughout the 1990s, most countries in Europe and North-America decided to force mandatory unbundling onto the telecom incumbents. The Telecommunications Act of 1996 in the USA was passed based on the hypothesis that unbundling would facilitate competition amongst telecommunication providers and eventually enable competitors to the incumbents to build their own facilities [8]. A firm may choose to unbundle and lease parts of its network at a voluntarily negotiated rate, or it may be forced to perform such a lease through regulation. The latter form is referred to as mandatory unbundling.

After the introduction of mandatory and voluntary unbundling, a number of competitive telecommunication providers have appeared. The introduction of these competitors has dramatically changed the telecommunication landscape. The economic and social welfare aspects of this change [8][9] are not relevant to this report. Rather, the focus will be on the new business environment and technological challenges this change has brought with it.

With the unbundling of network elements, a number of firms have appeared that specialize in specific parts of the value chain [9][2]. This has resulted in a number of service providers providing their services through the same access provider, and access providers selling access to a number of different service providers. An example of this is Svenska Stadsnätforeningen in Sweden working for a fiber infrastructure open to several

service providers [10]. The unbundling has also had consequences for wireless networks; an aspect that will be studied in the remaining part of this section.

3.2.3 Vertical Disintegration in Wireless Networks

Disintegration at Different Levels

With wireless networks being a later technology than wired networks, the path towards vertical disintegration has also been shorter. When considering deployment of the infrastructure, wireless networks are a lot cheaper than wired networks [12]. However, the most common services, such as internet access, are independent of the underlying network technology [7]. Since there already are a number of ISPs offering internet access through wired networks, these could be interested in offering the same services through a wireless network. With this approach, they have the service provider know-how, but lack the wireless networks to reach the users in shared WLANs.

Some municipalities and firms deploying shared WLAN aim to provide access on a wholesale basis to already existing ISPs [12][13]. Typically, these ISPs already provide services through wired networks, such as ADSL or dial-up. When providing internet service through a separate access provider, these ISPs are considered Virtual Wireless Internet Service Providers (VWISPs).

Figure 3-3 provides a high level illustration of vertical disintegration in a wireless environment. The access provider can provide such a solution in two different ways. The first approach is to control the two lower layers of the OSI model, the physical and data link layers as illustrated in Figure 3-4(a). With this solution, the access provider will control the network on the data link layer, using MAC addresses to perform frame switching. The network architecture is flat, with no address hierarchy such as the one found in the internet network layer. As the access provider does not control the network layer functionality in this framework, it is not responsible for distributing IP addresses to the users connected to the network. There are only data link layer switches in the network, no network layer routers. With this architecture, the users select the SSID of

their VWISP and the data is routed to the VWISP which assigns an IP address to the user. The following traffic is then switched directly to the VWISP. The advantage of this approach is that the user obtains an IP address that belongs to the VWISP, and not to the access provider. This results in the access network being completely transparent to the end users.

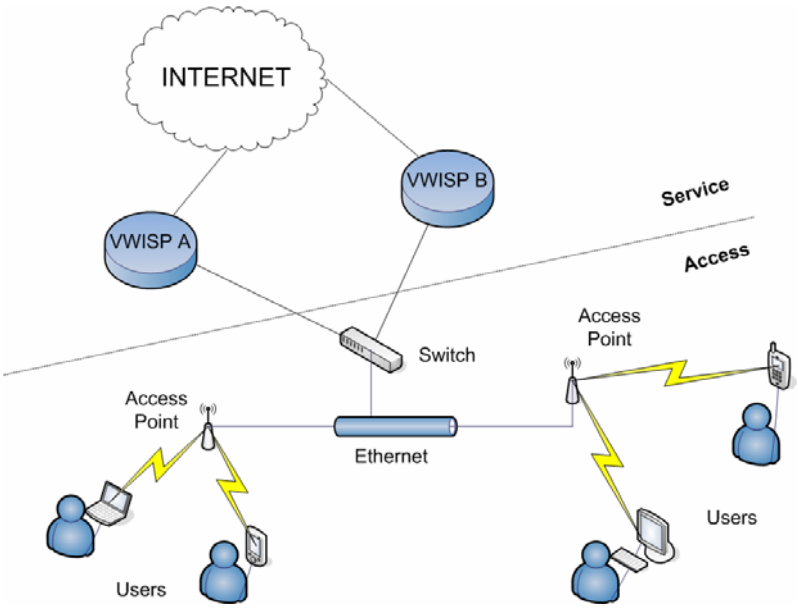

Figure 3-3: Illustration of vertical disintegration in shared WLAN.

The other approach to a vertically disintegrated wireless network is when the access provider controls the three lower layers of the OSI model, this time including the network layer as illustrated in Figure 3-4(b). The access provider now also distributes IP addresses, and the network carries out hierarchical network level routing. Network components include routers. The main difference from the previous solution is that the end users are assigned IP addresses designated to the access provider, and not those of the VWISP. The access network is no longer as transparent as with the previous solution.

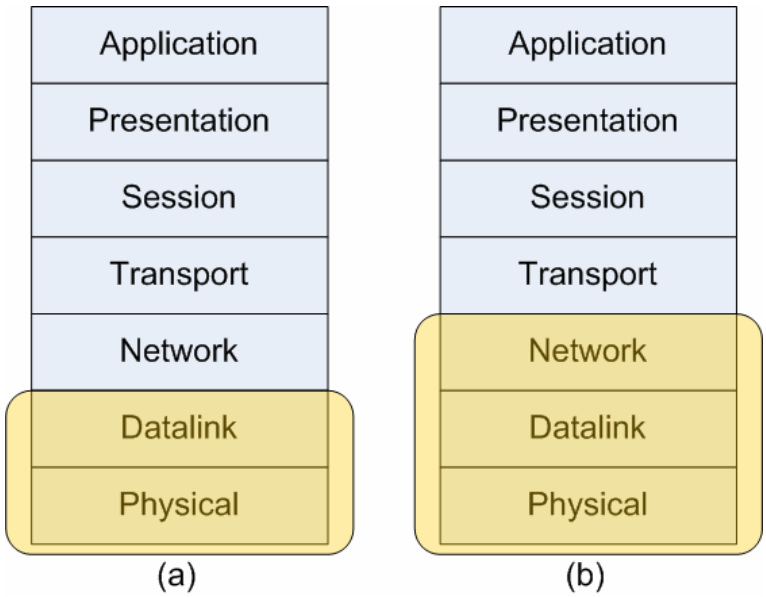

Figure 3-4. (a) and (b) illustrate the areas of responsibility for the two different access provider options in shared WLANs. The shaded areas represent the responsibilities of the access provider.

A third possibility is a combination of the above two options. The access provider could act as a service provider providing internet service to some major customers, while at the same time selling access on a wholesale basis to other service providers. This would imply a voluntary unbundling of the network.

Interaction between Service and Access Providers

In a wireless network with a user, an access provider and a service provider, the access provider acts as the connecting link between the user and the service provider. There is no direct link between the latter two. The access provider provides the network infrastructure that links them together. Figure 3-5 provides an illustration of this situation.

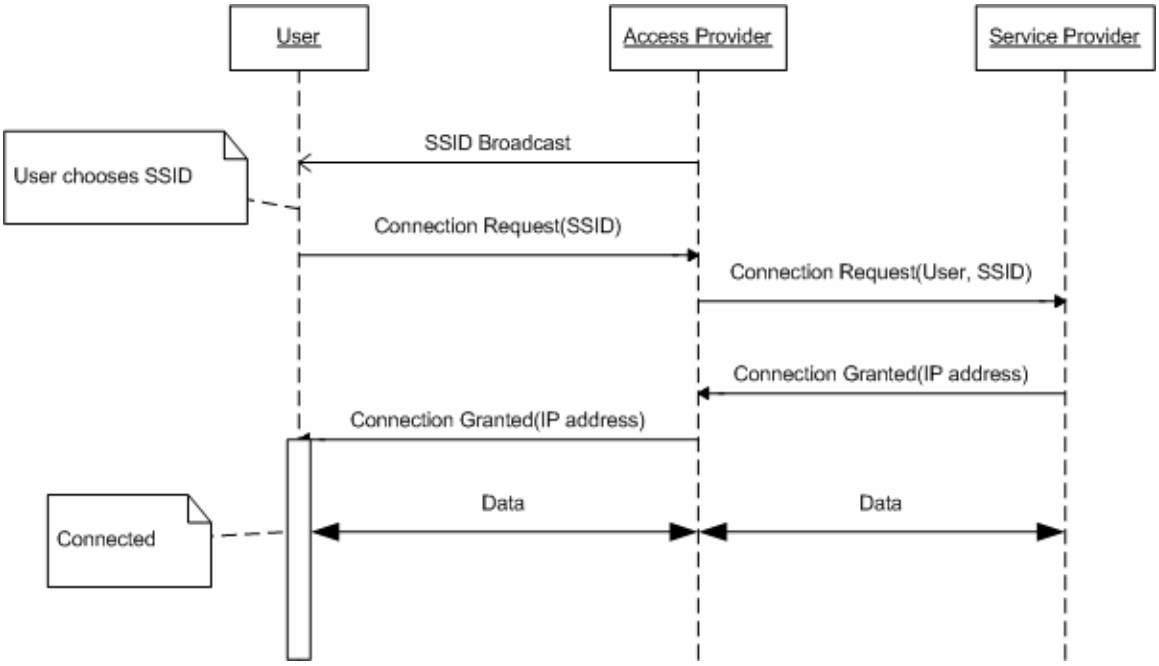

Figure 3-5. Message Sequence Chart showing the interaction between the user, access provider and service provider. This figure illustrates the situation where the access provider provides physical and data link layer functionality.

As discussed earlier, the access provider can interact with several service providers and provide the users with a choice between these. Technically, this is done by the access provider broadcasting one SSID for each service provider. The user chooses to which service provider he/she wishes to connect, and sends a connection request. If the request is granted, the service provider allocates an IP address to the user's network interface card (NIC), and a tunnel for transferring data is created. Authentication and authorization is an important part of this process.

3.3 Service Enablers and Business Actors

3.3.1 Introduction

A service enabler is a feature needed to enable the delivery of a service. In shared WLANs like the ones that are considered in this report, the service providers are the firms that provide services to end users. Because the network is vertically disintegrated, a service provider often has to request enablers from a number of other business actors.

Before describing the business model, it is important to identify the service enablers that shared WLAN access providers will provide to their customers. Through looking at services and service enablers, the business actors relevant for the business model are identified and briefly described.

3.3.2 Services and Service Enablers

This section describes a selection of the services offered to the end users in a shared WLAN network. The service enablers necessary for these services are specified in Table 3-2.

The service portfolio of a service provider in a shared WLAN environment consists of relatively few services, and does not require a great number of service enablers. The services are quite homogeneous. Table 3-2 identifies the providers of the service enablers necessary to deliver a service to the end user.

The process of delivering a service to end users involves the important process of service composition. This process is conducted by the service provider by utilizing the relevant service enablers and combining these to a service that constitutes value for to the end user. From Table 3-2 it is important to notice that the access provider delivers essential enablers that are needed for the delivery of all services because it is the controls the crucial link between the end users and other business actors. Furthermore, the service provider is another essential business actor because it conducts the service composition.

Service Offered	Service Enabler	Provider of Service Enabler
Connection Initialization	Network Discovery	Access Provider
	Authentication	Access Provider Service Provider
	Authorization	Access Provider Service Provider
Internet Access	Network Access	Access Provider
	Internet Connection[3]	Service Provider
	Internet Content	Content Provider
Position-based Services	Network Access	Access Provider
	Positioning Services	Service Provider
	Positioning	Context Provider
	Position-based Content	Content Provider
Voice over IP	Network Access	Access Provider
	Internet Connection	Service Provider
	Guaranteed QoS	Access Provider Service Provider
Billing of End Users	Authentication	Access Provider Service Provider Identity Provider
	Accounting	Service Provider

Table 3-2. This table shows the services offered to end users in a shared WLAN, the service enablers necessary to support these, and the providers of these enablers. When there are several options for the provider of one service enabler, all are listed.

3.3.3 Business Actors

From the services and service enablers specified the business actors in the environment that a shared WLAN access provider operates in are identified. Figure 3-6 shows an UML use case illustrating these actors interacting to provide a service to the end user.

[3] Internet Connection in this setting is the connection from the Service Provider to the rest of the internet.

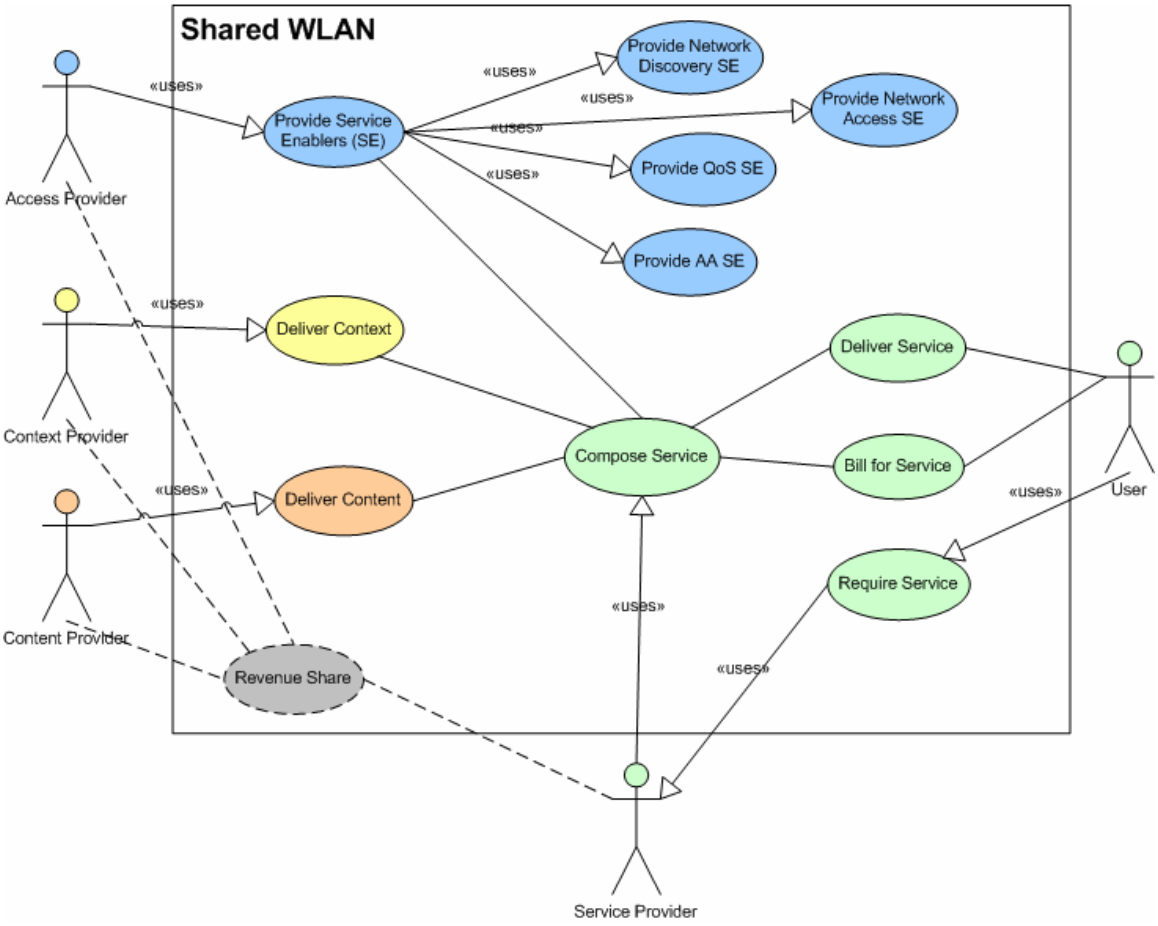

Figure 3-6. UML Use Case showing the interaction between business actors and users in shared WLAN.

The access provider provides several enabling services to the service composition. Network Access, Network Discovery, Quality of Service (QoS), and Authentication and Authorization are the most important. This is a generic model, and all these service enablers are not provided by all access providers. In vertically integrated networks, the access provider and the service provider are often the same business actor. In shared WLANs, however, the access provider is a separate entity, and provides its enabling services to a number of service providers.

The context provider provides context to the service composition. Some network solutions may use an external context provider, such as a firm delivering positioning with

the GPS technology. In the business model described in this report, it is assumed that the access provider also acts as a context provider using the access network to deliver context when necessary.

The content provider provides the content requested by the user. A wide variety of content is normally accessed by users through their service provider. In terms of OSI model layers, the content providers operate mainly on the application layer, and to a certain extent on the presentation layer. They deliver content such as web sites, web services and web based applications.

The service provider is the business actor that composes all components into a service delivered to the end user through the access provider. It is the only actor that has a direct interaction with the user, and takes care of customer billing. This is an important contributor to the revenue in the situation being discussed, and the revenue has to be divided between all business actors by a revenue sharing agreement. Typically, service providers collect a fee from users and distributes parts of this to the other business actors as specified in agreements between the relevant actors.

4 Business Model for an Access Provider in a Shared WLAN

4.1 Introduction

This section develops and specifies a business model for an access provider in a shared WLAN setting. As specified previously, such a provider operates in a vertically disintegrated business situation, selling access to service providers on a wholesale basis. The access provider does not provide services directly to the end-user, but provides service enablers to a service provider that composes these into services sold to the user through the access network of the access provider.

The goal of this report is to develop a sound and well specified model of the technological and business situation. Section 3 dealt with the technological situation, this section deals with the business situation; more specifically the business model itself. As modeling business differs from modeling technology, an ontology developed specifically for business models will be applied; suggested by Osterwalder in [20]. Furthermore, the value network model of Fjeldstad and Stabell [37] is used to investigate the joint value creation. Further details on the ontology of Osterwalder are provided in *Appendix A: Business Model Ontology*.

4.2 Strategy

It is out of scope for this report to describe the strategy of an access provider in a shared WLAN. However, as mentioned in section 1, a strategy deals with the goals, visions and objectives of a firm, and these can be seen as a framework for the business model. The strategy is often developed with the aim of obtaining a sustainable competitive advantage. Hence, the business model described in this section should be adapted to the competitive situation the firm operates in. To be able to create the business model without a thoroughly defined strategy, the business model in this report focuses on the money earning logic; how the firm operates to earn money.

4.3 Business Model Building Blocks

As described in section 2.1, the business model ontology that will be used in this report consists of nine building blocks, also called elements. Most of these elements consist of a set of sub-elements, as can be seen in Figure 4-1 and *Appendix A: Business Model Ontology*. Furthermore, elements and sub-elements interact with other elements of the ontology. This is specified in greater detail in the following sections.

The characteristics of each element are described in the form of a table or a text box, the templates for these are found in *Appendix A: Business Model Ontology*. Graphical illustrations showing the relationship between the elements are also provided.

4.3.1 General

Figure 4-1 provides an illustration of all the business model elements and sub-elements that will be specified. The elements are in a lighter shade than the sub-elements. The business model consists of four main pillars; Infrastructure Management, Product, Customer Interface, and Financial Aspects. In addition to these pillars, the element Actor describes the business actors interacting to create value.

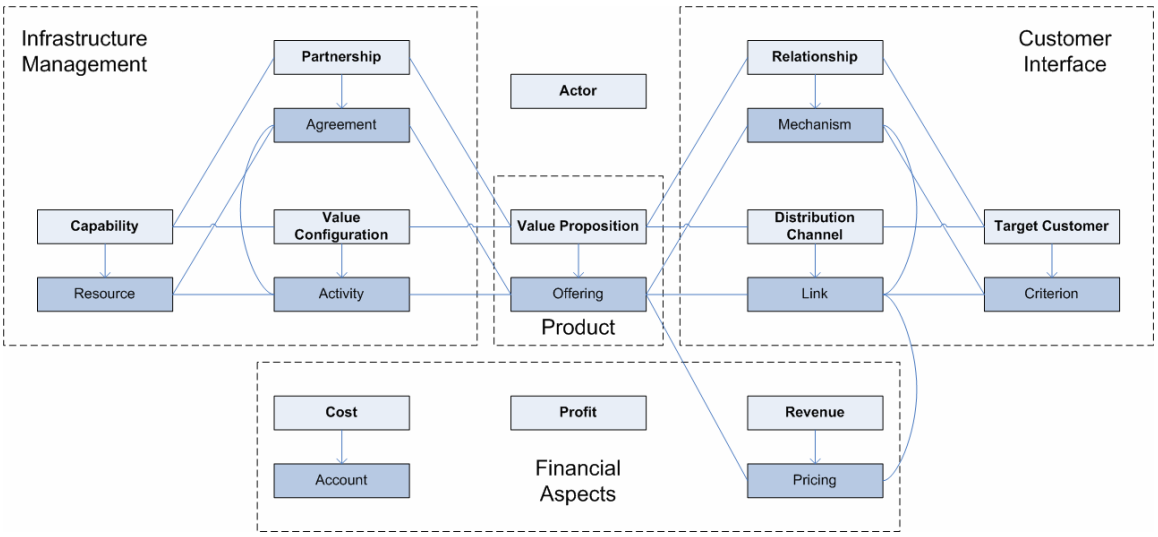

Figure 4-1. Overview of business model elements, sub-elements, and their relationship.

Who is the customer?

When starting to specify the business model one essential question stood out as more difficult than the others to answer; who is the customer? The end-users of the services provided are the users of the shared WLAN in the area where it is deployed. But the entities providing revenue to the shared WLAN access provider are VWISPs. These purchase the enabling services, such as network access, from the access provider (AP).

There is no revenue stream from the end user directly to the AP. However, the revenue from the end user to the VWISP is shared as specified in a revenue share agreement. By choosing this approach, the value proposition is created together with the partners of the AP. Hence, the model becomes a lot more interesting and describes what value the customer really receives. For these reasons the end user is modeled as the customer. The approach also makes modeling user/customer behavior easier since it is the behavior of the end user that affects the price-demand relationship.

Vertical Co-production

As discussed in [40], the firms in the telecommunications industry are mediators facilitating contact between the customers. They employ a mediating value creation technology. The technology creates value for the customers by facilitating a network relationship between them. This is also the case for a shared WLAN and the services provided. A value network model is used to describe the value configuration of the AP and its partners.

Mediators commonly co-produce services in a layered and vertically disintegrated situation, where the services of one mediator are provided over the network of another mediator [40]. With shared WLAN, the services are composed by the VWISP and delivered over the network of the AP. The enabling services of the AP serve as a platform for the higher-level VWISP services, and these again serve as the platform for the content provider services. The mediators serve the same customer, but at different levels. Hence, the business situation is one of vertical disintegration. This is illustrated in Figure 4-2.

The details of this interaction are discussed in section 4.3.4. The situation can be compared to that of mobile networks, where Mobile Virtual Network Operators (MVNOs) provide mobile telephone services over the network of a Mobile Network Operator (MNO) [39].

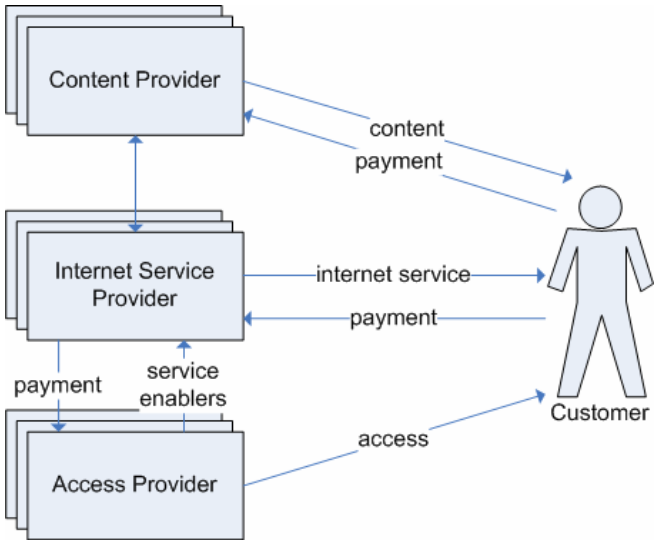

Figure 4-2. Vertical co-production of value with the same customer.

When considering Figure 4-2 in the specific case of shared WLAN, the Access Provider is the owner and operator of the access network infrastructure. The Internet Service Provider pays for use of the access network, and takes the role of a VWISP. The Content Provider provides content to the customer, but is not part of the revenue share agreement. The customer pays the VWISP for internet access, and a share of this payment is forwarded to the AP.

4.3.2 Actors

Before proceeding to the specific pillars and elements of the business model, the business actors that interact in a shared WLAN situation are described. The actors were identified in section 3.3.3, but this section will transfer the description to the business model ontology. The focus is on the access and service provider, since these are the two entities interacting directly to create value. It is assumed that there is no direct partnership

between the two aforementioned and the content providers. Furthermore, it is assumed that the access provider also takes the role of the context provider.

ACTOR	Virtual Wireless ISP (VWISP)	Access Provider (AP)
Description	The VWISP is the actor that composes all components into a service delivered to the end user through the network of the access provider. It is the only actor that has a direct interaction with the user, and takes care of customer care and billing. The VWISP collects a fee from the customers and distributes parts of this to the AP as specified in the revenue share agreement.	The access provider provides several enabling services to the service composition. Most importantly, the AP owns and operates the wireless access network and its wired backbone. The customers access the services of the VWISP through the network of the AP. The business model of the AP is studied in this report.

4.3.3 Product

This section will discuss the product offered to the target customers. As can be seen from Figure 4-3, the value proposition is composed of a set of offerings. The value proposition is created by a vertical co-production with the partners of the AP. It relies on the capabilities of the AP and its partners, and provides value for the target customers. The goal of specifying the value proposition is to get a better understanding of what the company is offering the customers. The specification can be used to analyze how the value can be increased, and to compare the value proposition to that of competitors.

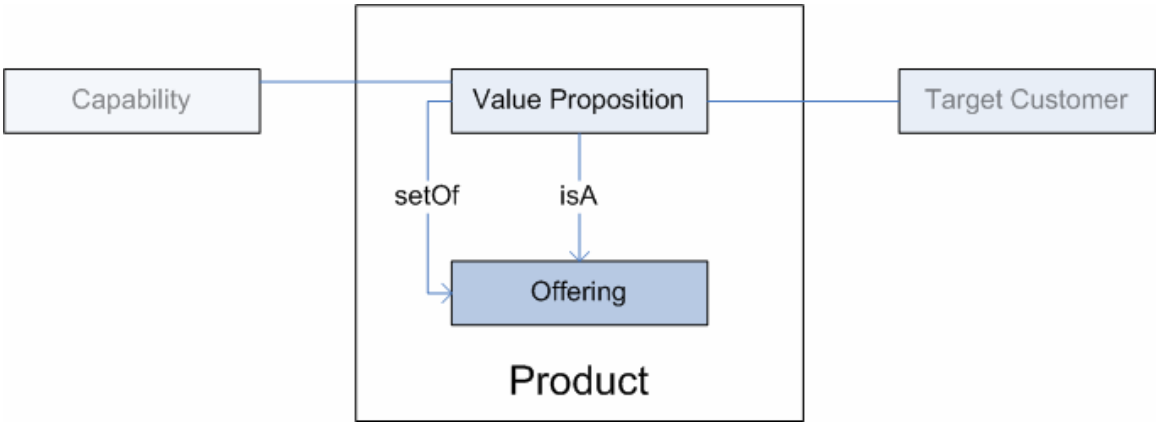

Figure 4-3: Product business model pillar.

Offerings and Value Proposition

The value proposition is composed of a set of offerings. Offerings are described by the attributes: Description, Reasoning, Value Level, Price Level, and Value Life Cycle. The three main offerings are presented in Table 4-1.

OFFERING	Internet Access	Wireless Access Network
Description	A connection through the AP to one of the VWISPs provides the customer with internet access	The access network covers large areas of the city center, and offers convenient access for the customers throughout this area at any time
Reasoning	{use} Value is offered through the use of the internet service	{effort} The large coverage area and availabilily reduces the effort to access the network
Value Level	{me-too} Not differentiated from competition	{innovation} Innovative offering; not offered by competition
Price Level	{market} Price at market level	{free} No extra charge
Value Life Cycle	{use} Value derived during use	{use} Value derived during use

Table 4-1: Offerings of a shared WLAN access provider.

The first offering presented in Table 4-1 is Internet Access. Internet Access is created through the collaboration between the AP and VWISP. The value for the Reasoning attribute is {use} because the value is created for the user through the use of the internet access. Moreover, the Value Level is {me-too} since this part of the offering does not differ from alternative existing offerings. The internet service is priced at market level. The other pricing options are {free, economy, market, high-end}. Google and Earthlink cooperate to offer free ad-based access in San Francisco (USA) [35], while Wireless Philadelphia offers economy-priced access [12]. The pricing scheme is a trade-off between pricing low to attract customers, and pricing high to generate greater revenue. It is assumed that the AP has no direct influence over the price set by the VWISP for the internet access. The AP charges the VWISP for network access as specified in the agreement between the two actors. However, the price does influence the AP if it charges

the VWISP on a per-user basis. This will be discussed in greater detail in section 4.3.6 and in section 5. The Value Life Cycle-row in Table 4-1 specifies in what phase of the value life cycle the customer value is created. With internet access the main value is derived during the use of the access, and the value for this attribute is hence {use}.

The second offering presented in the above table is Wireless Access Network. This offering gives the customer the opportunity to access the network throughout the large coverage area at the customer's convenience. The offering is bundled with Internet Access, and the two are always delivered together. Wireless Access Network creates value for the customer through reducing the effort the customer has to put in to access the network. It is a free add-on to the Internet Access offering, and value is created during the use-phase of the value life cycle. The large wireless coverage area of the AP network is what really differentiates the product from potential competition and substitutes. Thus, the value level is {innovation}.

As outlined above, the value proposition is composed of the specified offerings. The main value proposition of the AP and its partners is a wireless city-wide internet connection. The proposition is illustrated in Figure 4-4. Its relation to capabilities and customers is shown in Figure 4-5. The capabilities are examined in section 4.3.4 and the target customers in section 4.3.5.

VALUE PROPOSITION Name: Wireless City-Wide Internet Connection

Description: The main value proposition of the AP and its partners is the wireless city-wide internet connection they offer their target customers. This proposition offers the customers wireless internet access throughout the city center at their convenience.

Reasoning: {use}: Value is created for the user during the use of this value proposition.

Value Level: {innovation}: This is an innovative proposition, with little competition at this time. Very few other business actors offer a comparable service.

Price Level: {market}: The proposition is priced at market level.

Composed of OFFERINGs:

- Internet Access
- Wireless Access Network

Value for TARGET CUSTOMER:

- Local Citizens
- Visitors

Based on CAPABILITYies:

- Service Composition
- Maintain High Quality Network
- Attract and Keep Customers

Figure 4-4. Value Proposition of AP and partners.

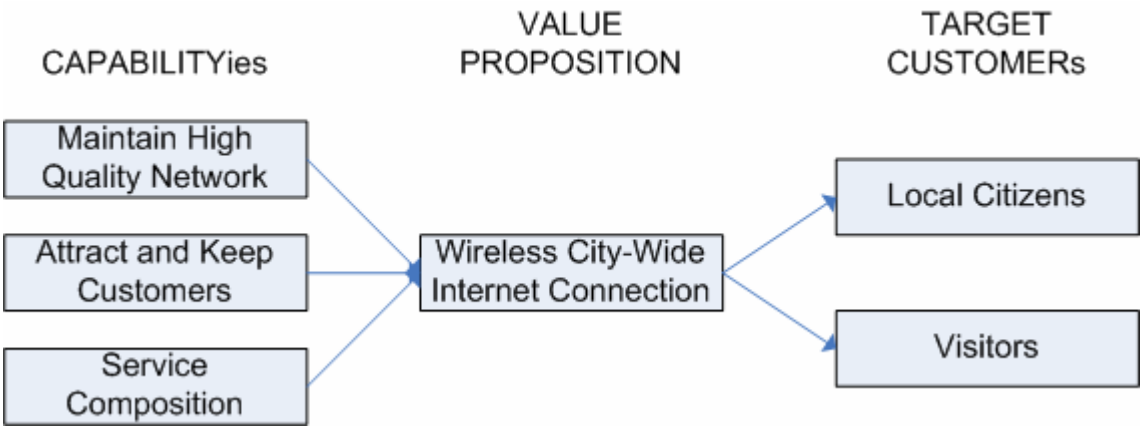

Figure 4-5. Value proposition and relationship with capabilities and target customers.

4.3.4 Infrastructure Management

Allee claims that the key business question in the knowledge economy is, “How is value created?” [42]. The Infrastructure Management pillar is about how a company creates value. It describes what abilities are necessary to provide its value proposition, and maintain its customer interface [20]. In other words, this section will describe how the AP and its partners relate to each other, and how the AP creates value relying on in-house capabilities and those of its partners. Through specifying the interface between itself and its partners, the AP can also work towards a plug-and-play interface. This will make the value proposition of the AP more independent of which partners it chooses, and increase the substitutability of its partnerships.

As illustrated in Figure 4-6, the Infrastructure Management pillar consists of the main elements Value Configuration, Partnership and Capability. The Value Configuration is a set of Activities relying on the Resources of the AP and its partners. The relationship between the AP and its partners is specified through the sub-element Agreement. Altogether, the Infrastructure Management is what supports the Value Proposition.

Because the customer in this business model is the end user of the network services, the partners play an important role in the value creation. The service enablers of the AP are a part of the final service offered to the customer. This section will specify the partnerships of the AP, and what resources and capabilities these partners contribute with to the vertical co-production of value.

Value networks are used to investigate the exchanges between the AP and its partners [37]. Using value networks makes possible modeling exchanges of both tangible and intangible value.

Agreements and Partnerships

This section will describe the partnerships that the AP engages in. The details of specific partnerships are specified by agreements. Since the business model developed here is generic for APs in a shared WLAN situation, the properties of the specific partners are not known. As a consequence of this, the report focuses on the general aspects of the partnerships and not on the details of the agreements. Hence, the ontology element Agreement is not specified.

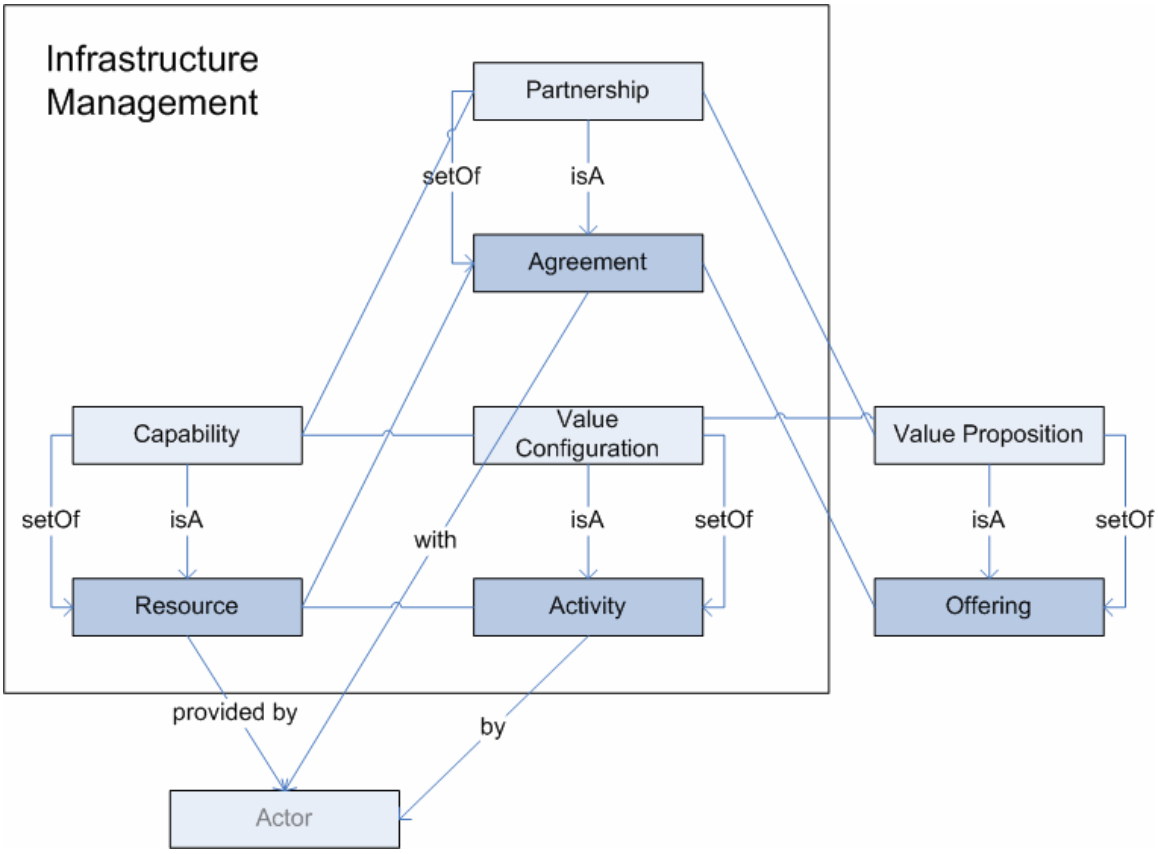

Figure 4-6: Infrastructure Management business model pillar.

The main partnership studied is with the VWISPs cooperating with the AP to create the value proposition and generate revenue. An AP can have partnerships with a number of VWISPs, using different SSIDs in the access network, provided that the network supports this. This section will specify one instance of such a partnership. Other possible partners are municipal entities and universities; these are studied in section 5. A partnership with a VWISP is specified in Figure 4-7.

PARTNERSHIP Name: VWISP Partnership

Description: The AP must enter into partnerships with one or more VWISPs to co-produce the value that is offered to the customers. The AP is dependent on several of the capabilities of the VWISP, just as the VWISP depends on the AP be able to offer services to the customers.

Reasoning: {acquisition of resources}: The VWISP supplies resources needed for the value creation, such as the capability to compose a service. It also contributes with a

customer base and a potentially strong brand name. See *Activities and Value Configuration* for further contributions.

Strategic Importance: {high}: These partnerships are crucial to the AP. The AP does not sell services directly to the customers; it needs to partner with VWISPs to compose the service and offer value to the customers.

Degree of Integration: {medium}: The network infrastructures of the AP and VWSIP have a low degree of integration, but the VWISP owns the customer base and is in this way somewhat integrated with the AP.

Degree of Competition: {low/medium}: Low degree of competition if the VWISP does not operate its own network. Medium degree of competition if the VWISP operates its own hotspot zones.

Substitutability: {medium/high}: Because the network infrastructure of the VWISP and the AP are not integrated, the AP can substitute the VWISP for another VWISP at its convenience.

PARTNERSHIP with ACTORs:

- VWISP (All partnerships are with one VWISP, but there can be a number of partnerships for an AP in a shared WLAN)

Figure 4-7. Partnership with VWISP.

Resources and Capabilities

This section explains the capabilities of the AP and its partners, and how these are made up of a set of resources. Table 4-2 and Table 4-3 present the resources of this business model. The capabilities are presented in Figure 4-8, Figure 4-9 and Figure 4-10. The resources are described by the attributes Description, By ACTOR, and Resource Type.

RESOURCE	Access Network	Customer Base	Network Know-How	Customer Care Knowledge
Description	The physical access network. The network supports mobility.	A customer base that may include customers currently not in the shared WLAN	The ability to efficiently operate the access network	Customer care, support center and knowledge
By ACTOR	AP	VWISP	AP	VWISP
Resource Type	{tangible}	{tangible}	{intangible}	{intangible}

Table 4-2. Resources.

RESOURCE	Brand Name	Positioning Enabler	Internet Access
Description	A strong brand name may attract customers and enable higher price levels	This resource enables positioning services	This resource provides internet access beyond the access network.
By ACTOR	VWISP, AP	AP	VWISP
Resource Type	{intangible}	{tangible}	{tangible}

Table 4-3. Resources continued.

CAPABILITY Name: Maintain High Quality Network

Description: The capability to maintain a high quality wireless network that spans large areas.

Composed of RESOURCEs:

- Access Network
- Network Know-How
- Internet Access

Figure 4-8. Capability, Maintain High Quality Network.

CAPABILITY Name: Attract and Keep Customers

Description: The capability to attract customers and create customer loyalty to keep them.

Composed of RESOURCEs:

- Customer Base

- Customer Care Knowledge
- Brand Name

Figure 4-9. Capability, Attract and Keep Customers.

CAPABILITY Name: Service Composition

Description: The capability to compose a service from the resources/service enablers provided by the different actors.

Composed of RESOURCEs:

- Access Network
- Positioning Enabler
- Internet Access

Figure 4-10. Capability, Service Composition.

Activities and Value Configuration

This section describes the activities that the AP and its partners perform. The activities constitute a value configuration, also described in this section. As mentioned previously, the main purpose of a firm is to create value that the customers are willing to pay for. An actor performs a value activity for profit or to increase utility [41]. The value configuration shows all the activities necessary for this value creation, and also describes what resources that are needed. An activity is described by the attributes Description, By ACTOR, Uses RESOURCE, Activity Level, and Activity Nature. This report concentrates on primary activities, and specifies to what part of the value network these belong.

As outlined previously, a value network is used to illustrate the value configuration of the business model. This is presented in Figure 4-11. By studying the value configuration, it can be seen that the AP executes activities at the network infrastructure operation level. This is because the AP's main contribution to the value configuration is the access network and the management of this.

ACTIVITY	Manage Subscriptions	Advertising	Customer Care
Description	Customer subscriptions and sales management	Advertising services/offerings	Customer care to increase loyalty
By ACTOR	VWISP	VWISP	VWISP
Uses RESOURCE	Customer Care Knowledge, Customer Base	Brand Name	Customer Care Knowledge, Customer Base
Activity Level	{primary}	{primary}	{primary}
Activity Nature	Network promotion and contract management	Network promotion and contract management	Service Provisioning

Table 4-4. Activities.

ACTIVITY	Sell Service	Manage Network	Interconnect with VWISP
Description	Selling services/offerings to customers	Network management and maintenance	Interconnection of AP's access network with network of VWISP
By ACTOR	VWISP	AP	AP, VWISP
Uses RESOURCE	Brand Name, Internet Access, Positioning Enabler, Access Network, Network Know-How	Internet Access, Positioning Enabler, Access Network	Network Know-How, Access Network
Activity Level	{primary}	{primary}	{primary}
Activity Nature	Service Provisioning	Network Infrastructure Operation	Network Infrastructure Operation

Table 4-5. Activities continued.

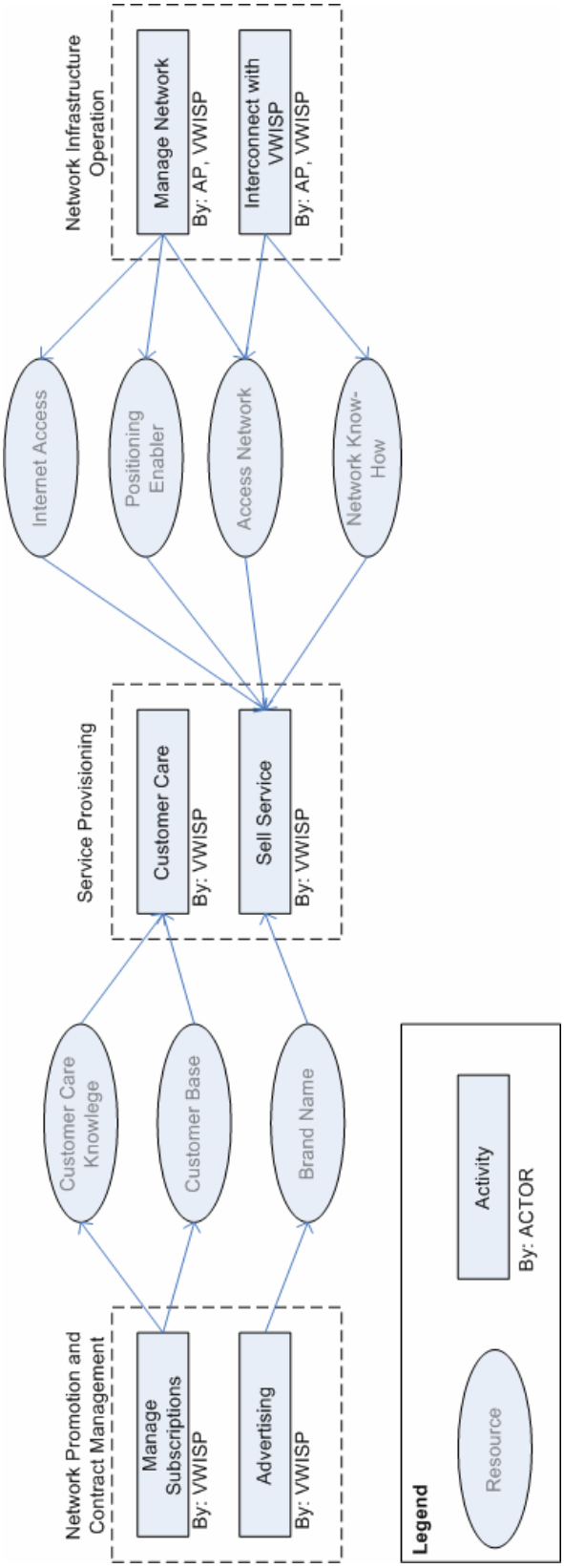

Figure 4-11. Value configuration illustrated by a value network. The illustration also shows which resources that are used for each activity.

4.3.5 Customer Interface

This section describes the Customer Interface pillar of the business model. The Customer Interface consists of the elements Target Customer, Relationship, Distribution Channel, and their sub-elements. The customer interface describes the customer, how the company relates to the customer, and how the value proposition is distributed. Figure 4-12 presents the business model elements of this pillar.

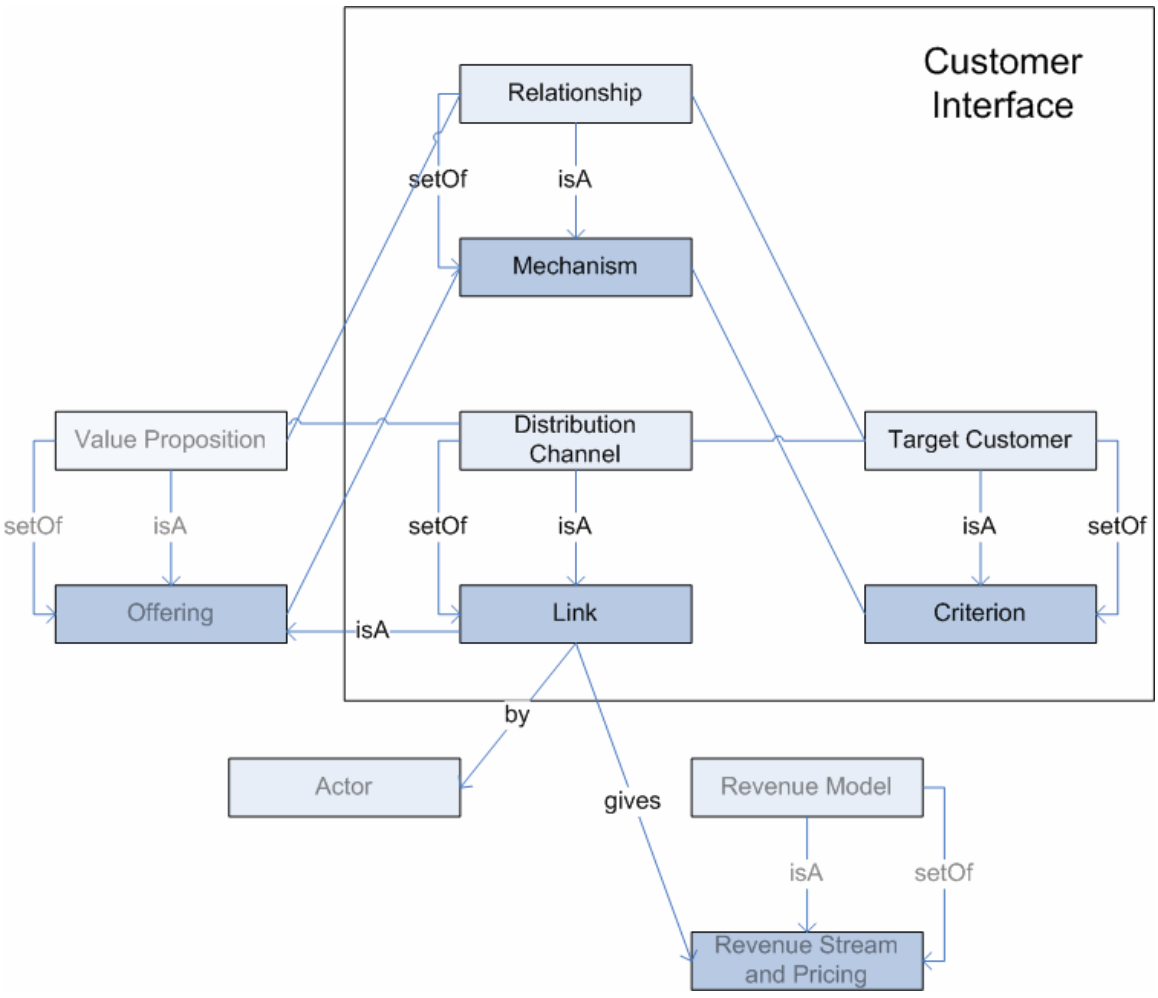

Figure 4-12: Customer Interface business model pillar.

For the customer interface pillar, the Osterwalder ontology [20] leans heavily on marketing and the use of ICT for customer relationship management. However, the AP does not market or sell its product directly to the customer; this is the responsibility of the VWISP. Hence, the report does not focus on the marketing. Furthermore, the VWISP is

responsible for customer care and acquisition, and these areas will not be described. What is important to the AP, however, is the access network and how this affects the distribution of the value proposition and the relationship with the customer. These aspects will be studied in this section. In other words, the customer interface specification of this report is more technical than the one of Osterwalder.

Target Customer and Criterion

This section describes the target customers segments of a shared WLAN offering, and the criterions that identify these customer segments. All customers studied are end users, and the nature of the relationship is thus business to consumer (B2C). A target customer segment defines the type of customer a company wants to address. To specify such segments, a set of criterion of geographical and socio-demographic nature are used. The criterion element of the ontology used consists of two attributes; Name and Description. Because of the limited amount of attributes, this report presents target customer segments together with the criterion in Figure 4-13 and Figure 4-14.

TARGET CUSTOMER Name: Local Citizens

Description: Local citizens living within or near the coverage area of the wireless access network.

Split into set of CRITERIONs:

- Local citizens: Citizens living within or very close to the coverage area of the wireless access network.
- Citizens of surrounding areas: Citizens living in the proximity of the coverage ares of the wireless access network.
- Local employees: Employees of local firms located or operating within the coverage are of the wireless network. These use the network for business purposes.

Figure 4-13. Target Customer segment: Local Citizens.

TARGET CUSTOMER Name: Visitors

Description: Customers visiting the city with the wireless access network for business or leisure purposes.

Split into set of CRITERIONs:

- Tourists: Out of town visitors, visiting within the coverage area of the wireless access network for leisure.
- Business visitors: Out of town visitors, visiting within the coverage area of the wireless access network for business purposes.

Figure 4-14. Target Customer segment: Visitors.

Segmentation is conducted to divide customers that behave in the same way or have similar needs into the same groups. It will also be useful for the scenario analysis in section 5. For the VWISPs marketing and selling the service further segmentation may be beneficial, but the above specification is sufficient for a generic AP.

Distribution Channel and Link

This section will describe the distribution channel of the value proposition. Since the focus is on the technical distribution of the value proposition and not on marketing channels, the wireless access network is treated as the distribution channel. A distribution channel is made up of a set of links; in the case this link is the wireless access network. The distribution channel allows the AP to deliver value directly to the customer. With the access network being the back-bone of the business of the AP, it is maintained by the AP itself.

The link is the main source of revenue for the AP through the revenue share agreement with the VWISP. This aspect is studied in further detail in sections 4.3.6 and 5.

The distribution channel and link are described in Figure 4-15. Note that the link in this business model, the Wireless Access Network, is also an Offering as described

previously. The relationship between the elements Value Proposition, Distribution Channel and Target Customer Elements is illustrated in Figure 4-16.

DISTRIBUTION CHANNEL Name: Wireless Access Network

Description: The distribution channel of the value proposition of the AP and its partners is the wireless access network.

Value Life Cycle: {use}: The value is delivered to the customer during the use-phase of the value life cycle.

Composed of LINK:

- Wireless Access Network: This is the only link between the value proposition and the customer that is relevant to the AP.

Figure 4-15. Distribution Channel: Wireless Access Network.

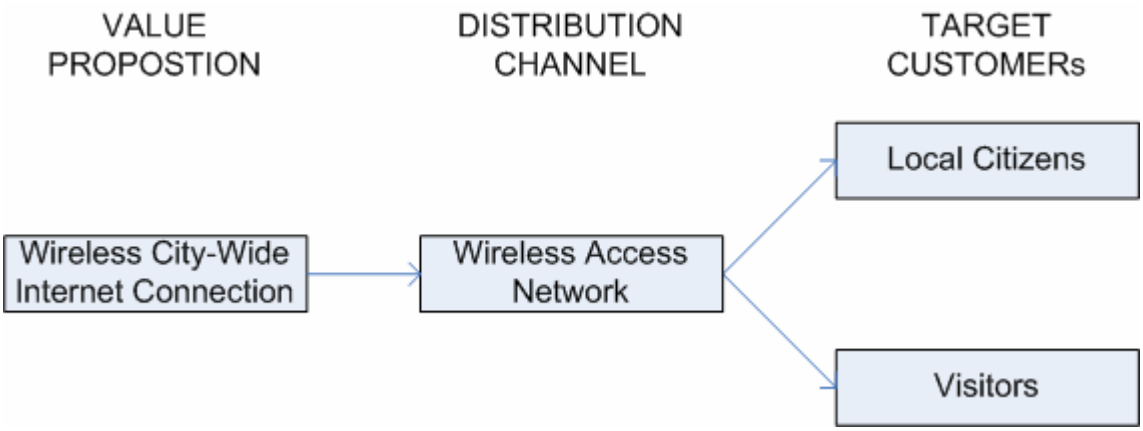

Figure 4-16. The value proposition is delivered through the distribution channel to the target customer segments.

Relationship and Mechanism

This section describes the relationship between the AP and the customer. The Relationship element promotes the value proposition, and is made up of the sub-element Mechanism. However, the customer relationship in a shared WLAN business situation is handled mainly by the VWISP. The VWISP takes care of customer acquisition and retention. The relationship with the customer is less important to the AP. Nonetheless, the actions of the AP affect the relationship between the customer and the VWISP. For this

reason, the relationship effects of the wireless access network will be described in this section.

The mechanism sub-element of the ontology inherits from the sub-element link, and the only mechanism discussed here is the wireless access network.

RELATIONSHIP Name: Wireless Access Network

Description: The wireless access network affects the relationship with all target customer segments.

Customer Equity: {retention}: A higher quality network will help reducing the churn.

Value Life Cycle: {use}: Inherited from LINK, value derived during use.

Function: {trust, brand}: The quality of the network affects the brand and trust of the VWISP and the network in general. It is therefore important to maintain a high quality network.

Composed of MECHANISMs:

- Wireless Access Network.

Figure 4-17. Relationship ontology element.

4.3.6 Financial Aspects

The Financial Aspects is the last pillar of the business model ontology. It is dependent of all the other blocks, in the way that the purpose of all other blocks is to generate revenue and profit for the firm. This block is the outcome of the rest of the business model's configuration [20]. The Financial Aspects building block consists of the elements: Cost Structure, Profit, and Revenue Model. The business model building block is illustrated in Figure 4-18.

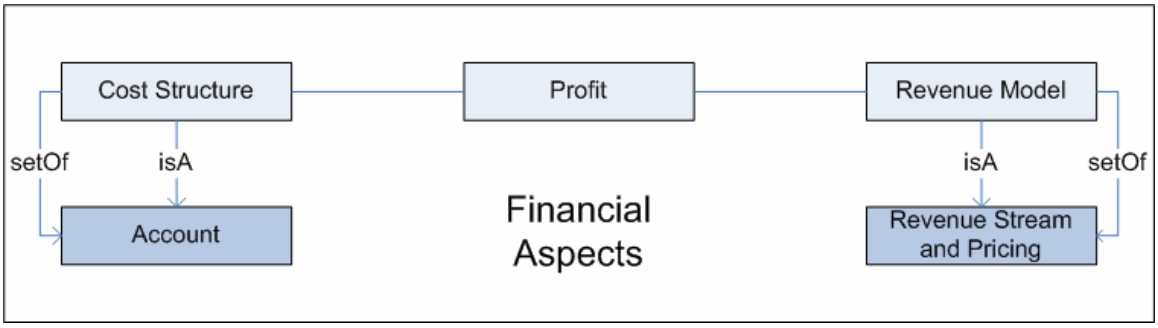

Figure 4-18. Financial Aspects business model pillar.

The focus of this section will be on the Revenue Model of the AP. A specification of the different revenue streams and pricing mechanisms is presented. This model focuses on a licensing fee and total traffic charge from each partner VWISP. Bear in mind, however, that there are many different ways of configuring the revenue model for an AP in a shared WLAN and that this in just one possible configuration. This section will also briefly outline some of the main costs of the AP. Because costs are specific for different APs, they will not be studied in detail.

Revenue Model

This section presents the specification of the revenue model for the AP in a shared WLAN business situation. The Revenue Model consists of two main ontology elements of the type Revenue Stream and Pricing, presented in Table 4-6. The wireless access network is the main source of revenue for the AP. This crucial resource is what separates the AP from the rest of the business actors, and it is the backbone of the business model and money earning logic.

The first revenue stream in Table 4-6 stems from the licensing of the wireless access network. In the model suggested, the AP collects a monthly licensing fee from every VWISP for the access to the network. Access to the network means that the SSID of the VWISP is broadcasted over the network, and that the customers are allowed to connect to the VWISP by choosing this SSID. The pricing method is {fixed}, meaning that the VWISP pays a fixed fee every month. Furthermore, this price and the fee for total traffic

need to be seen in relation to the customer demand. This will be done during the scenario analysis in the section 5.

REVENUE STREAM AND PRICING	Access Network Licensing	Fee for Total Traffic
Description	Each VWISP providing services through the wireless access network of the AP pays a fixed monthly fee.	Each VWISP is charged for total traffic generated by the customers associated with this VIWSP
Related to LINK, OFFERING	For OFFERING: - Wireless Access Network From LINK: - Wireless Access Network	For OFFERING: - Wireless Access Network From LINK: - Wireless Access Network
Stream Type	{licensing}: The AP licenses permission to use the wireless access network	{transaction cut}: The AP charges a fee based on the total transaction volume (traffic volume)
Percentage	NA	NA
Pricing Method	{fixed}: Explained above	{differential}: Explained below

Table 4-6. Revenue streams and pricing for the AP in a shared WLAN.

The second revenue stream is a fee for the total traffic generated by the customers of a VWISP. This fee is part of the revenue model to ensure that the fee the VWISPs pay depends on the traffic volume they generate. The pricing method for this revenue stream is {differential} because it depends on volume.

There are four main arguments for this pricing scheme. The first is that a total price dependent on the traffic volume will facilitate competition between the VWISP partners. Pricing with just a fixed fee would discriminate the smaller VWISPs. The second argument is that such a pricing scheme enables partnerships with VWISPs that have a high number of users, but a small traffic volume per user. Such VWISPs could be offering nation-wide coverage, and have customers that only visit the coverage are of the AP occasionally. These VWISPs would not enter into agreements which involve a high per-volume fee. The fourth argument is that a fee on total traffic volume would create incentive for the VWISP partners to limit the traffic of their users, thereby helping control the total traffic volume in the network. At last, a fixed fee per VWISP will most

likely give committed VWISP partners, and prevent unprofitable partnerships with VWISPs that do not generate traffic.

The shared WLAN AP has one Revenue Model, specified in Figure 4-19. The model is made up of the two revenue streams described above.

REVENUE MODEL Name: Charge for Network Access

Description: The revenue model for the AP in a shared WLAN business situation relies on charging for access to the wireless access network. This access network, also specified as a Link, Offering and Resource, is the backbone of the money earning logic. The network relates to the two Revenue Stream and Pricing sub-elements this revenue model is made up of.

Composed of REVENUE STREAM AND PRICING:

- Access Network Licensing
- Fee for Total Traffic

Figure 4-19. Reveneue Model of Access Provider in a shared WLAN.

Cost Structure

The cost structure of an AP in a shared WLAN is specific to the AP. Therefore, the ontology element will not be described here, but it is discussed in section 5. Important costs can be network maintenance, backhaul leasing fees, and wages.

5 Scenario Analysis: Wireless Trondheim

5.1 Introduction

This section will adapt the previously specified business model to Wireless Trondheim. Wireless Trondheim is a shared WLAN network in the Norwegian city of Trondheim. The goal of this section is to test the business model by applying it to Wireless Trondheim, and thereby also provide valuable insight into the business situation. Most business model elements can be applied as specified previously, while some need to be altered. The necessary modifications are presented in this section. Furthermore, the financial situation is looked into in detail to provide estimations of future profitability. These calculations are a rough estimation, and should not be used as a basis for any potential investment decisions. Social welfare implications and profitability for other business actors are out of scope for this report.

5.2 Wireless Trondheim

Wireless Trondheim is a cooperation between the Norwegian University of Science and Technology (NTNU), Sør-Trøndelag County, The Industry Association in Trondheim (nor: Næringsforeningen i Trondheim), Trondheim Municipality, SpareBank1 Midt-Norge, Adresseavisen, and Trondheim Electric Utility (nor: Trondheim energiverk, TEV) [43]. These actors constitute the shareholders of Trådløse Trondheim AS[4], the firm operating and owning[5] the network. The actors will be described by the business model element Actor.

The wireless network started as an initiative from NTNU in April 2005, with the vision to transform the city into a “laboratory for research and development of mobile data services” [43]. Following this, several commercial and public entities joined effort and

[4] Hereafter denoted by Wireless Trondheim.

[5] The access network was originally owned by NTNU, but the ownership will be transferred to Wireless Trondheim [45].

worked together towards the opening of the network on September 26th 2006. Figure 5-1 shows the coverage area of the wireless network as of November 1st 2006 [43]. Large parts of the city center are now covered by the network. The city of Trondheim has 150,000 inhabitants, with 31,000 of these living in the central areas [44]. Users with a nomadic or mobile use of the services are the target customers of the network [13].

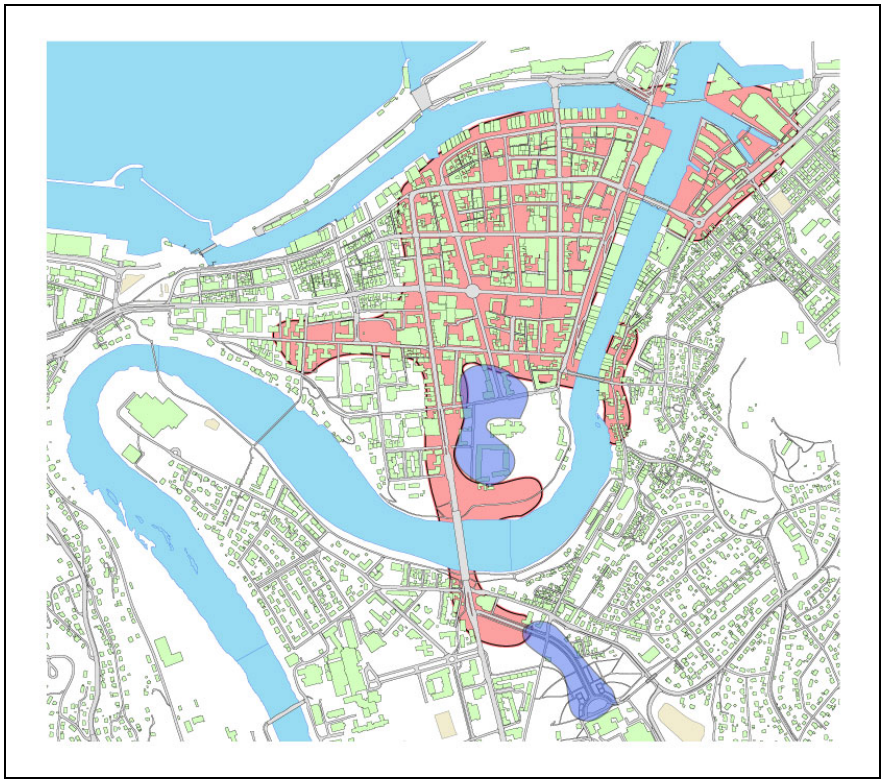

Figure 5-1. Coverage of Wireless Trondheim as of November 1st 2006 [43]. Areas shaded in red indicate current coverage, while areas shaded in blue are planned expansions.

Wireless Trondheim uses the main technologies described in sections 3.1.1 and 3.1.2. More specifically, the access network is based on IEEE standards 802.11a and 802.11b/g [13]. Wireless Trondheim uses equipment from Cisco that can broadcast up to 16 SSIDs simultaneously [45][26]. The backbone is mainly fiber, complemented by some 802.11a and high capacity radio links. The network infrastructure is flat, operating on the data link layer. This provides the VWISPs with the opportunity of providing the customers with their own IP-addresses, as discussed in section 3.2.3.

5.3 Analysis

This section applies the previously developed business model to Wireless Trondheim. Three scenarios are developed with estimates of future use and partnerships. These are used to conduct a cash flow analysis.

5.3.1 Business Model Applied to Wireless Trondheim

Most business model elements and sub-elements can be adopted directly to the business model of Wireless Trondheim, and need no changes. However, some elements need modifications to fit the specific business situation. More specifically, Actor and Financial Aspects will be redefined for Wireless Trondheim. A number of actors are specific for this firm, and the financial situation is dependent on the local partnerships and revenue share agreements.

Actors

The actors of the business situation are described according to the business model ontology in the tables below. Note that there can be multiple VWISPs.

ACTOR	**Virtual Wireless ISPs (VWISPs)**	**Wireless Trondheim (AP)**
Description	Wireless Trondheim cooperates with VWISPs to offer a wireless internet service to customers that are not included through any of the other partnerships. The VWISPs compose the service, and take care of customer acquisition, care and billing as described in section 4.	Wireless Trondheim is the owner and operator of the wireless access network. It does not provide direct access to customers, but cooperates with other entities to offer a service. Hence, Wireless Trondheim is an access provider (AP) as described in previous section 4. Wireless Trondheim operates on the data link layer of the protocol stack.

Table 5-1. Actor.

ACTOR	Sør-Trøndelag County	Trondheim Municipality
Description	Sør-Trøndelag County is a governmental entity. It employs a number of workers in the Trondheim area, and runs local high schools.	Trondheim Municipality is a governmental entity. It employs a number of workers in the Trondheim area, and runs local primary and secondary schools.

Table 5-2. Actor continued.

ACTOR	Trondheim Electric Utility (TEV)	Norwegian University of Science and Technology (NTNU)
Description	Trondheim Electric Utility is a governmental entity and the local electric utility company.	NTNU is a public university located at the outskirts of the central Trondheim area.

Table 5-3. Actor continued.

ACTOR	Adresseavisen	SpareBank1 Midt-Norge
Description	Adresseavisen is a regional newspaper.	SpareBank1 Midt-Norge is a bank with offices in the central region of Norway, including in Trondheim.

Table 5-4. Actor continued.

Partnerships and Agreements

Wireless Trondheim differs from the generic AP provider for which the business model in section 4 was specified in one significant way; it has also entered into partnerships with local firms and the local university. The partnerships with the VWISPs, however, are as described in section 4. This section will describe two new types of partnerships and list the actors that have entered into these partnerships. The partnerships are specified in Figure 5-2 and Figure 5-3. It should be noted that Trondheim Electric Utility and SpareBank1 Midt-Norge are shareholders of Wireless Trondheim, but have not entered into any partnerships.

PARTNERSHIP Name: Local Firm

Description: Wireless Trondheim has entered into partnerships with local firms. These partnerships resemble the partnerships with the VWISPs, in the way that the local firms purchase access for their employees and affiliates. The partnerships can be seen as a way of selling access to business customers without going through a VWISP.

Reasoning: {acquisition of resources, reduction of risk and uncertainty}: The local firm contributes with users to the network. It also reduces the risk by having a stable customer base which commits to using the network through the partnership, and by paying a fixed fee for their access.

Strategic Importance: {medium}: The importance of the agreement is increased because the local firm contributes with customers and reduces the risks.

Degree of Integration: {medium}: The network infrastructures of the AP and the local firm have a low degree of integration, but the local firm owns the customer base and is in this way somewhat integrated with the AP.

Degree of Competition: {low}: Low degree of competition as the local firm offers no similar services to the customers.

Substitutability: {medium}: The local firms are not technically integrated, but there are a limited number of large local firms for Wireless Trondheim to partner with.

PARTNERSHIP with ACTORs:

- Sør-Trøndelag County
- Trondheim Municipality

Figure 5-2. Partnership: Local Firm.

PARTNERSHIP Name: Knowledge and Research

Description: Wireless Trondheim has entered into a partnership with the local university, NTNU, and the regional newspaper, Adresseavisen. The network of Wireless Trondheim is meant to foster research and development, and Wireless Trondheim will benefit from the results of this research. Researchers and students at NTNU can conduct work for Wireless Trondheim as part of their research or studies. Adresseavisen will contribute to the partnerships through providing content and creating a web portal for Wireless Trondheim.

Reasoning: {acquisition of resources, reduction of risk and uncertainty}: The local university contributes with knowledge and wireless network know-how. It also contributes to reducing the risk by paying a fixed access fee for students and faculty. The

regional newspaper contributes with resources in the form of content management knowledge. It also contributes to reducing risk by paying a fixed fee for employee access.

Strategic Importance: {high}: This partnership is important to Wireless Trondheim because it makes it possible for the firm to be more advanced technologically than potential competition.

Degree of Integration: {low}: Low degree of integration as long as Wireless Trondheim does not share equipment with NTNU or Adresseavisen.

Degree of Competition: {low}: NTNU only offers on-campus wireless access for students and faculty. Adresseavisen does not offer wireless access.

Substitutability: {low}: There are no other universities in the vicinity of Trondheim with the same expertise or number of students and faculty. There is no regional newspaper with the same customer base or number of employees.

PARTNERSHIP with ACTORs:

- NTNU
- Adresseavisen

Figure 5-3. Partnership: Knowledge and Research.

Financial Aspects

The business model for Wireless Trondheim has the same two revenue streams as the generic model developed in section 4; Access Network Licensing, and Fee for Total Traffic. The exact price levels depend on the demand conditions, and are discussed in section 5.3.2. The Local Firm and Knowledge Exchange partnerships, however, generate a new revenue stream. These partnerships have specified a fixed fee which they pay for unlimited access to the network. Such a fixed fee is suitable for these firms because they have a limited number of employees which will use the network; hence it is easier to predict the traffic volume. The new Revenue Stream and Pricing sub-element is described in Table 5-5. The Revenue Model of Wireless Trondheim is presented in Figure 5-4. It is similar to that of the generic business model in section 4.3.6, but includes the new revenue stream.

REVENUE STREAM AND PRICING	Fixed Fee from Local Partnerships
Description	The local firms and the university pay a fixed fee to Wireless Trondheim for access to the network for their employees and affiliates.
Related to LINK, OFFERING	For OFFERING: - Wireless Access Network From LINK: - Wireless Access Network
Stream Type	{licensing}: Wireless Trondheim licenses permission to use the wireless access network.
Pricing Method	{fixed}: A fixed fee is paid to Wireless Trondheim.

Table 5-5. New revenue stream from local firms.

REVENUE MODEL Name: Charge for Network Access

Description: The revenue model of Wireless Trondheim relies on charging for access to the wireless access network. This access network, also specified as a Link, Offering and Resource, is the backbone of the money earning logic. The revenue model is composed of the three Revenue Stream and Pricing sub-elements.

Composed of REVENUE STREAM AND PRICING:

- Access Network Licensing
- Fee for Total Traffic
- Fixed Fee from Local Partnerships

Figure 5-4. Revenue Model of Wireless Trondheim.

Data on the operating expenses of Wireless Trondheim have been collected from the general manager of Wireless Trondheim [45]. These are presented in Table 5-6. Presenting the expenditures in the form of the Cost Structure ontology element would add little new information, and is therefore omitted from the report.

Expenditures	*2006*	*2007*	*2008*
Maintenance	200	800	800
Backhaul rent	-	280	280
Misc. operating expenses	25	100	100
Personnel	250	1 350	1 500
Accounting expenses	25	50	50
Other operating expenses	50	250	250
Total Operating Expenses	**475**	**2 830**	**2 980**

Table 5-6. Operating expenses of Wireless Trondheim. All figures in real NOK, thousands.

This concludes the presentation of the business model for Wireless Trondheim. The business money earning logic has been specified. There is no financial evaluation framework included in the business model ontology; scenarios will therefore be used to provide cash flow estimations.

5.3.2 Scenario Analysis

This section presents three different scenarios for Wireless Trondheim and suggests a price level for the network access. The price suggested and scenarios presented will form the basis for the cash flow analysis.

There are few other shared WLAN projects like Wireless Trondheim, and even fewer that have experience of pricing and use that is publicly available. As a consequence, the estimations of this section are based on data from other sources, such as reports and surveys from Statistics Norway (SSB). Furthermore, the scenario evaluations are based on estimated penetration rates of the previously specified target customer segments.

The goal of this section is to form the basis for the cash flow analysis. The costs have been received from Wireless Trondheim. This report approximates the marginal cost of adding new customers and VWISPs to zero; hence no more cost estimations are needed. Figures on revenue from local firms have also been received. However, the report needs to perform estimations of the revenue from the VWISP partners. The key drivers of the revenue are the number of partnerships and customers, traffic volume per customer, and pricing. Estimation of these revenue drivers are presented in the following sections. Because of the uncertainty when it comes to predicting the future for state of the art

telecommunication businesses, the time span for the scenario and cash flow analysis is five years.

The estimation of the number of users is based on data collected on the number of people in the different target customer segments, specified in section 4.3.5. The data has been collected from SSB [44][47]. The customer segment, Local Citizens, is divided into the specified criterion; Employees, City Center, and Proximity. The customer segment Employees is the estimated number of people working in the municipality of Trondheim. City Center is the registered population of the city center, while Proximity is the remaining inhabitants of Trondheim. SSB has accurate information on the population and number of employees of these areas. The Visitors row shows the estimation of the average number of visitors staying in hotels in Trondheim on an average day.

Customer Segment		**People**
Local Citizens	Employees[6]	82 934
	City Center	30 870
	Proximity	119 247
Visitors[7]	Tourists	1 100
	Business	1 256

Table 5-7. People in target customer segments.

Drivers of Revenue

This report will use the pricing of similar wired products as the basis for the price estimation. The Norwegian Post and Telecommunications Authority (NPT) regulates the rate that the telecommunications incumbent, Telenor, can charge for access to the local loop. This fee is currently NOK 105 per user [46]. The idea behind the price calculations in this report is to charge a per-volume fee that approximates this fee for an average

[6] Approximated by multiplying the work force in Sør-Trøndelag with the percentage of Sør-Trøndelag citizens living in Trondheim.

[7] This row shows the average number of visitors in Trondheim on an average day of the year. The number is estimated by dividing the total number of overnight stays in hotels in Sør-Trøndelag by 365, and by multiplying this by 80% as the estimation of the percentage of these stays in Trondheim.

private customer. The premium value of the wireless network will be converted to revenue through the fixed licensing fee paid by the VWISPs. Hence, an estimation of the average traffic volume per customer needs to be performed before the per-volume price is calculated. The estimation is based on the average traffic of private customers, excluding tourists, to simplify the equation and because the business users are thought to be less price-sensitive. This estimation will hold as long as the average volume of the business users does not exceed the private volume by a large amount. If the volume of the business users were to exceed the private volume by a large amount, this would result in a price level viewed as unreasonably high by many business users.

Pricing Suggestion:

Avg. monthly volume of private customers * Per-volume fee = NOK 105

Figure 5-5. Price calculation formula.

It is difficult to predict the average traffic volume per customer because of the limited previous experience and data available. However, the above pricing model suggests that the per-volume fee should be adjusted such that equation still holds if the initial data indicates use differing greatly from the preliminary estimations. Two sources studying the data traffic in UMTS networks and hotspots will be used for estimating the average traffic volume in Wireless Trondheim. Svoboda et. al. [48] study the UMTS data traffic in the network of mobillkom austria, and find that the median traffic volume is 5.4MB/week per user. A white paper from Pronto Networks [49] running a number of hotspots reports that they experienced an average of 14.25MB/day for their users. Bear in mind, however, that the Pronto measurements only report traffic when the user actively uses the network, such as when the user goes to a hotspot zone in a hotel or cafe. Customers of Wireless Trondheim will most likely have periods when the use of the network is limited or non-existing. The anticipation is that the use will be greater than the more expensive UMTS data traffic, but less than the hotspot traffic. This paper estimates an average use for local citizens and employees between the two figures, as presented in Table 5-8. Furthermore, the business users that use the network are expected to have a significantly higher average monthly volume because they are normally less price

sensitive and expected to use the network more actively for work purposes, thereby generating more traffic. Citizens living outside the city center are believed to generate lower volumes because they live outside the coverage area of Wireless Trondheim.

There is limited amount of data on which to base the fixed monthly licensing fees of the VWISP partnerships, this paper suggests NOK 10.000 as a reasonable amount. This will prevent VWISPs with few customers and little traffic from free-riding on the access network. It will also collect some of the higher value a wireless access network has compared to a wired network.

User Group	Monthly Usage [MB]
Private	100
Proximity	50
Business	200

Price target	105,00
Per-volume price:	1,05

Fixed monthly fee	10 000

Table 5-8. Volume estimations and price calculation. Amounts in MB and NOK.

Predicting the number of VWISP partnerships is a challenge for such a novel business as Wireless Trondheim. This report solves this by estimating from 1 to 6 VWISP partnerships in the different scenarios.

To predict the number of customers of Wireless Trondheim and its partners, this report estimates the penetration rate of the different customer segments. The scenarios below will present different rates; optimistic, realistic and pessimistic. As a starting point for these estimations, the predictions Wireless Philadelphia [12], chaska.net Citywide Wi-Fi [50], and penetration rates of wired broadband in Trondheim [51] are used. Wireless Philadelphia has a goal of a penetration rate of 13% of the local citizens by the first year, and 22% by the fifth. chaska.net report that 25% of the households in the coverage area subscribe to the wireless internet service. Statistics Norway report that 57.6% of the households in Trondheim subscribe to some form of wired broadband service [51].

Because of the stated goal of attracting nomadic and mobile users, the penetration rate is expected to be significantly lower than that of wired broadband. The product of Wireless Trondheim and its partners will most likely be a complement to wired broadband. This report estimates a somewhat higher penetration rate for the local citizens and employees than for out-of town visitors, based on the assumption that locals will be more exposed to the marketing and have better knowledge of the network and its possibilities. The rate is also expected to be higher for private users than for business users. For local citizens and employees, this is because many employees are already covered by the large firm partnerships. For business visitors, this is because this segment is believed to use wireless facilities from other providers such as hotels and the companies they are visiting.

This report does not attempt to attach probabilities to the scenarios presented. Assessing these probabilities would be interesting, but also involve an amount of work making it unfeasible for this project. Nonetheless, the scenarios represent value through quantifying possible outcomes.

Evaluation Parameters

This section briefly presents risks for Wireless Trondheim in the form of parameters affecting the success of the business. These are presented and described in Table 5-9. Moreover, the effects on the penetration rates of the product are explained. The cash flow estimations in section 5.3.3 account for risk by evaluating the different scenarios, which have different outcomes for the parameters described below. Another way of accounting for risk is by adjusting the discount rate with a risk premium, but this is out of scope for this report. A more advanced financial evaluation could also include real options for dealing with future investment decisions.

Parameter	Description	Effects
Acceptance of technology and product	This factor deals with whether the product of Wireless Trondheim and its partners is accepted and valued by the target customer segments.	A high valuation of the product is needed to obtain a high penetration rate in the target customer segments.
Number of VWISP partnerships	The number of VWISP partnerships affects the expected cash flow	A higher number of VWISP partnerships will increase the revenue
Competition	The level of competition and its ferocity will affect the business of Wireless Trondheim	Highly competitive products by competitors will decrease the penetration rate of Wireless Trondheim
Disruptive technologies	Disruptive technology changes could undermine the core business of Wireless Trondheim	Introduction of such technologies could severely reduce the success of Wireless Trondheim

Table 5-9. Risks considered by scenarios.

Scenario: Optimistic

They key characteristics of this scenario are presented in Table 5-10. The penetration rates, average volume, and number of partnerships are presented in Table 5-11.

Parameter	Outcome
Acceptance of technology and product	The service gains acceptance and is highly valued across target all customer segments
Number of VWISP partnerships	A significant number of VWISP partnerships are entered
Competition	There are no significant competitors competing with similar products in the same segments
Disruptive technologies	The technology stays popular, and there are no new disruptive technologies attracting the same customers as the technology of Wireless Trondheim

Table 5-10. Scenario description of optimistic scenario according to evaluation parameters.

Scenario: Optimistic

Year		2006	2007	2008	2009	2010	Avg Volume
Local Citizens	Employees	0,0 %	3,0 %	5,0 %	7,0 %	7,0 %	200
	City Center	0,0 %	15,0 %	20,0 %	20,0 %	22,0 %	100
	Proximity	0,0 %	3,0 %	5,0 %	5,0 %	5,0 %	50
Visitors	Tourists	0,0 %	5,0 %	5,0 %	10,0 %	10,0 %	100
	Business	0,0 %	2,0 %	5,0 %	5,0 %	5,0 %	200
Number of VWISPs		0	4	6	5	5	

Table 5-11. Penetration rates, average monthly volume per user, and number of VWISPs for the optimistic scenario.

Scenario: Realistic

The key characteristics of this scenario are presented in Table 5-12. The penetration rates, average volume, and number of partnerships are presented in Table 5-13. These penetration rates are half of those in the optimistic scenario, but have the same percent wise year-to-year development.

Parameter	Outcome
Acceptance of technology and product	The technology and product are accepted by half the number of customers as in the optimistic scenario
Number of VWISP partnerships	Some VWISP partnerships are entered
Competition	There is some competition, but the level of ferocity is low and Wireless Trondheim does well in the competitive arena
Disruptive technologies	No significant disruptive technologies are introduced

Table 5-12. Scenario description of realistic scenario according to evaluation parameters.

Scenario: Realistic

Year		2006	2007	2008	2009	2010	Avg Volume
Local Citizens	Employees	0,0 %	1,5 %	2,5 %	3,5 %	3,5 %	200
	City Center	0,0 %	7,5 %	10,0 %	10,0 %	11,0 %	100
	Proximity	0,0 %	1,5 %	2,5 %	2,5 %	2,5 %	50
Visitors	Tourists	0,0 %	2,5 %	2,5 %	5,0 %	5,0 %	100
	Business	0,0 %	1,0 %	2,5 %	2,5 %	2,5 %	200
Number of VWISPs		0	2	3	2	2	

Table 5-13. Penetration rates, average monthly volume per user, and number of VWISPs for the realistic scenario.

Scenario: Pessimistic

The key characteristics of this scenario are presented in Table 5-14. The penetration rates, average volume, and number of partnerships are presented in Table 5-15. These penetration rates are half of those in the realistic scenario, with a decline to 2008-level in 2010[8].

Parameter	Outcome
Acceptance of technology and product	The technology is not widely accepted, and the product is only perceived to be valuable by a small share of the people in the target customers segments
Number of VWISP partnerships	Few VWISP partnerships are entered
Competition	Competitive services steal most of the market
Disruptive technologies	An alternative and superior technology is introduced, leading to a decline of penetration rates towards the end of the five year period

Table 5-14. Scenario description of the pessimistic scenario according to evaluation parameters.

Scenario: Pessimistic

Year		2006	2007	2008	2009	2010	Avg Volume
Local Citizens	Employees	0,0 %	0,8 %	1,3 %	1,8 %	1,3 %	200
	City Center	0,0 %	3,8 %	5,0 %	5,0 %	5,0 %	100
	Proximity	0,0 %	0,8 %	1,3 %	1,3 %	1,3 %	50
Visitors	Tourists	0,0 %	1,3 %	1,3 %	2,5 %	1,3 %	100
	Business	0,0 %	0,5 %	1,3 %	1,3 %	1,3 %	200
Number of VWISPs		0	1	2	2	1	

Table 5-15. Penetration rates, average monthly volume per user, and number of VWISPs for the pessimistic scenario.

5.3.3 Cash Flows and Net Present Value

This section first presents cash flow data general for all scenarios. This includes revenue from the local firm partnerships and from NTNU, and the operating expenses. Operating expenses and investment costs have been received for the first three years of operation [45], and have been extended for two further years as presented in Table 5-16. Data on fixed fees from NTNU, Trondheim Municipality, Sør-Trøndelag County and

[8] The rates are rounded off to the first decimal.

Adresseavisen are as specified by the general manager of Wireless Trondheim [45]. These numbers have also been extended by two years and are presented in Table 5-16. All calculations and figures are in Norwegian kroner (NOK), thousands, as real values before tax. Hence, the effects of inflation have been accounted for. Discounting is done on a yearly basis, with a value discount rate of 15%. This is an estimate of the cost of capital for Wireless Trondheim, and a sensitivity analysis for each scenario is conducted to investigate the effects of different values for this variable.

Operating expenses	***2006***	***2007***	***2008***	***2009***	***2010***
Maintenance	200	800	800	800	800
Backhaul rent		280	280	500[9]	500
Misc. operating expenses	25	100	100	100	100
Personnel	250	1 350	1 500	1 500	1 500
Accounting expenses	25	50	50	50	50
Other operating expenses	50	250	250	250	250
Investment in network	8 000	-	-	-	-
Total operating expenses	**8 550**	**2 830**	**2 980**	**3 200**	**3 200**
Operating revenue, from large firm partnerships					
NTNU	500	500	500	500	500
Trondheim Municipality	248	240	200	200	200
Sør-Trøndelag County	248	240	200	200	200
Adresseavisen	250	250	250	250	250
Total revenue	**1 246**	**1 230**	**1 150**	**1 150**	**1 150**

Table 5-16. Operating expenses and revenue from large firm partnerships for Wireless Trondheim.

Cash Flow for Optimistic Scenario

Given the data presented for the optimistic scenario in section 5.3.2, and the previous data on expenses and customers in each segment, the revenue figures and NPV for Wireless Trondheim will be as in Table 5-17. The sensitivity analysis is presented in Figure 5-6, showing the NPV given different values of the discount rate. The data in this scenario result in a NPV favorable to Wireless Trondheim, giving a NPV of NOK 51 mill for the project with a discount rate of 15%.

[9]Wireless Trondheim expects an increase in the backhaul rent from 2009. NTNU, which now provides much of the backhaul network, is expected to increase its fees as Wireless Trondheim becomes more independent [45].

Operating revenues, from VWISP partnerships	*2006*	*2007*	*2008*	*2009*	*2010*
Local, Employees	-	6 270	10 450	14 630	14 630
Local, City Center	-	5 834	7 779	7 779	8 557
Local, Proximity	-	2 254	3 756	3 756	3 756
Visitor, Tourists	-	69	69	139	139
Visitor, Business	-	63	158	158	158
Fixed fee	-	480	720	600	600
Total revenues	**-**	**14 971**	**22 933**	**27 062**	**27 840**
Operating profit/loss before tax	**(7 304)**	**13 371**	**21 103**	**25 012**	**25 790**
Time, t	**0**	**1**	**2**	**3**	**4**
NPV	(7 304)	11 627	15 957	16 446	14 745
Accrued NPV	**(7 304)**	**4 323**	**20 279**	**36 725**	**51 471**

Table 5-17. Revenue and NPV for Wireless Trondheim with the optimistic scenario.

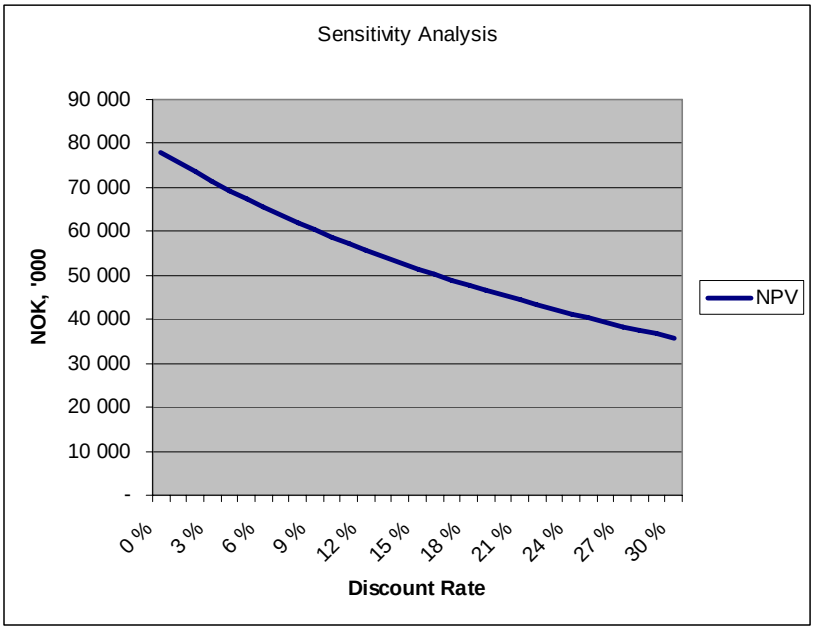

Figure 5-6. Sensitivity analysis for the optimistic scenario.

Cash Flow for Realistic Scenario

With the same assumptions as for the previous section, the revenue figures and NPV for Wireless Trondheim will be as in Table 5-18. The sensitivity analysis is presented in

Figure 5-7, showing the NPV given different values of the discount rate. This scenario results in a NPV of NOK 19 mill with a discount rate of 15%.

Operating revenues, from VWISP partnerships	***2006***	***2007***	***2008***	***2009***	***2010***
Local, Employees	-	3 135	5 225	7 315	7 315
Local, City Center	-	2 917	3 890	3 890	4 279
Local, Proximity	-	1 127	1 878	1 878	1 878
Visitor, Tourists	-	35	35	69	69
Visitor, Business	-	32	79	79	79
Fixed fee	-	240	360	240	240
Total revenues	**-**	**7 485**	**11 466**	**13 471**	**13 860**
Operating profit/loss before tax	**(7 304)**	**5 885**	**9 636**	**11 421**	**11 810**
Time, t	**0**	**1**	**2**	**3**	**4**
NPV	(7 304)	5 118	7 286	7 509	6 752
Accrued NPV	**(7 304)**	**(2 186)**	**5 100**	**12 610**	**19 362**

Table 5-18. Revenue and NPV for Wireless Trondheim with the realistic scenario.

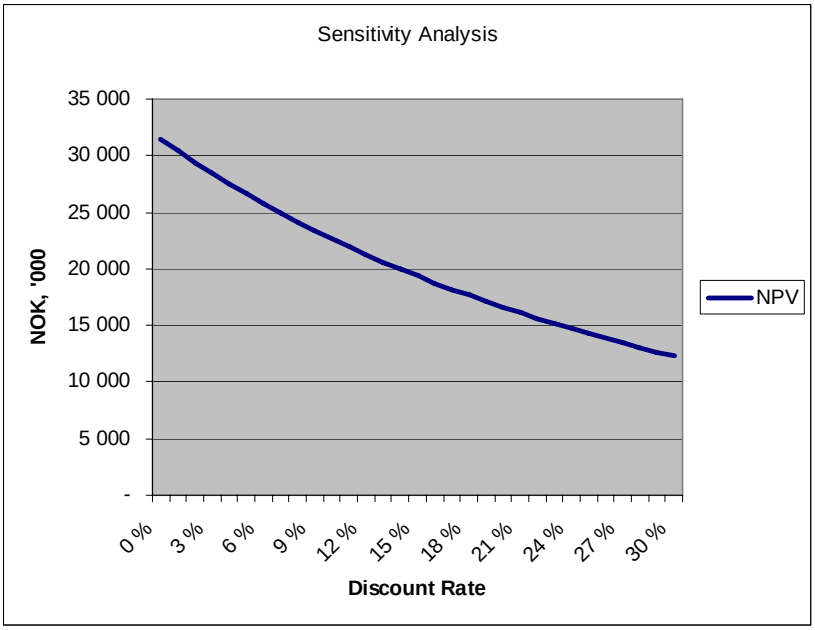

Figure 5-7. Sensitivity analysis for the realistic scenario.

Cash Flow for Pessimistic Scenario

With the same assumptions as for the previous sections, the revenue figures and NPV for Wireless Trondheim will be as in Table 5-19. The sensitivity analysis is presented in

Figure 5-8, showing the NPV given different values of the discount rate. This scenario gives a NPV of approximately NOK 3 mill with a discount rate of 15%.

Operating revenues, from VWISP partnerships	***2006***	***2007***	***2008***	***2009***	***2010***
Local, Employees	-	1 567	2 612	3 657	2 612
Local, City Center	-	1 459	1 945	1 945	1 945
Local, Proximity	-	563	939	939	939
Visitor, Tourists	-	17	17	35	17
Visitor, Business	-	16	40	40	40
Fixed fee	-	120	240	240	120
Total revenues	**-**	**3 743**	**5 793**	**6 855**	**5 673**
Operating profit/loss before tax	**(7 304)**	**2 143**	**3 963**	**4 805**	**3 623**
Time, t	**0**	**1**	**2**	**3**	**4**
NPV	(7 304)	1 863	2 997	3 160	2 072
Accrued NPV	**(7 304)**	**(5 441)**	**(2 444)**	**716**	**2 787**

Table 5-19. Revenue and NPV for Wireless Trondheim with the realistic scenario.

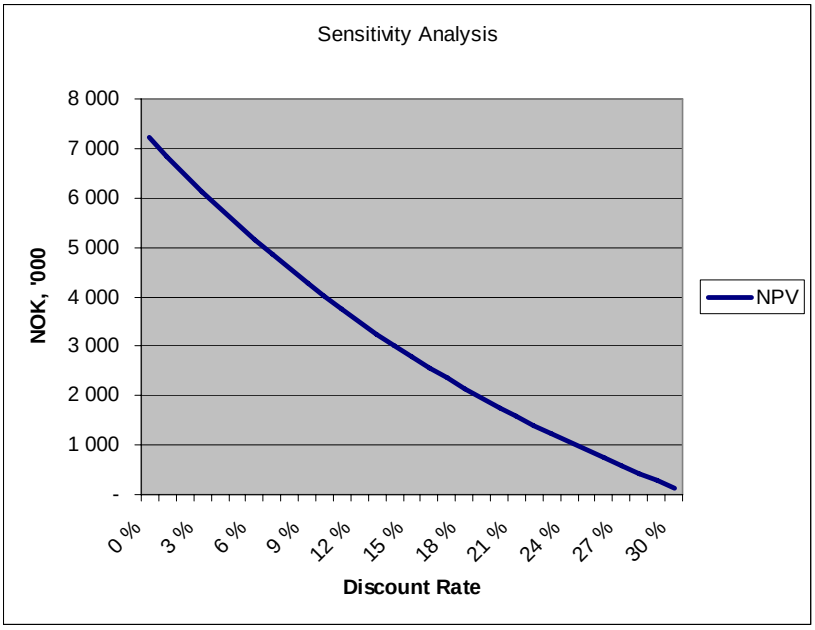

Figure 5-8. Sensitivity analysis for the pessimistic scenario.

5.4 Discussion

The generic business model of a shared WLAN access provider was adapted to Wireless Trondheim in this section. This has given a thorough overview of the money earning logic of the firm. The specification has identified the product, the customer interface, and the infrastructure management. In other words, it identifies what the product is, how and with whom the product is created, and how and to whom it is sold. The business model of Wireless Trondheim provided the basis for an estimate of the future cash flow.

All three scenarios in this report result in a positive NPV for Wireless Trondheim. However, the scenarios rely on parameters that are hard to predict due to limited experience and available figures for similar business situations. The estimations have had to rely on vague penetration estimates of other shared WLAN networks, and on pricing of similar services. The model is sensitive to changes in penetration rate, traffic-volume and to the customer price sensitivity. Due to the uncertainty regarding these parameters, the scenarios span a large variation of penetration rates, where the maximum penetration rates are four times that of the pessimistic scenario.

Although the size of the positive NPV varies greatly between the three scenarios, the average monthly revenue per user (ARPU) remains similar. The ARPU for the above scenarios is NOK 123.85 for the optimistic scenario, NOK 123.32 for the realistic scenario, and NOK 115.30 for the pessimistic scenario. The reason for this similarity is the equal percent wise reduction in penetration rates among all groups. The slight difference can be explained by the fixed contributions from the fixed VWISP and local firm fees.

6 Conclusion

This report has developed a generic business model for shared WLAN access providers, and tested its feasibility by applying the model to Wireless Trondheim. The model is based on the framework proposed by Alexander Osterwalder [20]. The specified business model contributes to understanding the business architecture and money earning logic of shared WLAN access providers. This understanding is reached through specifying important aspects of the business architecture, such as the product, the customer interface, the infrastructure management, and the financial aspects. These aspects constitute the four pillars of the business model. The specified model will be useful for communicating the business logic throughout the company and to other stakeholders. Such communication facilitates a common understanding of the money earning logic, unquestionably important to effectively run the company. In addition to being useful for understanding the current business situation, the model is also a good framework for analyzing future changes in the business logic.

A cash flow analysis has been conducted to investigate the profitability of Wireless Trondheim. All three scenarios have a positive NPV with a discount rate of 15%. However, the model is based on several parameters that are hard to estimate due to limited data available. A more detailed investigation into the price/demand relationship and the acceptance of such wireless services among consumers are an interesting area for future work.

The business model for shared WLAN access providers is the main contribution of this report. The report shows that this model is feasible through applying it to the case of Wireless Trondheim. Moreover, the model is used as a basis for a cash flow analysis of the project, and the results show that Wireless Trondheim could prove to be a profitable investment.

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Appendix A: Business Model Ontology

This appendix presents contains an overview of the business model ontology used for the business model. It also contains lists all the business model elements and sub-elements as defined by Osterwalder in [20].

General Overview

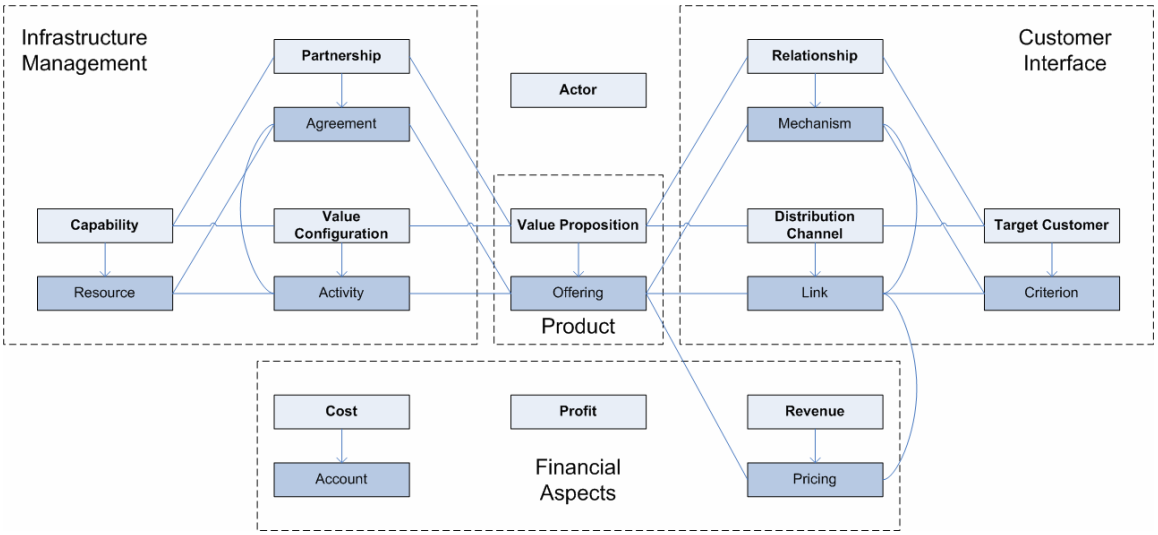

Figure 0-1. Overview of business model elements, as presented by Osterwalder in [20].

Business Model Elements

Name of BM-Element	**VALUE PROPOSITION**
Definition	A VALUE PROPOSTITION represents value for one or several TARGET CUSTOMER(s) and is based on one or several CAPABILITY(ies). It can be further decomposed into its *set of* elementary OFFERING(s). A VALUE PROPOSITION is characterized by its attributes DESCRIPTION, REASONING, VALUE LEVEL and PRICE LEVEL and an optional LIFE CYCLE.
Part of	PRODUCT
Related to	*Value for* TARGET CUSTOMER *Based on* CAPABILITY(1-n)
Set of	Elementary OFFERING(s) (0-n)
Cardinality	1-n
Attributes	Inherited from elementary OFFERING

Name of BM-Element	**OFFERING**
Definition	An elementary OFFERING is a part of an overall VALUE PROPOSITION. It is characterized by its attributes DESCRIPTION, REASONING, LIFE CYCLE, VALUE LEVEL and PRICE LEVEL.
Element of	VALUE PROPOSITION (1-n)
Cardinality	0-n
Attributes	*NAME* {abc} *DESCRIPTION* {abc} *REASONING* {USE, RISK, EFFORT} (0-n) *VALUE LEVEL* {ME-TOO, INNOVATIVE IMMITATION, EXCELLENCE, INNOVATION} *PRICE LEVEL* {FREE, ECONOMY, MARKET, HIGH-END} *LIFE CYCLE* {CREATION, PURCHASE, USE, RENEWAL, TRANSFER}

Name of BM-Element	**TARGET CUSTOMER**
Definition	A TARGET CUSTOMER segment defines the type of customers a company wants to address.
Part of	CUSTOMER INTERFACE
Related to	*Receives* a VALUE PROPOSITION (1-n)
Set of	CRITERION(s)(0-n)
Cardinality	1-n
Attributes	Inherited from CRITERION

Name of BM-Element	**CRITERION**
Definition	A CRITERION defines the characteristics of a TARGET CUSTOMER.
Part of	TARGET CUSTOMER
Cardinality	0-n
Attributes	NAME {abc} DESCRIPTION {abc}

Name of BM-Element	**CHANNEL**
Definition	A distribution CHANNEL describes how a company *delivers* a VALUE PROPOSITION to a TARGET CUSTOMER segment. Normally a firm disposes of one or several direct or indirect CHANNEL(s) that can be decomposed into their LINK(s).
Part of	CUSTOMER INTERFACE
Inherits from	LINK
Related to	*Delivers* VALUE PROPOSITION (1-n) *Delivers to* TARGET CUSTOMER (1-n)
Set of	LINK(s)(0-n)
Cardinality	1-n
Attributes	Inherited from LINK

Name of BM-Element	**LINK**
Definition	A channel LINK is part of a CHANNEL and describes a specific channel role. It may be part of the VALUE PROPOSITION and it may be related to another LINK.
Element of	LINK
Inherits from	OFFERING
Related to	A LINK can be *connected to* another LINK (0-n)
Cardinality	0-n
Attributes	Inherited from OFFERING *CUSTOMER BUYING CYCLE* {AWARENESS, EVALUATION, PURCHASE, AFTER SALES} (overwritten by *VALUE LIFE CYCLE* if the LINK element is also an OFFERING.

Name of BM-Element	**RELATIONSHIP**
Definition	The RELATIONSHIP element describes the relationship a company establishes with a TARGET CUSTOMER segment. A RELATIONSHIP is based on customer equity and can be decomposed into several RELATIONSHIP MECHANISMs.
Part of	CUSTOMER INTERFACE
Inherits from	relationship MECHANISM
Related to	A RELATIONSHIP promotes a VALUE PROPOSITION (1-n) A RELATIONSHIP is maintained with a TARGET CUSTOMER (1-n)
Cardinality	1-n
Attributes	*CUSTOMER EQUITY* {ACQUISITION, RETENTION, ADD-ON SELLING} All other attributes are inherited from the RELATIONSHIP MECHANISM

Name of BM-Element	**relationship MECHANISM**
Definition	A RELATIONSHIP MECHANISM is part of a RELATIONSHIP and describes the function it accomplishes between the company and its customers. It may also be a channel LINK or a part of the VALUE PROPOSITION.
Element of	RELATIONSHIP
Inherits from	LINK
Cardinality	0-n
Attributes	Inherited from LINK *FUNCTION* {PERSONALIZATION, TRUST, BRAND}

Name of BM-Element	**CAPABILITY**
Definition	A CAPABILITY describes the ability to execute a repeatable pattern of actions. A firm has to dispose of a number of CAPABILITYies to be able to offer its VALUE PROPOSTION. CAPABILITYies are based on a set of resources from the firm or its PARTNER(s).
Part of	INFRASTRUCTURE MANAGEMENT
Inherits from	RESOURCE
Related to	A CAPABILITY(ies) allows a firm *to provide* its VALUE PROPOSTION (0-n)
Cardinality	1-n
Attributes	Inherited from RESOURCE

Name of BM-Element	**ACTOR**
Definition	A business model ACTOR is an outside organization that is involved in the firm's business model and is integrated through a partnership
Attributes	NAME {abc} DESCRIPTION {abc}

Name of BM-Element	**RESOURCE**
Definition	RESOURCEs are inputs into the value-creation process. They are the source of the CAPABILITIES a firm needs in order to provide its VALUE PROPOSITIONs.
Element of	CAPABILITY (1-n)
Related to	A RESOURCE can be provided *by* an ACTOR (0-n)
Cardinality	0-n
Attributes	*NAME* {abc} *DESCRIPTION* {abc} *RESOURCE TYPE* {TANGIBLE, INTANGIBLE, HUMAN}

Name of BM-Element	**VALUE CONFIGURATION**
Definition	The VALUE CONFIGURATION of a firm describes the arrangement of one or several ACTIVITY(ies) in order to provide a VALUE PROPOSITION.
Part of	INFRASTRUCTURE MANAGEMENT
Related to	The VALUE CONFIGURATION relies on a set of CAPABILITIES (1-n) The VALUE CONFIGURATION makes VALUE PROPOSITIONs possible (1-n)
Set of	ACTIVITIES
Cardinality	1-n
Attributes	*CONFIGURATION TYPE* {VALUE CHAIN, VALUE SHOP, VALUE NETWORK} Other attributes inherited from ACTIVITY

Name of BM-Element	**ACTIVITY**
Definition	An ACTIVITY is an action a company performs to do business and achieve its goals.
Element of	VALUE CONFIGURATION
Related to	An ACTIVITY is executed by an ACTOR (1-n) An ACTIVITY {fits}, {flows} to or is {shared} by one or several RESOURCE(s) (0-n)
Cardinality	0-n
Attributes	*NAME* {abc} *DESCRIPTION* {abc} *ACTIVITY LEVEL* {PRIMARY ACTIVITY, SUPPORT ACTIVITY} *ACTIVITY NATURE* (0-1) - for Value Network {NETWORK PROMOTION AND CONTRACT MANAGEMENT, SERVICE PROVISIONING, NETWORK INFRASTRUCTURE OPERATION}

Name of BM-Element	PARTNERSHIP
Definition	A PARTNERSHIP is voluntarily initiated cooperative agreement formed between two or more independent companies in order to carry out a project or specific activity jointly by coordinating the necessary CAPABILITIES, RESROUCES and ACTIVITIES.
Part of	INFRASTRUCTURE MANAGEMENT
Related to	Concerns a VALUE CONFIGURATION (1-n) PARTNERSHIPS are developed to provide a VALUE PROPOSITION (1-n)
Set of	AGREEMENT(s)
Cardinality	*0-n*
Attributes	Inherited from AGREEMENT

Name of BM-Element	AGREEMENT
Definition	An AGREEMENT specifies the function and the terms and conditions of a partnership with an ACTOR
Element of	PARTNERSHIP
Related to	An AGREEMENT is always made with an ACTOR (1-n)
Cardinality	0-n
Attributes	*NAME* {abc} *DESCRIPTION* {abc} *REASONING* {OPTIMIZATION AND ECONOMIES OF SCALE, REDUCTION OF RISK AND UNCERTAINTY, ACQUISITION OF RESOUCES} *STRATEGIC IMPORTACE*[10] {0-5} *DEGREE OF COMPETITION*[11] {0-5} *DEGREE OF INTEGRATION*[12] {0-5} *SUBSTITUTABILITY*[13] {0-5}

[10] This report uses {low, medium, high} instead of {0-5} for this attribute.

[11] This report uses {low, medium, high} instead of {0-5} for this attribute.

[12] This report uses {low, medium, high} instead of {0-5} for this attribute.

[13] This report uses {low, medium, high} instead of {0-5} for this attribute.

Name of BM-Element	**REVENUE MODEL**
Definition	A REVENUE MODEL describes the way the company makes money. It can be composed of one or several REVENUE STREAM AND PRICING elements.
Part of	FINANCIAL ASPECTS
Related to	A REVENUE MODEL is built on and depends of the firm's VALUE PROPOSITIONs (1-n)
Set of	REVENUE STREAM AND PRICING(s) (0-n)
Cardinality	*1-n*
Attributes	Inherited from REVENUE STREAM AND PRICING

Name of BM-Element	**REVENUE STREAM AND PRICING**
Definition	The REVENUE STREAM AND PRICING element describes an incoming money stream from the value offered by the company. Furthermore, it defines what mechanisms is used to determine the price of this value offered. The element is characterized by its attributes STREAM TYPE and PRICING METHOD
Element of	REVENUE MODEL
Related to	A REVENUE STREAM AND PRICING is for one or several OFFERINGs (1-n) Every channel LINK can have one or several REVENUE STREAM AND PRICING elements (1-n)
Cardinality	0-n
Attributes	*NAME* {abc} *DESCRIPTION* {abc} *STREAM TYPE* {SELLING, LENDING, LICENCING, TRANSACTION CUT, ADVERTISING} *PERCENTAGE* {123} *PRICING METHOD* {FIXED, DIFFERENTIAL, MARKET}

Name of BM-Element	**COST**
Definition	The COST element measures all monetary costs incurred by the company
Part of	FINANCIAL ASPECTS
Inherits from	ACCOUNT
Set of	ACCOUNT(s) (0-n)
Attributes	Inherited from ACCOUNT

Name of BM-Element	**ACCOUNT**
Definition	An ACCOUNT is a registry of pecuniary transactions (expenditure) of a certain category
Element of	COST
Cardinality	1-n
Attributes	*NAME* {abc} *DESCRIPTION* {abc} *SUM* {123} *PERCENTAGE* {123}