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Pricing of additional features in mobile telecommunication networks

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Tiivistelmä

Tässä pro gradu tutkielmassa on tutkittu erilaisia hinnoittelustrategioita matkapuhelinverkkojen (MTN)lisäominaisuuksille. Hinnoittelua on tutkittu kolmesta eri näkökulmasta (i) MTN laitteistojen valmistajien kustannukset (ii) MTN lisäominaisuuksien tuoma arvo matkapuhelinoperaattoreille (iii) loppukäyttäjän saama hyöty MTN lisäominaisuuksista. MTN toimialalla arvo muodostuu sadoista eri muuttujista ja matkapuhelinoperaattorit vaihtelevat huomattavasti kokonsa ja liiketoimintakonseptinsa puolesta. Tässä pro gradu tutkielmassa huomattiin, että ei ole mahdollista muodostaa yhtä yksittäistä menetelmää tai työkalua, jolla voitaisiin hinnoitella yleisesti kaikkia MTN lisäominaisuuksia. Pääsäätöisesti hinnoittelustrategiat, jotka perustuvat mitattavissa olevaan muuttujaan, kuten kustannuksiin, kysyntään tai arvoon, ovat parempia kuin ilman mitattavia muuttujia käyttävät hinnoittelustrategiat. Pro gradu tutkielman tulokset näyttävät vaikka yhtä yksittäistä toimivaa hinnoittelumenetelmää ei ole mahdollista luoda, niin on mahdollista muodostaa sekvenssikaavio tai yleisperiaateet avustamaan sopivan referenssihinnan löytämiseksi. Lisäksi on mahdollista rakentaa uusia työkaluja tai muokata olemassa olevia työkaluja avustamaan hinnoittelua käyttäen analyyttisia menetelmiä.

Avainsanat

Hinnoittelu, Lisäominaisuus, Ohjelmisto, Laitteisto, Telekommunikaatio, Matkapuhelin, CDMA, WCDMA, LTE, Operaattori, Verkko

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Abstract of master's thesis

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Abstract

In this Master's thesis are investigated different pricing strategies for additional features in Mobile Telecommunication Networks (MTN). Pricing is studied from three different perspectives (i) MTN equipment vendor costs (ii) MTN operator value from additional features and (iii) end user benefits from additional features. In the MTN industry value is formed from hundreds of different variables and the MTN operators are varying significantly on size and business concept. In this Master's thesis it was found that it is not possible to select any universal pricing strategy or tool that would fit for all additional features. Generally pricing strategies based on a measurable variable like cost, demand or value, are better than those strategies, where the price or part of it is set without any direct link to any such variable. Even if no single common practical pricing method can be formed; it is possible to build a sequence chart or guidelines for assisting pricing decisions in finding most suitable method for finding an optimal reference price. Also for some individual features it is possible to build a new pricing tool or modifies an existing tool for calculating a proper reference price for an additional feature via analytical methods.

Keywords

Pricing, Additional feature, Software, Hardware, Telecommunication, Mobile, CDMA, WCDMA, LTE, Operator, Network

1. Introduction

1.1. Background for the study

In the past two decades we have seen a rapid change in the telecommunication industry. For many centuries fixed line telecommunication networks dominated the way people communicated and how information was spread through telephone and fax modem. However, already for many years mobile communication has clearly dominated the traditional voice communication in developed countries (e.g. BBC 2007). Today the line between information and voice communication has become increasingly blurred as internet is used for voice communication and Mobile Telecommunication Networks (MTN) are used for data services. In data services fixed line subscriptions were still dominating few years ago also in developed countries and the few attempts to launch mobile data had failed (Saarikoski 2006). However, there came a clear trend towards mobile broadband data as MTN technology evolved and was able to provide better and faster data rates for subscribers (e.g. Gartner 2007). Worldwide mobile data traffic will increase 13-fold over the next four years, and from which global mobile data traffic represents annual growth rate of 66 percent (Cisco Systems 2013).

The importance of MTN industry to national security, IT (Information Technology) and business applications as well as personal and data communication is still increasing rapidly throughout the world. Because of the importance of the MTN industry for society, it is no wonder that the MTN industry faces many external norms in form of different standards, as well as domestic and international laws and regulations. This is discussed more in later chapters. The MTN industry is also characterized by huge investment and R&D costs, extreme technological complexity, rapid technological evolution, tight competition and mergers both from the vendor and the operator side. In MTN the network is split into smaller parts, which are sold independently to the operators, giving the operator the possibility to customize the network for their specific needs. Because of the reasons explained, the MTN industry is very different from any other industry. This is particularly clear when it comes to the pricing strategies applied for the MTN equipment and services, offered by the vendors to the operators. The correct price offer is an essential part of competitive advantage and should be carefully considered by each vendor's business strategy.

There has been a clear trend in the resent years for customization, so that the operators can also buy additional features for their MTN in addition for the basic functionalities at a single Network Element (NE) level. The additional features typically increase capacity, reduce operator costs or provide some new service, which can be sold to the end user. However finding a suitable analytical method for calculating an appropriate reference price for the additional features is problem in many cases. Most MTN business model studies have been mainly marketing related, and lacked the analytical linkage between marketing and management accounting, and this is why further studying is needed in this area.

Research on intangible additional feature pricing and MTN business modeling in the feature level is quite limited. In Techno-Economics of Integrated Communication Systems and Services (ECOSYS) project is studied MTN business in macroeconomic level by modeling different business scenarios. ECOSYS has published both articles and developed tools for modeling the MTN business mostly from the macroeconomic operator point of view. The ECOSYS project is done in cooperation with universities, MTN operators and MTN vendors aiming to develop a strategic techno-economic analysis framework for the MTN industry. In theHelsinki School of Economics (HSE) two master's thesis have been done about pricing of digital products and about factors affecting the pricing software products. These thesis concentrated of pricing of whole products and not independent features sold on top of the main product. Many articles exists about the actual MTN business and business development. Ballon (2007) and Engel (2007) are some of the most interesting ones in this area, covering in their articles how new technology in MTN industry will be adopted and how IP technology will change the industry.

1.2. Goals and scope of the study

The purpose of this master's thesis is to examine the different analytical pricing methods for the MTN additional features via a Case Company. The paper is divided into two parts. First the price setting methods are studied from three different perspectives (i) vendor costs (ii) operator benefits and (iii) end user benefits and price elasticity. Pricing is studied trough articles, prior studies, MTN industry related literature as well as marketing and management accounting related literature and interviews. Emphasis is put on how general theories and practice fit to the special characteristics of the MTN industry, and how management accounting and marketing theories and practices link together. Also it is studied does any

public tools or analytical methods, which could be used for calculating the operator or end user benefits for an individual MTN feature exist.

In the second part the findings of first part are analyzed. The goal is to investigate, if it is possible to form common recommendations to what kind of analytical pricing method should be used for a specific additional feature, when a MTN vendor and the additional MTN feature's properties are considered. Also is investigated is it possible to build a sequence chart recommendation for selecting the most suitable pricing method. Recommendations for possible pricing tool development are given based of part 1 of this study.

Therefore the primary research question can be stated as:

How pricing and pricing strategies of additional features in MTN could be done most efficiently via management accounting and marketing perspective?

The secondary research questions are:

1) *How the pricing methods takes into account (i) vendor costs (ii) operator benefits and (iii) end user benefits*

2) *Are there any public methods or tools available, which can be used for assisting in the pricing of MTN additional features?*

3) *How additional features properties and MTN customer knowledge can be used in different analytical pricing methods?*

4) *Is it possible to build a sequence chart or tools, which would recommend a suitable pricing method?*

With efficiency is meant pricing strategies, methods or tools for MTN additional features, which seem most prominent for optimizing the business partnerships between the vendors and the operators especially in cases, where it has been difficult to find the right reference price with traditional tools and pricing methods. The main target group for this master's thesis is product and upper technical management in the MTN industry. This master's thesis is also targeted to personnel involved in MTN marketing and Research and Development (R&D).

In this paper with the reference price method and price setting strategy is meant concepts to set a reference price for certain MTN features, which is used as the basis for pricing, when a product is launched. The reference price is a price, which will not be the actual price the customer will finally pay for a certain feature. The actual purchase price will be influenced by e.g. changes in the competitive environment, the chosen marketing strategy, new trends in the industry, technological evolution, the global economic situation and the bargaining power of buyers and will be typically lower than the reference price, as the product gets more mature and pricing erosion starts to effect (e.g. Porter 1979 and 1980, Nagle 1978). In the scope of this paper are management accounting and investment calculations methods for calculating a reference price for MTN additional features. In this paper are covered very lightly marketing related pricing issues i.e. how the final marketing and pricing strategy should be set and how game theories, speculation of competitive actions or cannibalization of old products will affect the final price the customer will pay. In this master's thesis no analytical tool for wider business case simulation is built or simulated any specific scenarios for different marketing strategies. Rather indications, which areas should be covered, in case such a tool would be implemented are given.

1.3. Used methods

In management accounting area the typical research methods are typically separated in a higher level between case studies and quantitative statistical analysis. Salmi and Järvenpää (2000) see that case studies concentrate on finding multiple views, new theories and new hypothesis. Case study usually does not need to test theories or hyphotesesi, unlike nomothetical research. Kasanen, Luukka and Siitonen (1993) on the other hand separate the research depending the research type, data collection methods and how the findings are presented. Research type can be normative or descriptive type and based in theoretical or empirical data. Data can be collected via statistical analysis, descriptive case studies, and analytical mathematical models. The most important thing in the research, is not how the data is collected, rather how the findings are presented via different approaches or procedures. *Conceptual approach* produces new knowledge primarily through reasoning via theoretical frameworks. In *nomothetical approach* via causal models are tried to be formed descriptive general laws. *Action-oriented approach* is somehting in between descriptive and normative study, in where deep understanding of the studied subjects, involved humans and change

processes is targeted. *Decision-oriented* approach is similar Nomothetical approach, excepts the research type is normative; the results are meant to help management in running the firm

Constructive approach is a research procedure for producing new managerial constructions, i.e. new ways how to apply management accounting in problem scenarios. For a case study the three latter ones are the recommended ones.

Quantitative methods are not suitable for this study, since there is not enough background information for making the quantitative questionnaire. Also there would be a risk that the sample size would be too small since there is only a limited size of MTN vendors globally. There exist more operators globally, but insides on country typically on a few, and it might be difficult to get enough operator responses for a questionnaire from abroad. For this kind of study, where the goal is to study additional feature pricing method in an oligopoly MTN industry from different perspectives, a better method is to study it through a case company study and prior research. There is no testing of hypothesis and existing theories. Thus this master's thesis is a qualitative normative-constructive case study. For achieving a better view on the MTN business and additional feature pricing, triangulation based on structured and themed interviews, literature review and analysis of available public pricing and network business modeling tools are used in the thesis.

Case company interviews are mostly theme based. Interviews done outside the case company are structure based. Used literature is articles, as well as marketing and management accounting related books.

1.4. Outline of the study

Chapter two describes the MTN industry from both a technical and an economical point of view. The technical description covers the MTN evolution, architecture and standardization in order to give an overview of the technological nature of the MTN industry. This is done because the target group is assumed to have some technological background in the MTN industry and because the main focus is in the economic study of the MTN additional features. The economical description is divided between an operator and a vendor perspective. Chapter two covers the current trends in the industry, and the most important drivers and issues which should be taken into account, when reference prices are set. The chapter lists MTN vendor market shares and technologies in order to give some perspective on the possible strategies,

which competitors may have on pricing. The aim of this chapter is also to give technical personnel an overview on the economical nature of the MTN industry.

Chapter three covers basic pricing theories in the context of competition, customers and segmentation strategies. This chapter also discusses price sensitivity and the problems related to determining price sensitivity in MTN industry.

Chapter four starts with interviews from both the operator and the MTN vendor point of view. Interviews are done based on a loose question frame, from which the most important points related to MTN pricing especially related to used investment and cost accounting methods, which can be used by the operator of vendor for evaluating a proper price range, are collected. The chapter continues concentrating on the different approaches described in the introduction, including more detailed insight in different cost accounting methods and their suitability for the MTN additional feature pricing.

Chapter five lists and analyzes the pricing strategies, which are formed from the information gathered from chapters two to four. This chapter also shows guidelines based on the pricing strategies, which can be used by the vendor side for selecting a proper method for calculating most suitable reference price for the MTN additional features. The guidelines also help in estimating the feasibility of the additional features. Calculations about some example reference prices for additional MTN features are at the end of chapter five.

Conclusion in chapter six gathers the results and discusses the found solutions to additional feature pricing in the MTN industry. This chapter also summarizes the remaining problems for the additional feature pricing, which were not solves under this study.

2. MTN industry description

There are certain aspects, which make the MTN unique compared to many other industries. First of all both the operators and the vendors are relatively large in size compared to other industries. Both the seller and the buyers are professionals, with good resources for supporting the procurement and selling process. Also, the industry is quite heavily regulated and standardized and it has many connections to national security and the defense industry. However, the nature of the industry changing rapidly because of technological evolution, changes in regulation as well as merges and acquisitions in both the vendor and the operator side.

2.1. Mobile telecommunication networks technical description

To understand what actually is meant with an additional feature in the MTN, some basic MTN architecture concepts should be explained, staring from the MTN evolution. There are hundreds of additional features sold separately in the MTN market. In this chapter is concentrated on the MTN general characteristics.

2.1.1. MTN evolution

The MTN technologies can be divided in to different generations according to established practice in the telecommunication industry (e.g. Toskala and Holma 2002 & Toskala and Holma 2011). The First Generation (1G) contains the analog system like ARP and NMT, which are no longer supported in most countries. 1G MTN was used mainly for voice calls and had poor security control and very limited additional services.

The Second Generation (2G) contains the first digital MTN technologies such as European Global System for Mobile Communications (GSM), American Interim Standard 95 (IS-95) and Japanese Personal Digital Cellular (PDC). 2G systems are all digital systems, which resulted to, to some extent, better voice quality, extra services, such as call forwarding and call barring. Security control was taken into use in the form of International Mobile Station Equipment Identity (IMEI) and A5 codes, which are phone specific, and A3 and A8 codes, which are Subscriber Identity Module (SIM) card specific to prevent tapping, use of stolen terminals and unauthorized calls. The first 2G systems had also a limited data call possibility reaching bit rates of 10 kilo bit per second (kbps). One major change was also the global

standardization, which allowed international transparency and global roaming possibilities especially with GSM standard.

The data call started to really evolve, when General Packet Radio Service (GPRS) was introduced in 2001 on top of the GSM platform. In the beginning GPRS gave 40 kbps data rates, which was already enough for simple Wireless Application Protocol (WAP) browsing. The MTN evolution in data transfer distinguished the MTN from the earlier generation, so that the concept 2.5G was introduced in the MTN industry. 2.5G followed soon in 2003 by Enhanced Data Rates for GSM Evolution (EDGE) also known as Enhanced General Packet Radio Service (EGPRS), based on GSM platform. It gave theoretical bit rates of 384 kbps, which was enough to get an actual mobile internet connection. However it did not reach quite the date rates promised by the third generation (3G) systems, already under development at this time. Therefore EDGE got the status of 2.75G.

The 3G MTN systems are mainly grouped based on their data rate capability, which was increasing trough wider bandwidth and more efficient modulation. At the moment there are three competing standards. Biggest standard both in market size and spread is Universal Mobile Telecommunications System (UMTS) also known as Wideband Code Division Multiple Access (WCDMA). WCDMA name comes for the air interface technology it uses. The second biggest standard is an IS-95 follower Code Division Multiple Access-2000 (CDMA-2000), which has lost most of its market share to UMTS. The third standard is Time Division Synchronous Code Division Multiple Access (TD-SCDMA), which is a Chinese 3G variant. In addition to the higher data rates, 3G MTN systems provide also the possibility to video calls.

At first UMTS gave the same date rates as EDGE, but later releases with High-Speed Packet Access (HSPA), increased the data rates already to several Mega bit per second (Mbps) and introduced different Quality of Services (QoS) traffic classes like streaming data traffic, which could be used for video telephony. Again a new generation step was introduced in form of 3.5G, pointing to UMTS HSPA releases.

In 2009 first 4G MTN networks were introduced into commercial use. The first one was Mobile Worldwide Interoperability for Microwave Access (WiMAX). It is an advanced version of fixed WiMAX. WiMAX uses bigger bandwidth compared to 3G, as it offered already in the first release data rates of 15 Mbps. WiMAX like other 4G a entirely based on

data calls, lower data packet latencies and IP, for offering big enough data rates and QoS for fulfilling most of the needs for true mobile data services ranging from online gaming and video streaming to traditional web browsing and internet banking. QoS is defined mainly by bitrates, packet latencies, and packet error rate and as guaranteed combination of these three QoS variables. WiMAX was soon replaced by Long Term Evolution (LTE) as the main 4G technology, which opened its first commercial networks in 2010. LTE has even higher frequency bandwidth and data rates, currently already up to 150 Mbps.

In the coming years LTE Advanced (LTE-A) networks, in where the data rates will be even up to several hundreds of Mbps due to higher frequency bandwidth and increased BS processing power, are planned to be launched.

2.1.2. Standards

The MTN business is a highly standardized industry in all its generations, and different standards regulate strongly the telecommunication industry development. The aim of the standards is to ensure interoperability between device manufacturers and to create open global markets for MTN devices and ensure global penetration for the MTN systems.

The two most important standardization bodies in the industry are the 3rd Generation Partnership Project (3GPP) and The Institute of Electrical and Electronics Engineers (IEEE). 3GPP is responsible for most MTN technologies, like GSM, UMTS and LTE (3GPP 2007). For CDMA based technologies the standards are separated from the 3GPP to the 3rd Generation Partnership Project 2 (3GPP2). IEEE is responsible for WiMAX standards (IEEE 2005). The 3GPP and IEEE standards define how the traffic and signaling between NE interfaces should be implemented, e.g. which are the highest supported data rates, how the network functionality is shared between the NE and how NE's communicate with each other. This brings limitations to the vendors when the MTN equipment and features are designed, since the equipment has to strictly fulfill the standards for getting standard and operator acceptance. There has been a trend during the past few years to extend the standards even further beyond NE interfaces inside the NE functionality. Thus also some of the plug in cards inside the NE and NE modules would be included to open markets and could also be tested against the standards for getting comparable quality acceptance requirements. The Open Base Station Architecture Initiative (OBSAI) is one example of a standard, which defines inter NE

functionality. In OBSAI standards it is defined e.g. how certain module interfaces inside the Base Station (BS) should be implemented (Lanzani 2007).

2.1.3. MTN architecture

The 3GPP and CDMA based MTN architecture can be divided into different sub networks depending on sub network functionality. Access network is responsible for radio path control (e.g. radio transmission power and radio error control), connections establishment to the mobile and handovers (call transfer to another cell or to another base station). The NE related to access network is formed from BS and the BS controllers. Access network is distributed over the whole geographical MTN coverage area, and has the highest installation costs. Thus the existing install base from an earlier network is a crucial benefit for cutting costs, since co-siting a BS is typically just one third of the cost of installing a new BS. (Smura et al. 2005)

Tables 1-4 gather the most important network elements for illustrating the investment needed for the MTN, and how the elements scale to both geographical size and amount of subscribers. In table 1 are listed access network BS attributes, which are mostly geographically scaled. Whereas the core network elements listed in table 2, the scaling is based more on amount of subscribers. Value adding Network Elements in table 3 are not compulsory, but are needed for creating value adding additional services. The tables 3 network elements are scaled mostly on load.

Table 1 Access Network NE. *indoor coverage probability in dense urban/urban/suburban/rural surroundings (Smura et al. 2005, Toskala and Holma 2002, table modified)

Network Element	Functionality	Call capacity	Cell radius*	Price (Euro)
Transmit and Receive unit (TRX) GSM	Transmitting and receiving equipment, which connects antenna to BS via feeder cable. Transforms digital data into analog radio frequencies and vice versa. Either as a plug in unit or independent module.	6.4 calls 70.4 kbps	0.73/2.51/3.21/6.36	4000
Transmit and Receive unit (TRX) EDGE		6.4 calls 256 kbps	0.73/2.51/2.84/6.36	5700
Transmit and Receive unit (TRX) CDMA		700 kbps	1.5/2.5/5.0/15.0	2900
Transmit and Receive unit (TRX) UMTS		96 calls 1536/14400 kbps	0.57/0.89/2.11/6.36	6600
Base Station (BS) GSM	Fits the traffic suitable for air interface transmission and reception, performs modulation, performs call handover inside the BS and handles error protection in air interface.	Max 18 TRX	up to 180 km	110 000 (new installation) 26 000 (co-site)
Base Station (BS) EDGE		Max 18 TRX	up to 180 km	30 000 (upgrade from GSM)
Base Station (BS) CDMA		Max 6 TRX	up to 40 km	115 000 (new installation) 35 000 (co-site)
Base Station (BS) UMTS		Max 18 TRX	up to 180 km	100 000 (new installation) 40 000 (co-site)
Base Station Controller (BSC) GSM	Handles admission control, i.e. checks that the cells can handle the requested traffic, performs cell load and radio frequency power control. Separates the data traffic and voice calls. Performs call hand overs between two different BS.	Max 300 TRX	-	350 000
Radio Network Controller (RNC) UMTS		Max 100 BS	-	1 300 000

Core network elements in table 2 are responsible for call control, like identifying subscribers, establishing and clearing calls. Core Network is also responsibility for charging, mobile location management and transferring calls with other networks. Core Network is usually centralized to few secure locations and is considered to be an essential part of national security.

Table 2 Core network NE (Smura et al. 2005, Toskala and Holma 2002, table modified)

Network Element	Functionality	Capacity	Price (Euro)
Mobile Services Switching Centre (MSC)	Call center for voice calls. Acts as a bridge between mobile network and fixed network, controls calls for the mobile network and identifies the origins and destinations of calls, handles parts of charging and collects call logs.	1 000 000 users	4 000 000
Serving GPRS Support Node (SGSN) GSM	Call center for data traffic. Controls calls for the mobile network and identifies the origins and destinations of calls, handles parts of charging and collects call logs.	1 000 000 users	230 000
Serving GPRS Support Node (SGSN) UMTS		1 000 000 users	888 000
Gateway GPRS Support Node (GGSN)	Acts as a bridge between mobile network and internet.	1 000 000 users	280 000
Call Processing Server (CPS) UMTS	Provides connection signaling between NE's and controls the establishment of IP multimedia sessions and handles part or multimedia related charging.	1 000 000 users	9 900 000
Voice call media gateway UMTS	Converts circuit switched voice calls suitable for Core Network	1 000 000 users	350 000
Ip multimedia media gateway UMTS	Converts ip multimedia sessions suitable for Core Network.	1 000 000 users	1 800 000
Home Location Centre (HLR)	Stores both own and visiting subscriber parameters, like phone numbers and used services.	1 000 000 users	4 000 000
Authentication Centre (AuC)	Performs subscriber authentication and generates encryption codes for voice calls.	1 000 000 users	Included in HLR
Authentication server	Performs subscriber authentication and generates encryption codes for data traffic.	1 per operator	290 000
Home Subscriber Server (HSS)	Provides HLR functions, also for IP traffic.	1 000 000 users	4 000 000
Firewall	Protects the network from unwanted connections from outside networks.	1 000 0000 users	42 000
Packet Data Serving Node (PDSN) CDMA	Routes packet data traffic.	1 000 000 users	1 600 000
Home agent CDMA	Routes packet data traffic to the mobile when it is away from home network.	1 000 000 users	350 000

As part of a core network NE value adding services are typically added, which are listed in table 3. Basically as a value added service anything on top of basic voice, video and data traffic cervices, can be considered.

Table 3 Value adding NE (Smura et al. 2005, Toskala and Holma 2002, table modified)

Network Element	Functionality	Capacity	Price (Euro)
Short Message Service (SMS) Center	Handles and stores SMS	1 per operator	400 000
Multimedia Message Service (MMS) Center	Handles and stores MMS	600 messages/s	4 500 000
Intelligent Network (platform)	Network architecture that provides possibility for value added services like televoting, call screening, telephone number portability, toll free calls and prepaid calling	1 per operator	2 300 000
Voice-mail Server	Sends, stores, and retrieves audio messages	1 per operator	340 000
WAP gateway	Converts WAP protocol stack to the web protocol stack	600 messages/s	4 500 000
MM Email Gateway	Enables sending and receiving of e-mail messages directly to the phone and MMS from phone to internet	400 messages/s	1 900 000
MM Terminal Gateway		400 messages/s	3 000 000

The CAPEX costs are roughly divided into three parts: Radio Access Network 60 %, Core Network 20 %, and passive elements in Base station site (building premises, sites and masts) 20 % (Meddour *et al.* 2011). The actual price from the NE is small compared to the installation and building costs for mast, antennas, power and backhaul. This is also visible in Table1, when new installation and co-site solution costs are compared.

Table 4 Mobile Network Operator CAPEX Elements (Market Research 2010)

CAPEX Elements	Developed markets	Emerging markets
Masts, buildings and other infra costs	**42**	**37**
NEs (BS) price	**15**	**15**
Network testing	12	2
Site acquisition and Network planning	10	4
Power installation	10	31
Backhaul parts and installation	6	6
Spare parts	3	3
Router parts and installation	2	2

the network connecting different NE is called transmission network and it is implemented using different transmission links like optical fibers, copper lines or RF links. The transmission media, which is used to carry data is called a bearer, and it has a defined capacity, delay, and bit error rate. The whole network is managed by using Operation Support System (OSS), which is used for monitoring and controlling network flaws, configuration and performance. (e.g. Toskala and Holma 2002)

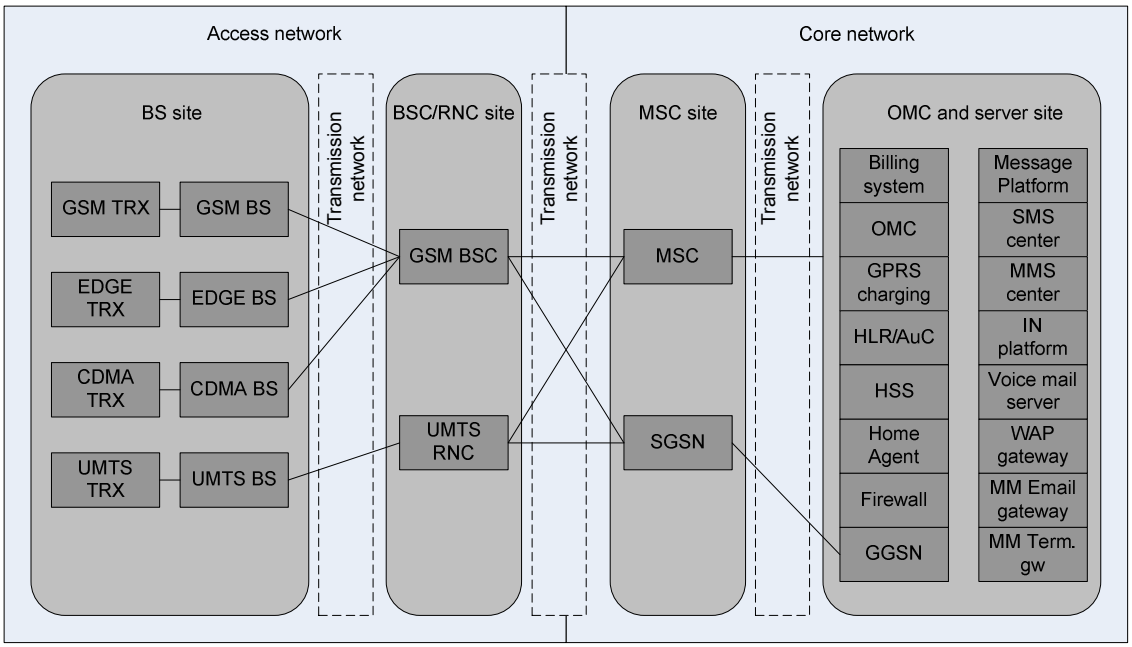

Figure 1 3GPP and CDMA based MTN architecture

2.1.4. MTN additional features

According to the interviews with the case company product managers and program managers, it depends on the MTN vendor, what MTN functionality they want to sell as additional feature. Usually the NEs presented in tables 1, 2 and 3 are sold with basic SW, which in included in the product price. The basic SW offers the basic functionality, but with lower performance and lower flexibility. Additional features are SW expansions to the basic SW, which can be typically activated with a proper license key. Occasionally additional features require also HW updates; for example an additional server, RF amplifier or a new interface plug-in card. Another thing is that if the feature is not supported at all by the old NE HW platform. Then the whole NE HW platform has to be replaced. In this kind of case the true HW costs get really high, even if the MTN vendor does not perceive them.

However, the HW price is typically much less than the SW license price for a specific feature. The additional features are linked to SW releases, which are published with most MTN vendors annually. A SW release may include 20-50 new features, which are sold separately on top of the basic SW. It is also up to the MTN vendor, to decide whether it will sell the additional features separate, or whether it will it include to the basic SW them at some point. Some features require SW update to two network elements; a HSPA upgrade requires changes both in BS and RNC SW. Still the license key is usually applied only at one NE. Additional feature examples are listed in table 19.

Development efforts for individual MTN features vary greatly and can be anything between few months to hundreds of years, measured as total work effort. Development efforts include design, specification, SW code writing and HW schematics drawing, different test phases and product management. Also laboratory resources, test tools, office space for the employees and support functions for daily work; line managers, HR, payroll and secretaries, are needed. Test tools can be very expensive as well as building new laboratory space.

2.2. Operator business

The MTN operators vary in size and strategy. There are small domestic players, like DNA Finland and huge international global giants like Vodafone. Clearly they all have different strategies and buying behavior, which should be reflected in the pricing strategy of the MTN vendors. For example DNA has limited resources and a need for different kind of services compared to Vodafone. Buying behaviors are also different, Vodafone is actually bigger than the MTN vendors themselves, which gives it a clear bargaining power. According to interviews made for this master's thesis, small operators tend to ask for an offer from the MTN vendor, whereas bigger operators use internet auctions or other ways to drag the equipment price down.

It is suggested that complex items and complex bundle offerings increase the overall difficulty of the online auction (Beall *et al.* 2003, Schoenherr & Mabert 2007) and that reverse auctions should be primary used for commodity purchasing, less complex and less customized standard products (Tassabehji *et al.* 2006, Parente *et al.* 2004). Still according the interviews, bigger international operators are adopting the reverse online auctions as a part of their standard procurement processes. The web based auctions has actually been shown to lower procurement costs by as much as 35% (Turbin *et al.*).

The MTN operators can be grouped to into categories, shown in table 5, depending on how the MTN infrastructure ownership and actual MTN end user service management are handled. Despite the operator segments, the overall cellular business ecosystem is typically vertically integrated due to close partnerships among operators (Kiiski 2007).

Table 5 Operator segments (Verkasalo 2010, Smura et al. 2005, Kaleelazhicathu et al. 2004, table modified)

Mobile operator segment	Description	Owned network NEs/service components
Mobile Service Operator (MS-O), Virtual Operator	Provides basic mobile telecommunication services to end users, like voice, video telephony, data services, and SMS and Multi Media Message MMS services. Service providers handle the management of user profiles, subscriber acquisition, and subscriber retention, provides security services and handles charging and billing for the end users. Service operator doesn't own the network it uses. The network capacity is leased or rented from RAN and CN Network Operators trough Service Level Agreements (SLA), which defines the incoming traffic costs, offered services and possibilities for value added services. The service operator may resell the capacity onward to a third party.	Billing system, Customer Relationship Management (CRM) and service management systems
Mobile Network Operator (MN-O)	Owns and administrates the physical network and spectrum license. Provides transport and bearer services to other operator segments, but not to end users. Can be divided into Access, Core and Transmission network operators. Dominant or predominant network operator is called an incumbent operator.	Spectrum license, RAN, CN and TN
Radio Access Network Operator (RAN-O)	Owns and administrates the access network and provides transport and bearer services to service operators	Spectrum license, BS, antennas, BSC/RNC (GSM/UMTS), ASN Gateway (WiMAX)
Core Network Operator (CN-O)	Owns and administrates the core network and provides core network capacity to access network operators	Mobile switches and MTN management database NE's
Transmission Network Operator (TN-O)	Owns and administrates the transmission network and provides transmission services to core network operators	IP-routers, Optical back bone, E1/STM-1 lines, wireless transport links
Mobile Vertically Integrated Operator (MVI-O)	Owns the spectrum license and physical network and provides telecommunication services to end users	MN-O and MS-O NEs and components
Mobile Virtual Network Operator (MVN-O)	A service operator that owns its core network (but not RAN) and is independent in making interconnections with other virtual network operators or network operators. Has greater freedom in developing own services and value added services compared to service provider. Incoming traffic is priced by the virtual operator itself.	MS-O and CN-O NEs and components excluding SGSN
Re-seller/Brand operator	Distributes subscriptions of a another service operator under its own brand name	Own brand, marketing and distribution
Value added service provider	Provides complementary and value added services to the basic mobile telecommunication services, like location based mobile advertising services	Service server and platform
Content provider	Sells games, music, ring tones etc. content to mobiles either developed by itself or by other content providers	Content server and platform

In many countries the big operators are a legacy from a government monopoly. Together with new operators they form an oligopoly market, which allows collusive pricing. This combined with consumers' switching costs across service providers are the main reason for the operator market power in different countries. (Nunn & Sarvary 2004) Government ownership is strong indeed in the MTN industry, but it is less visible in the operational management level for these firms. We have seen this e.g. in the case of Sonera, where the Finnish government didn't take an active part in running the company, except in supporting Sonera's balance after the costly German 3G license trade. Another example of low government interference is a case study made by Sidak (2002) with Deutche Telecom. Even though mostly owned by German government, Deutche Telecom did not anticompetitive behavior compared to private operators. Also bond ratings and weighted average cost of capital were in line with competitive markets.

Access prices are those prices the operators have to pay or what they can charge, when the MTN network is used by another operator. Access prices are usually regulated by the government. It has been analyzed that a vertically integrated monopolist telecommunications network provider will under invest relative to the social optimum, especially if access price between the incumbent and entrant is regulated (Kotakorpi 2006). Asymmetric access price regulation favoring market entry will cause lower charges for consumers and encourage entry and as a drawback cause a loss in total surplus because of distorted per-minute price by the incumbent (Peitz 2003). There are also differences between continents. In US access prices spur deployment of new technology by incumbent operators. Whereas in EU countries where the originating access charges are higher than the EU average, then telecommunications operators as a whole allocate more money towards investments (Changa *et al*. 2003). During this millennium in many countries for the subscribers were allowed to change the operator without a need to change phone number. This was a concern for many operators. In Finland the switching sensitivity has decreased during the past year and also a study of US subscribers operator switching sensitivity revealed that subscribers still perceive the switching barrier high, discouraging them from switching carriers (Shin & Kim 2007).

Usually operators have to pay for the government for the air interface frequency spectrum they are using. The charging can be based on usage or one time auction. Usage in charged based on frequency bandwidth, emission power, coverage area, frequency band, dedicated use vs. shared use, time of use, transmit vs. receive-only use, application/service type, supply vs. demand, and special purpose. Charging based on usage is applied in UK, Canada,

Australia, Korea, Singapore, France, Israel and Taiwan. Auctions are held in US, Germany, UK, Austria and Switzerland. (Yu *et al* 2004) In some countries like Finland, there are no charges for the spectrum, but other requirements ranging from coverage to pricing. It is a huge difference in investment calculation if the Spectrum cost is a billion dollar one time charge or an annual charge based on volume. The 3G spectrum auctions left many operators in bad debts, which decreased their interest for additional investments. (Laitinen *et al.* 2008) This is now in the past, but still in good memory for many operators, when bigger investments are considered. The investment calculations are probably now done more carefully. The spectrum is indeed a valuable asset according to the interviews made for this master's thesis. For operators who have a lot of bandwidth in their use, it is a lot easier the sell wide bandwidth technology than for those operators, which should first acquire the required spectrum from the markets.

Operator costs can be divided to Capital Expenditures (CAPEX) and Operational Expenditures (OPEX). CAPEX consist of those investments, which are considered to last over a year and are activated in the balance sheet. CAPEX for different MTN can be estimated from tables 1, 2 and 3. OPEX consists of all of those involved in operating a network.

Table 6 Operator OPEX elements and average relevance for operators, MS-O=Mobile Service Operator, MN-O= Mobile Network Operator, RAN-O= Radio Access Network Operator, MVI-O= Mobile Vertically Integrated Operator, MVN-O= Mobile Virtual Network Operator, 4=Dominant, 3=Very relevant, 2=Relevant, 1=Not very relevant, 0=Not existing (Lähteenoja et al. 2005, table modified)

OPEX category	OPEX elements	MS-O	MN-O/ RAN-O	MVI-O	MVN-O
1) Maintenance of equipment and components	Preventative network equipment maintenance and reparation cost	2	4	3	2
2) Equipment software licenses	Yearly license costs to network equipment or software vendor	2	4	3	3
3) Sales and marketing, customer acquisition	Marketing, advertising, SLA negotiation and subsidization of handset vendors	4	1	3	3
4) Customer provisioning	Customer registration and activation of customer devices	4	1	3	3
5) Customer care	Customer service, help desk and CRM operations	4	1	3	2
6) Charging and billing	Metering, data collection, charging, billing, accounting and controlling to enterprise management	4	2	3	4
7) Service management	Product management, supervision of quality and SLA management	4	1	2	3
8) Network management	Faults, Configuration, Accounting, Performance and Security (FCAPS) management, supervision and control of NE's, OSS operation	2	4	3	3
9) Product/ platform development	Network planning, Service design and development, SLA design	4	2	3	2
10) Rental of physical network resources	DSL access, leased lines, dark fiber, co-location, hosting, mast for BS's, mobile access, Storage Area Network (SAN)	2	3	3	4
11) Roaming	Roaming contract agreement and negotiation, testing of the roaming functionality, maintenance of roaming profiles across multiple networks	2	3	3	2
12) Inter-connection	Termination charges from another network operator responsible for completing a call originated in another network	2	3	3	3
13) Yearly cost of radio spectrum licenses	Spectrum license fees paid to government agency or network operator owning the spectrum license	0	3	3	0
14) Regulation	Regulation information collecting and reactions to regulation changes, reporting to regulators, fines based on regulation decisions	2	0	1	1
15) Content	Licenses paid for content owner	4	2	3	3

Table 7 Mobile Network Operator OPEX elements (Market Reasearch 2010)

OPEX element	Developed markets	Emerging markets
Land rent	42	15
HW & SW support and maintenance	16	20
Backhaul rent and lease costs	12	14
Electricity	10	20
Power maintenance	8	5
RF engineering support & Network optimization	5	7
Management	4	3
Spare parts	3	4
Insurance	0	5
Other expenses	0	7

In western countries, where fixed networks like copper Transport Protocol (TP) and coax networks are progressed, the reuse of existing infrastructure often is an attractive option, when static broad band investments are considered compared to new investments in optical fiber technology. In countries where fixed networks are not rolled out, the choice is mainly between different wireless technologies. (Fijnvandraat & Bouwman 2006)

There has been a clear trend globally for declining or static Average Revenue Per User (ARPU) in the MTN industry. This is because of three reasons, (i) competition has increased and regulation has favored low pricing by allowing subscribers to keep their phone number when changing operator and forcing operators to lease their network to virtual operators (ii) MTN technology has matured, making the investments less expensive (iii) MTN services have expanded to third world countries, where the buying power cannot support high ARPU. As a total value, however, the MTN industry has grown, because the amount of active subscribers has grown. How can the operators in develop countries find growth possibilities in this kind of environment? First of all, the new technology will bring a better platform for high speed traffic and services requiring wider band width. It has been envisioned, that the growth in MTN industry would be achieved in Business to Business (B2B) markets from data traffic in services to utilities, manufacturing, logistic and banking. (Olla & Patel 2006) Also the cost per megabyte (MB) is expected to drop from about 7 cents per MB in 2010 to about 0.89 cent per MB until 2014 (Brunetti *et al.* 2011), which will compensate lower ARPU. This

is still high compared to fixed line costs, which varies between 2 and 5 cents per gigabyte and declines at approximately 10 percent per year

In IP based networks the costs per Mbit of traffic is predicted to vary based on offered service depending on QoS, volume of traffic per source relative to the capacity and traffic peaks. (Davies et al. 2004). There will be a definite change in the MTN industry for the operators, when Voice Over IP (VoIP) expands. The new MTN technologies will use mainly VoIP for delivering voice. VoIP will decrease the revenues of traditional operators for long distance and international call, which might decrease their investment willingness for some features. Much depends on whether, the VoIP will be granted traditional phone numbers and the right to charge for incoming calls. (Engel 2007)

Already during the last millennium it was predicted that flat rate pricing will continue to dominate the data transmission market also in the future (e.g. Odlyzko 2001 and Anania & Solomon 1997). To satisfy user's demand for simplicity, predictability and risk avoidance, block pricing would also be applied. In block pricing users' are allowed to use large amount of time for phone calls or large amount of data for internet access for a flat rate, and the excess usage is charged as extra (Odlyzko 2001). This has indeed been the case and the Telecom market seems to be heading even more into flat rate pricing direction.

How the new MTN technology changes the MTN industry will be seen in the future. Ballon (2007) has studied the trade between old (2G and 3G) and new (4G) technology. In his study based on specialist panels, no dominating operator strategy came up, and the expected strategies vary from pre-emption strategy of new entrant competitors from integrating the mobile broad band into single offer. Verkasalo (2009), on the other hand, used end user statistics for his studies in analyzing the future of broadband mobile data, but also emphasized the uncertainty factors in estimating, in which direction the mobile broadband will develop.

Table 8 The most important drivers and bottlenecks for new MTN technology and mobile broadband in Europe (Verkasalo 2009, Ballon 2007, table modified)

New MTN technology drivers	New MTN technology bottlenecks
1) Poor fixed broadband infrastructure development in many small cities, towns, rural and remote areas across Europe	1) Lack of interconnection and roaming agreements between new technology operators.
2) Government incentives, programs and public-private partnerships to stimulate broadband connectivity	2) Pricing models in many EU countries oriented towards occasional use, limiting scope of new technology to business market
3) Competition in WiFi markets	3) Licensing in many EU countries limit spectrum availability allowing technical but not market experiments with new technology
4) Emerging integration of new and old technology dual mode handsets	4) Lack of structural advantages over well developed fixed broadband infrastructure
5) Increased usability of mobile handset and mobile applications	5) Potential saturation and congestion of unlicensed spectrum in prime locations
6) Falling hardware prices and backhaul costs	6) Limited amount of terminals and other certified equipment in the market
7) Limited number of licensed operators in some markets, creating incentives for new stakeholders to enter national markets using new MTN technology	7) End user lack of knowledge of differences between old and new MTN technology
8) New applications possibilities such as VOIP over wireless, deployment of new MTN technology on trains, etc.	8) Lack of content applications
9) Expected expansion of LTE	9) Reluctance to investments due revenue streams from circuit-switched voice
10) Open mobile handset software platforms	10) Incumbent Network Operators control of the cellular network access

2.3. Vendor business

The MTN business from the vendor perspective can be treated as an oligopoly. For many technologies there are only few relevant vendors in the market. Biggest vendor, if only MTN products and services are included, is the Swedish Ericsson, followed by the Finnish German Nokia Siemens Networks (NSN). Third biggest is the French American Alcatel Lucent. The other vendors are the Chinese Huawei and ZTE, the Japanese NEC and Fujitsu and the Korean Samsung (Infonetics Research 2011). Cisco doesn't have mobile Radio Access networks, but it is strong player in Core Networks.

At the moment in many regions GSM still has a dominant market share, but in developing markets UMTS dominates. CDMA2000 and especially IS-95 have a marginal share of the MTN markets. Most of the MTN vendors also offer partial or full services for the MTN installation and maintenance. Service correspond 50% to 10 % of the total revenues and the share is increasing (Infonetics Research 2011).

Table 9 Supported MTN technologies by vendors (MTN vendor homepages, 29.11.2011)

Technology/ Vendor	GSM	IS-95	CDMA2000	UMTS	WiMAX	LTE	TD-SCDMA	Core Network	Fixed networks	Other industries involved
Ericsson	X	X	X	X	-	X	X	X	X	None
NSN	X	X	X	X	X	X	-	X	X	None
Alcatel Lucent	X	X	X	X	X	X	X	X	X	None
Huawei	X	X	X	X	X	-	X	X	X	None
ZTE	X	-	X	X	X	X	X	X	X	None
Samsung	-	-	-	-	X	X	-	-	-	Micro chips, mobile terminals
Cisco	-	-	-	-	-	-	-	X	X	Various IP network products
NEC	-	-	-	X	X	X	-	-	X	Various different IT products
Fujitsu	-	X	X	-	X	-	-	-	X	Various different IT products

In the recent years there has been a trend for mergers, started by Alcatel and Lucent in 2006 and followed by Nokia Networks and Siemens Communications in 2008. With the initial mergers of NSN and Alcatel lucent economics of scale and larger install base for beating Ericsson were sought. Ericsson has been the market leader in most MTN technologies, still having a strong grip in the 3G market. In 2009, the MTN vendor consolidation continued when NSN first tried to buy bankrupted Nortel, but lost the auction to Ericsson. NSN continued to find access to the North American and Asian markets, and managed to buy Motorola networks division in 2010. The acquisition was delayed until 2011 due to ZTE law

suits of proprietary GSM collaboration with Motorola, and consequently the GSM part of Motorola was left outside of the NSN acquisition. The motivation for the mergers and acquisitions has been the price competition on the MTN equipment market and the fierce competition for market shares. Especially the US markets have been difficult for both Ericsson and NSN and acquisitions have been seen as a good way to enter both the US markets and also the IS-95 and CDMA2000 technology.

Falling equipment prices are due to two main reasons, the operator ARPU has dropped and market shares are reached by aggressive pricing. The interviews made for this thesis pointed out that market share is seen crucial for three reasons (i) public references are vital as proof of quality and trustworthiness in an industry where miss investments may be lethal for the operator (ii) a larger install base brings significant economies of scale, because upgrades for old customers can be sold with major cost savings compared to new networks, (iii) market share was seen as a major influence to share price.

According to interviews made for this master's thesis other MTN industry characteristics are pilot phases between vendors and operators and multi-vendor contracts. Before a new release or technology is released to mass markets, it is piloted in a limited network by some selected partner operators. The aim of the piloting phase is to ensure the final quality of the release or technology. A pilot phase is a good opportunity to scan for operator bias for pricing. Multi-vendor contracts are done by most operators to reduce the risk and dependency from a single operator. Multi-vendor contracts limit the pricing opportunities, since the prices between operators can not deviate too much. However, quality, references, responsiveness and roadmap or delivery schedule leave space for pricing.

3. Pricing theory

Like said in the introduction, the aim of pricing is to find the optimal price. Optimal price can be defined in many ways. According to Porter (1985) the price is optimal when it supports the companies' strategy of differentiation or low cost as where economists define optimal price as the point where marginal revenues and marginal cost cross and profit is maximized. In this thesis with optimal price is meant a price, which allows healthy and profitable customer relationships, and maximizes steady demand, realized deals and profit for services and products manufactured with target customer satisfaction. For the MTN industry there are no common norms of setting the correct reference price, especially an analytical one, and the pricing methods change rapidly as the MTN industry develops, which is explained more detailed in chapter five. Still many of the common pricing principles can be applied also for the MTN industry. Price should always be possible to justify to the customer e.g. with work load, value, market price or costs (Sipilä 2003, pp 447), but also be possible to market internally, so that the management and marketing department will justify the price.

3.1. Customers and segmentation

Segmentation aims to find ways to group potential customers based on their differences and similarities, so that competitive advantage is achieved by targeting profitable customers segments with optimized and positioned marketing mix, including proper pricing. Segmentation can be used for reference pricing in three ways. (i) Different reference prices are set for different customers. (ii) Reference price calculation takes into account different segments, and "averages" the results based on segment importance. (iii) Reference price allows tuning in the actual sales process so that individual segment needs are fulfilled.

The same principle applies for segmentation as for business models; simple is beautiful. Marketing literature lists many different frames for segmentation. These frames differ in aspects how the segmentation criteria are defined, how segmentation variables are grouped and in which order the segmentation process proceeds. E.g. in Nested approach by Bonoma and Shapiro (1984) segmentation starts from demographic variables and proceed to operating or financial variables, purchasing approaches, situational factors and personal characteristics as the segmentation processes proceeds. In the Bottom up model by Kotler (2001) masses of customer data is analyzed and the segments are built based on similarities and expected

reactions to marketing mix. Most common criteria for defining a useful segment is that it's characteristics are measurable, it's buying potential is substantial, it is accessible through communication and distribution channels, it's characteristics remain stable over time, marketing efforts for the segment is actionable and that the segments are differentiable to marketing mix reactions (e.g . Frank *et al*. 1972; Kotler 1994; Wedel and Kamakura 1998)

Many researchers suggest that geographical demographic segmentation variables response poorly to the marketing mix (Moriarty and Reibstein 1986, Mitchell and Wilson 1998). Although geographical location may influence procurement processes due to socioeconomic and cultural factors (Jobber 1995) and a specific geographical location may offer competitive advantage to the company itself due to available resources or business relationships (Mitchell and Wilson 1998). But even in these cases it is better to concentrate on the procurement process itself as a segmentation variable and leave resource handling strategy out of the scope of segmentation. Companies, which have a clear strategy, also usually have clear collaboration guidelines for temporary subcontractors, regular suppliers, partner and strategic partners (Sipilä 2003, pp 115). Knowledge about the operators' procurement process is essential in the MTN industry. The interviews in chapter 4.1 revealed that the variation among MTN deals is wide and that there are various way the operators compete the MTN vendors and how they proceed Request processes; Request for Information (RFI), Request for Proposal (RFP), Request for Quotation (RFQ), and other procurement processes like negotiations, penalties, roadmaps and reverse auctions. In the procurement process the customers' quality sensitiveness versus customer price sensitiveness should be emphasized, since at least according to theoretical models among price sensitive customers, cyclical price wars are more common with many different pricing strategies (Sairamesh & Kephart 2000).

Demographic variables are widely used in segmentation, because they are easily available, inexpensive and the segmentation process is fairly simple when using demographic variables (Moriarty and Reibstein 1986, Bonoma and Shapiro 1984, Griffith and Pol 1994). However, the usefulness of demographic variables has been criticized because demographics are more descriptive than actual causal variables (Haley 1968, pp. 30), their responsiveness to marketing mix is not explicit (Moriarty and Reibstein 1986) and because demographic variables are not ambiguous, e.g. size can be measured by number of employees, turnover, braches, geographical locations, etc. (Griffith and Pol 1994).

In industry market segmentation Wind and Cardozo (1974, pp. 153-166) have divided the market segmentation into two step macro and micro segmentation processes. Macro segmentation is based on publicly available demographic, geographic and organizational variables, which characterize the buying organization and the buying situation like company size, product usage rate, application of product, industry sector, location, new vs. repeat purchase, organizational structure, etc. From these variables those, which fit the company's objectives and used marketing mix, are selected for the actual segmentation process. In the case of the MTN industry the macro segmentation variables presented by Wind and Cardozo are not very useful as such, since the customers are mainly from one industry sector and have no fundamental differences in how they use MTN's. Above also the problems, which might come up with geographical and demographic variables, were explained. Thus the segmentation variables might be better to customize to fit better the needs of the MTN industry. E.g. Operator segmentation in table 5, based on the network ownership and population distribution, plays an essential role in network planning and further in additional features needed for the MTN, like extended cell range.

If the publicly available MTN industry customized macro variables don't seem to generate segments, which would react distinctly to the marketing stimulus, the segmentation can be continued to micro segmentation. In micro segmentation the variables focus deeper inside the customer's procurement process, which importance should not be underestimated in the MTN industry. For micro segmentation variables, the MTN specific customization might not be needed, and the variables could cover e.g. purchasing strategy, decision making process, attitudes towards the supplier and buying decision weighting between quality, delivery, price, technical support and supply continuity (Hutt and Speh 2001). Micro segmentation fits best to expensive and high capital industries, because finding out the needed variables many times requires insight knowledge about the customers and the people involved in their procurement processes, making the variables time consuming, difficult and expensive to define (Sudharshan 1998).

Under this thesis it is expected that the MTN vendor will not change its existing segmentation method. If the existing segmentation method is expected to react poorly to pricing input, segmentation can be left to lower significance in the pricing method selection.

3.2. Pricing strategies

Traditionally costs and market share have been key drivers for pricing. Lanzillotti's (1958) research of large US companies found the most important objectives for pricing to be i) achieved target yield for an investment, ii) stabilizing the price and contribution margin, iii) keeping or increasing market share, iv) reacting to competition and v) differentiating the product. In later studies Cunningham and Hornby (1993) grouped the pricing objectives of small firms based on cost, demand and competition. **Cost based pricing** drivers were i) target margins, ii) incremental costs and iii) brake even analysis. **Demand based pricing** was formed from i) market conditions, ii) elasticity of demand, iii) perceived value for the customer and customer loyalty. **Competition based pricing** relied on i) market competitiveness, ii) reacting to competition and comparison of competitor prices iii) and following the price leader. In Shim's and Shudit's (1995) study over 600 US manufacturing companies the cost based pricing was used in 82 % of companies, when only 18 % used market based pricing. However even though the MTN industry is in many respects a production business, MTN additional features fit poorly to cost based pricing, which is discussed more in chapter five.

3.2.1. Pricing strategy frames

There is no single universal pricing strategy frame, which could be used for all instances. Some general theories apply for most cases and should be considered also in the case of the MTN industry. Woodside (1995) lists customer price sensitivity, competitor's responsiveness to different price points for the new products and primary pricing objective, like market share or price skimming, as the first things that should be solved before the recommended prices are set for new products. Sipilä (2003, pp 71-75) has defined a more detailed frame for pricing strategy putting emphasizing on markets, customer value and competition aspects:

1. Define pricing basis: Markets, competition, customer satisfaction surveys and government norms. This is analyzed in chapter 5.

2. Define pricing goals: Volume, ROE, market share, competitor control actions, new product launch, capacity, and industry pricing method change. In this thesis the pricing goal of MTN additional features is defined in the beginning of chapter 3 as goals "which allows healthy and profitable customerships, and maximizes steady

demand, realized deals and profit for services and products manufactured with target customer satisfaction."

3. Set reference price level and define pricing methods: Price level for different segments and different product stages. This is analyzed in chapter 5.

4. Define how price is used for marketing and sales: Discount policy, price reactions to competitor actions, offering policy; pricing strategy change and pricing strategy responsibilities, bundling, and risk management. The scope of this thesis is to find suitable reference prices, not to investigate how the reference price is later used in marketing and sales. Thus this step is only partly analyzed in chapter 5.

Aside the general pricing strategy, especially in a technology intensive industry the product life cycle should be taken into account. The product life cycle defines how product is introduced to the market and how it will gain attention from both consumers and competitors. It can be divided e.g. to traditional four phase S-curve (e.g. Levitt 1965). The life cycle management is not directly in the scope of reference pricing, but the reference price should be set so that the actual sales price can adapt to changing markets.

Introduction: Costs are high and sales volume and competition is low. Demand has to be created and competitors are trying to get acceptance in the market. The Primary target is to educate customers about product value. **Skim pricing or skimming** is a strategy where products are sold with high margins with the expense of sales volume. Skimming is based on the belief that the lack of substitutes and lack of competition will make customers relatively price insensitive. This happens usually during the launch phase. Economies of scale and threat of competitors gaining market share will cause skimming not to be profitable in the long run. Skimming when price is dropped as the product matures is called sequential skimming. Large production costs compared to products price favors the skimming strategy, because even a small price premium significantly increases the product contribution. **Penetration pricing** is used when sales volume is increased on the expense of profit margins. Penetration pricing is favorable, when a company has a cost advantage, unused resources, can gain economies of scale or there is not yet significant competition in the market or the companies small size will not cause too heavy reaction among competitors. In the MTN industry economies of scale exist, but other penetration pricing components do not exist, and usually in the MTN industry for new technology skimming is used. What comes to additional

features, in the telecommunication industry many additional features are SW, with low or zero incremental costs, which would not favor skimming.

Growth: Profitability increased due to public awareness sales volumes and possible economies of scale. Competition begins to increase and new players enter the market. **Differentiated price strategy** or **price leadership strategy** is enforced. Price reductions are considered if markets' are price sensitive and economies of scale or over capacity exist. Price reductions are also expected if market share can give significant competitive advantage like de facto industry standard. In the MTN industry the price leadership strategy has been more common due to standards, which makes differentiation more difficult. But according to interviews network quality and roadmaps are gaining more share among operators, and many additional features could be used for a differentiated pricing strategy.

Maturity: Costs are low due to low marketing and R&D efforts. Sales volume peaks and prices and profits drop due to increased competition. Increased competition also causes brand differentiation and feature diversification. Customer experience, product imitations and more standardized products have increased the customer price sensitivity. Gained market share is defended against competitors by unbundling products, improving cost control, expanding product line and re-evaluating distribution channels. In the MTN industry unbundling is not visible, rather on the contrary, but otherwise it seems to match the general maturity stage.

Decline: Sales volume starts to decline and prices and profitability continue diminishing. **Retrenchment strategy**'s goal is to concentrate the business only to most profitable segments, typically forcing either low or high costs pricing strategy. **Harvesting strategy** is used, when the goal is to withdraw from the industry. In harvesting strategy marketing expenditure is gradually eliminated and the product is allowed to sell on its goodwill until sales revenue falls below a cutoff point. **Consolidation strategy**'s goal is to gain market share and pressure competitors out of the markets through aggressive pricing. In MTN industry for GSM could be seen the symptoms of Harvesting strategy and for WCMDA symptoms of Consolidation strategy

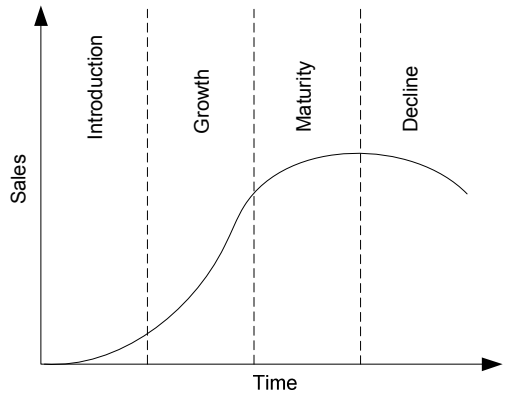

Figure 2 S-Curve (Levitt 1965)

Even if monopoly, strong market position and brand, entry barriers, weak competition and strong quality criteria increase the pricing range, Sipilä emphasizes (2003, pp 167-174) that the most important factor for possible future pricing range is defined by the company it self. The launching price predefines the future price ranges. Price can be dropped, but is difficult to increase and therefore pricing strategies based on cheap launch price aiming for market share growth should be considered carefully. This is strongly visible in the case in the MTN industry since oligopoly and strong competition degrease the allowed pricing range inside the industry, and thus the product life cycle limitations should be carefully considered, so that reference price is set correctly to support the early phases of product lifecycle. At the decline point the reference prices are no longer that important.

Also discount benefits should be clearly visible, since there is a risk that the discount practice is adopted among the customers and industry (Sipilä 2003, pp 364). Like described in chapter 2, in MTN industry some vendors introduced a pricing strategy, where competitor BS where offered to swap with low or negative profit, investing on future SW upgrade cashing. In many cases the SW upgrades proved not to be as profitable as was expected due to price wars. However, based on theoretical models it is often optimal to sell the initial SW package cheap and cash in on the upgrades, even though in practice the situation is exactly the opposite; upgrades are sold cheap and the initial SW packages are used for cashing in (Ahtiala 2004).

Regardless which pricing strategy frame is used a very important aspect during the pricing strategy formulation is analyzing the strategy risks. There are many tools available for risk analyzes. Here is picked a risk frame from Sipilä (2003, pp 175-176), which suits the MTN industry quite well.

Table 10 Pricing risks (Sipilä 2003, Risk probability and risk impact dimensions added to be filled when analyzing the MTN additional feature pricing risks)

Pricing Risk	Risk probability	Risk impact
The demand is overestimated		
Set price is over or under priced		
Competitor reactions are underestimated		
Customer loyalty was underestimated		
Price doesn't reflect chosen strategy		
Price fails to profile as high cost and high quality or low cost and simple product		
Pricing system is difficult and confusing		
Fixed costs are underestimated		
Products cannibalization is underestimated		
New pricing regulations is introduced by the authorities		
Pricing gets negative publicity in the media		

3.2.1. Competition based pricing strategies

According to Nagle (1987, pp. 86-100) in open markets, competition has to be taken into account, and this applies also to pricing. Nagle sees that the general competitor pricing behavior can be analyzed trough their market share, strategy, goals, historical behavior, capabilities and assumptions the competitor has about itself and the industry.

Cooperative pricing strategy is typical in oligopolistic situations where all the main suppliers have viable market shares, they are operating near capacity and there is a high incremental cost of expanding capacity. Price leader price changes are followed by competitors, so that the price differential and price positioning is maintained leading to a stable market share situation. In the oligopolistic MTN industry there have been quite aggressive price wars, when the vendors have tried to gain or keep market share. At the change of the millennium Nokia and Ericsson dominated the GSM and WCDMA markets and their pricing had cooperative characteristics, but pricing has changed to more aggressive direction after that. Pricing could change back toward a more cooperative direction, if the amount of considerable MTN vendors reduces to three. This sets certain pressure for feature reference price, if the market prices change dramatically.

Adaptive pricing strategy is used by companies, whose products have small contribution margins and are sufficiently price insensitive, and which have so small market share, that they cannot affect the industry general price level. In adaptive pricing the company reacts to price changes of bigger companies, so that it tries to increase its market share or keep it at present level. The price differential is not constant like in cooperative pricing. In the MTN industry there no longer are small players left and thus adaptive pricing is not likely to happen.

Opportunistic pricing strategy is used by companies, which have low incremental costs, seek market share increase, are new players in the market and have sales concentrated to few buyers. Opportunistic pricing is more luring also if the companies believe that competitors will react slowly to their price changes either because the competitors don't know the negotiated price or because the competitors' structure doesn't allow fast price changes. In opportunistic pricing prices are reduced for gaining market share and additional sales. This has been quite visible during the past few years in the MTN industry, where the price leader changed few times. Typically the Chinese vendors have been aggressive in pricing. After the mergers in the MTN industry and gained market share by the Chinese vendors, there is not so much pressure for opportunistic pricing. In the past year there has been a trend for decreasing price competition and marketing focus on other aspects like quality and road map. One scenario, which could launch opportunistic pricing, is the market gap left by the possible withdrawal of Alcatel-Lucent from the MTN industry. This is something that could maybe be considered in the reference price, but should not be a main driver in the reference price calculation due to the many uncertainty factors included.

Predatory pricing strategy means the opposite of cooperative pricing. In predatory pricing a product or service at a very low price, intending to drive competitors out of the market, or create barriers, or forcing a smaller company back to cooperative pricing. It can also be used in a declining industry or in an industry where the incremental costs have declined rapidly, by a stronger company for trying to get its competitor to leave the industry and gain the competitors market share. Predatory pricing requires large cash reserves. Typically in the MTN industry the market leaders have not started price wars, even though Ericsson was considered to be swapping quite aggressively the BS for the operators with quite moderate HW prices relying on more profitable SW sales. In the current economic situation, however, it is unlikely that the market share leaders would start predatory pricing with the expense of cash flow, so predatory pricing effect should not be considered that heavily in the additional

feature reference price calculations. Also the aggressive pricing is more a factor on the basic product side, even as sometimes additional features have been bundled with almost no cost on top of the basic offering,

After the competitor price reaction is evaluated the effect the competitor reaction will have on to own goals and objectives. Competitor price reactions can be controlled to some extent, e.g. by publishing price changes in advance with explanations or by highlighting the chosen strategy.

Oligopolistic markets, over capacity, rivalry for market shares, declining growth on industry and uneven cost structure among competitors increases the threat of price competition and price wars (Sipilä 2003, pp 376). Price wars can lead to a long lasting profitability tumble inside the industry, but it can also force the companies inside the industry to rationalize their operations (Sipilä 2003, pp 380). As explained earlier in this chapter, the price war drivers have been indeed quite visible in the MTN industry.

The MTN vendors' price drivers can be analyzed by e.g. Sipilä's (2003, pp 124) list, where the information for competitor analyzes are received from competitor public sources, competitor customers, analyst reports, survey reports and by purchasing competitor products or hiring test shoppers i.e. "mystery shoppers". Sometimes the information can be retrieved from the competitors themselves, by asking directly. It's is allowed to know your competitors personally, but it is not allowed to agree on common strategies or prices. Tables 10 and 11 pricing driver examples are based on the authors experience, Current Analysis (2011) and Infonetics (2011) analyst reports. In the tables + means increased pricing pressure, – means decreased price pressure, 0 means no effect to pricing and N/A that there is not enough information:

Table 11 Market leader MTN vendors' pricing drivers (Sipilä (2003), rating based indirectly to Current Analysis (2011) and Infonetics Research (2011) analysis about the MTN vendors)

Price driver/Vendor	Ericsson	NSN	Huawei	Alcatel Lucent
Product prices	+	0	-	-
Strength and weaknesses	-	0	+	+
Market position	-	-	+	+
Image	-	-	+	0
Customer loyalty	-	0	+	0
Cost structure on profitability goals	-	-	+	-
Marketing budgets	-	0	0	N/A
Strategy	0	0	+	N/A
Owners	0	-	+	0
Historical behavior and management preferences	+	0	+	0
Critical success factors	0	0	+	0

Table 12 Niche market MTN vendors' pricing drivers (based indirectly to Current Analysis (2011) and Infonetics Research (2011) analysis about the MTN vendors)

Price driver/Vendor	ZTE	Samsung	Cisco	NEC	Fujitsu
Product prices	+	0	N/A	0	0
Strength and weaknesses			+	0	0
Market position	+	+	+	+	+
Image	+	0	0	-	-
Customer loyalty	+	0	N/A	-	-
Cost structure on profitability goals	+	0	N/A	-	-
Marketing budgets	0	-	N/A	0	0
Strategy	+	0	0	-	-
Owners	+	0	0	0	0
Historical behavior and management preferences	+	N/A	N/A	-	-
Critical success factors	+	0	0	-	-

For the MTN industry also game theory to some extent can be applied, when competitor actions in pricing are estimated or a company's own pricing strategy is changed. Oligopolistic competitor actions can be described with game theory and Nash equilibrium (Nash 1950). Nash equilibrium is achieved, if each player involved has chosen a strategy and no other player can benefit by independently changing its strategy, while other player strategies remain constant. One of the most famous game theory examples is prisoner's dilemma, where the prisoners A and B can choose either to confess or not. The verdicts would be such as in table 13. The situation, where none of the players want to change their behavior, when their opponents' behavior is given is called the Nash equilibrium. In the prisoner's dilemma the Nash equilibrium is the situation, where both A and B confess. In this situation neither A nor

B doesn't want to confess if the opponent has already confessed, because it would increase their serving time in prison. (Flood 1952). In MTN industry the past pricing wars are an example of prisoner's dilemma. Best solution industry overall solution would not to start price wars, but an opportunist vendor might gain from a early mover advantage.

Table 13 Prisoner's dilemma (Flood)

	Prisoner B doesn't confess	**Prisoner B confesses**
Prisoner A doesn't confess	Both serve 6 months	Prisoner A: Serves 10 years Prisoner B: Goes free
Prisoner A confesses	Prisoner A: Goes free Prisoner B: Serves 10 years	Both serve 5 years

Examples of game theory inside the MTN industry are the swapping and dumping of HW and merger trend. Without dumping of HW the industry would have been healthier, but when one started or was predicted to start HW swapping operations, other were forced to join the game.

3.2.2. Analytical pricing strategies

As one analytical method for pricing the Bayesian analysis could be mentioned. It is based on the Bayesian inference (Bayes 1763), developed by the 18th century mathematician Thomas Bayes. Bayesian analysis can be used in a pricing situation, in where price sensitivity and competitor actions are uncertain. Bayesian analysis is similar to the real option investment method in many aspects. In Bayesian analysis the expectation values of possible outcomes related to price sensitivity or competitor action as a function of price, which requires that probabilities and competitor action are defined, are calculated. (Roberts 1963, Green 1963). There have been studies how Bayesian analysis can be used for estimating end user churn, price sensitivity and optimal price (Kisioglu & Topcu 2011), but no research about how Bayesian analysis could be used for estimating optimal price for the operator investments, even if it could be quite a useful method.

Another way to use analytical methods for calculating expected outcomes under uncertainty is to use computer simulation in business modeling tools. In the ECOSYS project the MTN business cases have been simulated by using Monte Carlo simulation (Smura 2005). With Monte Carlo simulation demand, competition, cost development and other variables are changed in semi-random order by allowing them a predefined fluctuation range.

Table 14 Variables for sensitivity analysis when calculating operator business cases (Smura et al. 2005, table modified)

Sensitivity Variable	Variable explanation
Tariff Erosion	How much service prices decrease annually due to competition and reduced OPEX
New service installations	How fast operators roll out new services to new geographical areas
Handset Penetration	How fast new handset capable of new services are taken into use by end user segments
Service Usage	How much different mobile service usage increase or decrease in different end user segments
CAPEX Components	What is the price erosion of Network Elements, interest rate for loans, terms of payment
OPEX Components	What is the share of each OPEX component from total revenue
Industry Growth	How fast the industry grows/shrinks annually
Start market share	What is the starting market share for the operator
Stop market share	What is the final marker share for the operator at the end of analysis period

As an outcome a distribution about expected cash flows, OPEX, CAPEX and other financial and investment data is received, from where the expected MTN investment value can be estimated. Computer aided simulation is quite useful for performing sensitivity analysis for uncertain variables. In the MTN business models many of the variables face difficulty of predictability due to technological evolution, fast competitor reactions, changes in end user preferences and government norms. However building a single model for the MTN industry, which would cover both the uncertainty of the variables as well as the network quality parameters, is extremely complex and difficult. This is discussed more on chapter 4.

3.3. Price sensitivity

As Woodside (1995) emphasized, customer pricing sensitivity is an essential part of pricing and pricing strategies. Defining an accurate price sensitivity curve is a whole different story and proves to be virtually impossible in many cases. However, indicative estimations about price sensitivity can be done. These guidelines indicate what features and market situation are such, were the price sensitivity should be considered in pricing decisions.

Also a bigger market share reduces the product price elasticity. Usually price elasticity is largest in the short run, but in the case of a substitute or a sunken investment, the effect the price elasticity is biggest in the long run. It should be noted that price elasticity curve is not

symmetric, all customers will not return when prices are reduced to the initial value. And all new customers will not disappear when promo trial pricing campaign ends.

The only practical method for defining a product's price sensitivity with moderate costs is survey research. More advanced methods for surveys are uncontrolled and experimentally controlled methods, which unfortunately suit mostly for consumer products and not that well for B2B industry products. The problem in price sensitivity and price image surveys is that the customers usually overrate the importance of quality and underrate the importance of price, even though professional buyers tend to give more accurate results. (Nagle 1987, pp. 265-293)

Uncontrolled purchase data: Aggregate sales data can give information about price sensitivity, especially if the purchase events can be traced accurate enough and price variation exists. The longer the time period for collected data is the more other factors than price affect the demand. This is probably the most suitable method for the MTN industry, because sales data is available at the vendor side and the interview based methods described below are not that suitable for B2B industry products.

Uncontrolled preference data: Direct questioning is a highly inaccurate method. In this method customers are asked with different techniques, which price level they feel is the correct price for a product and by which price level they would buy more or less. One example could be that for a supplier's product is given grades from 1 to 5, on professional skill, reliability, co-operation, business understanding, price quality ratio, flexibility, etc. (Sipilä 2003, pp 128-131). A buy-response survey is a more advanced method for direct questioning. a buy-response survey doesn't give accurate price sensitivity function but it gives an estimate on which price range a new products price should be set, or if the price sensitivity for an older product has changed. In this method customers are given certain prices and asked if they would buy the product or not. In the MTN industry there should be reference tool, where the sales negotiation data, not only the closed sales prices are saved.

Experimentally controlled purchase data: Not suitable for B2B industry products.

Experimentally controlled preference data: A Conjoint analysis aims to solve the tradeoff between different features inside the product. Potential customers are asked to rank products, so that some product feature, like size or performance, is changed each time. When the responses have been analyzed, the product feature or attribute values can be ranked.

According to the interviews in the MTN industry the vendors perform annual satisfaction surveys from the operators, and perhaps some questions could be added, which could be used for conjoint analysis for the most important features.

Unfortunately survey research results are many times quite unreliable according to tests, and often the only way to get reasonable results is to use managerial analysis for setting the price sensitivity (Nagle 1987, pp. 72-73). This is especially the case in the MTN industry B2B industry products, where the buying behavior among operators is very different, where competition plays a huge role in the demand, and where consumer product like surveys cannot be arranged. Perhaps the most suitable way to use price sensitivity analysis is to check if the most important features are price sensitive or not. And rather than trying to determine the exact price sensitivity curve form a rough estimation of the price sensitivity. Complex estimations will most likely not be accurate. As general rule can be said according to table 15 that MTN industry products are quite price sensitive.

Table 15 Effective elements to price sensitivity, +=increases price sensitivity, -=decreases price sensitivity, 0=effect is case dependent (Sipilä 2003, pp 110-115 and 116 and Nagle 1987, pp. 59-72, pp. 77, table modified)

Price sensitivity element	Additional MTN feature properties	Effect to price sensitivity in MTN industry
The sold product is a necessity	Additional features are typically rarely necessities in the actual MTN network	-
There is a lack of substitutes	Once a MTN network is launched its unlikely that it will changed for a different MTN technology	-
There is a lack of competition	MTN industry is highly competed	+
The product differs from competitors	Products are based mostly on standards, in some features there are more differentiation	+
The product has a unique brand	In MTN industry the brand has not played that big role, but is becoming more important, especially with the Chinese vendors	0
The product price is small compared to available budget or income	Network investment are huge, and also the additional features require a lot of financing	+
The customer can transfer the product cost to it's own customers	Typically due to high competition and pricing trends it's difficult to make the end-users pay. Also some features are not visible for the end user	+
The customer knows the supplier personally and is committed to the supplier	Personal relations and commitment depends on the operator	0
The product is part of a bigger offer	Additional features are part of a bigger offer	-
The product is related to an earlier bought product and there are no substitutes	Additional features are add-ons	-
The product is sold to B2B markets, in where the quality is important	MTN is B2B market	-
The product creates unique value	Some features differentiated the BTS more than others	0
The product quality is difficult to measure or compare due to technical complexity	The product quality can be compared based on automatically generated KPI statistics	-
The customers experienced product quality is high due to technical features or advertising images	Expected quality depends on operators	0
The Product procurement can't be delayed	Many times operators delay procurements due to market or economic trends	+

4. MTN industry specific pricing aspects

4.1. Vendor perspective

The vendor perspective for pricing was studied via semi structured interviews for personnel working among pricing related tasks. Only one MTN vendor was selected for the interviews. From the case company Head of Technology, two Product Managers, Marketing Manager, Head of Business Modeling, Program Manager, Key Account Manager and two Business Modeling Specialists were interviewed.

4.1.1. Cost accounting and budgets

Challenges in cost accounting came partly from currency changes. A bigger problems were the R&D. Cost allocation for R&D was seen difficult both by the controller and the program manager, when individual products and mass products were compared. Also bundling and discounts were seen problematic, if they were allocated only to one product instead of putting the discount to the whole offering. Otherwise the product profitability calculations are no longer valid. On program management it was also admitted that a traditional matrix organization build to serve programs is not suitable for verifying the true implementation effort of a single MTN feature. This was because people were more concentrated in reporting correct total working hours than reporting accurate hours between different programs or activities. And in many cases the working hours were reported only at program level and reporting did not drill down to individual feature level. A better organizational structure would have been feature teams, which would be dedicated over certain time period for specifying, testing and implementing only one feature. This way the true R&D work effort for a single feature would be much easier to verify compared to the situation where most R&D work would be commonly allocated for a program. According to program management the feature content changed typically in every program depending on available resources and the emerging of new customer requests. This caused additional problems in feature cost estimations, especially when program budgets were not necessarily changed according to new feature content. Calculating variable costs was on the other hand more straightforward, but this was mostly done for the HW.

Both sales and cost budgets were an important part of controlling the activities. According to the head of technology sales budgets were a bit problematic in the early phases of a new mobile technology, because there was for many years no or a limited amount of sales before operators started to ramp up the roll-out of the new technology. Still millions of Euros of R&D cost were running all the time. According to the controller when the technology got more mature, the sales and cost budgets worked better. The sales budget naturally gave pressure for the sales team to close deals, which sometimes resulted in to feature bundling and other non-planned discounts.

4.1.2. Business modeling and sales process

In the interviews the importance of an install base as the main competitive advantage was clearly emphasized. With small additional work it is possible to achieve a big increase in the sales. The importance of install base increases even further when the technology matures, because the SW share of the MTN delivery increases and the margins of HW fall. SW maintenance and HW spare part business is quite profitable, as well as network parameter optimization services. Especially among smaller operators network planning support is needed. Operators respect end to end services, and link to some kind of terminal manufacturer, in order to be sure that the new features were properly verified. Services on the other hand were not currently seen as that attractive business. Operators were considered business driven, which in practice means that for each investment a business case for calculating the profitability is sketched.

Also in many interviews it was revealed that additional features are not used that widely by operators. This can bring profitability pressure for developing additional features. Operators are interested in additional features, which can be installed with small additional investments. The importance is mainly judged based on ARPU. Such pricing methods, which reduce risk, are favored by operators. An example of these could be pricing based on volume or a hosting agreement. In a hosting agreement a feature is hosted by the vendor in operator network in first phase and the operator has the option of purchasing the feature, if it seems to have market potential.

Both the program manager and product manager agreed that more emphasizes could be put on early profitability and business model analysis for the bigger features. Some features were

so big that they required almost their own program, and there were big risks that the cost could not be covered if price or even proper demand was not carefully estimated.

The head of technology emphasized that the additional feature revenues was not only coming from sales, but also cashing competitors with patents created during the feature development process. What came to the operators, they also appreciate the MTN vendors help in arranging the financing for the MTN investment, either by pre-negotiating with the finance sector, arranging flexible terms for payment, or by accepting operator shares instead of cash. Typically the operators take multiple vendors for building their RAN, for reducing the risk of rollout problems and for reducing the negotiation power of a single vendor, and possibly for launching price competition among the MTN vendors. Vendors were selected by price, reputation, capability to fulfill RFQ, feature list, roadmaps and national and security politics. Previous Key Performance Indicator (KPI) quality references played an important role. The original network deal shares among MTN vendors could change during the ramp-up phase, if the MTN vendor's roadmaps were delayed or if MTN features were missing. In the past there had been dynamically changing competition, and changes in the road map and content, as well as operator requests, which had lead that the the features were sometimes sold by bundling or as given as a bonus. This would lead into a situation where sales price would not have that much to do with the set reference price. Some competitors also had made the pricing scene more difficult by trying to sell HW cheap and then cash in with expensive SW upgrades. One of the biggest problem in the MTN industry was the over capacity of MTN vendors, which were brining the overall prices down, especially in uncertain economic situations, in where the operators were reluctant to make big investments. The MTN huge R&D expenses and declining ARPU did not make the situation any better, and the estimation was that operators were making double decade higher profit than the equipment vendors. However, the demand and supply could not be analyzed based only by MTN vendor and operator (virtual-, service-, network-) interaction. Handset availability and features, where becoming a key drives for network investments, as well as content for the handset, was it then games, maps or applications. The head of technology saw that if the feature was unique in the market, clearly best pricing method was the value based pricing. However, many times this was not the case and pricing turned into competition based aimed for getting or keeping planned market shares. Cost plus pricing was seen many times still, but was not a recommended way. The marketing manager pointed out that the pricing scene was stabilizing and operators were no longer "married" with the initial HW provider, which reduced the

possibilities to cash with SW upgrades. One thing which might change in the pricing field and make price comparison more difficult is the different price units. One operator could sell the features priced and licensed per BS and the other per subscriber. Also there had been discussions regarding if the pricing should be related to some KPI value, for example a promise from the vendor that the operator subscriber amount will increase or the vendor will give discounts. Even there we discussed many types of different pricing models, the product manager agreed that sometimes the reference price was copied from an existing feature, due to lack of resources and time to make detailed pricing analysis.

The key account manager also emphasized the importance of keeping the feature and roadmaps of RFQ. Currently they were not seen as risk for total vendor swaps, but they affected the future deals negatively. In RFQ the price played a major role, but also feature roadmaps, stability and environmental issues were important. The operators asked also the MTN vendors' opinion before starting to consider investments in new technology and filling in the RFI. The operator naturally required that there were indications about existing new technology terminals, before they were interested in launching any new technology investments in a bigger scale. The local sales team had a big influence on the closed deals and final prices. This was natural, since the local team many times had the best customer knowledge and could convince the customer with proper rationalizing. On the other hand a local sales team could promise customer features, which were not implemented, and it was naturally causing confusion inside R&D and other functions not related to the sales process. According to the key account manager operators were mostly interested of new features, which directly brought more ARPU and which could be installed with small investment and effort. Bigger features were not taken that eagerly, because of the uncertainty of the business case. One solution for reducing the barrier for operators to start using also the bigger of more expensive features, would be to offer a hosting agreement. The vendor offers to install and maintain the new feature as leased service and the operator commits the buy the feature, if it fulfills a set of requirements.

If cost allocation was seen difficult, the head of business modeling saw that also the customer business case calculations were many times problematic. Even if there would have been sophisticated internal tools available for calculating operator business cases, they would not have been available for the customer. Thus using complicated internal tools for marketing purposes and for justifying feature prices for customer operators is out of the question, when the tool and underlying methods and algorithms themselves require more training and

briefing than the end results. Many times the best approach for justifying an individual business case was an empty Excel sheet, in were the business case calculation were built from scratch. This kind of approach can over simplifies the real operator business and leaves many relevant variables outside calculations, but results are easier to explain to a customer in that limited time frame the customer allows the MTN vendor in sales meetings. One product manager also pointed out that especially for new products; the business cases emphasized mostly the whole product, and not individual features. There were simply not enough resources for making complicated business case studies for each individual features. Then basically the only option was to benchmark existing feature business cases.

The business modeling specialists were aware of the problem of the lack of common tools for operator business modeling. There had been co-operation with universities and operators for developing a common business modeling tool, but so far no common tool was spread over the industry as a de-facto standard. There was a lack of research about the effect of end user perceived value, operator competition and operator marketing efforts to operator revenue. Thus there was no one agreed way to model these effects in existing tools. This "uncertainty" effect was not taken into account in the business modeling tools at all or then it was considered to be included in the business case sensitivity analysis.

In the Helsinki University of Technology Telecommunication department, now part of Aalto University, the common tools were not seen that big of a problem, since the focus was naturally in developing new methods for business modeling. However, the lack of network quality research was admitted also at the university. There were plans to start some research concerning the QoE and some articles were published after the interviews, which are covered later in this thesis.

4.2. Vendor costs

In this chapter the suitability of different cost accounting methods for the pricing of the additional MTN features is discussed. Cost accounting is a fundamental part of any company's profitability management routines and legal reporting for financial statements. Costs are commonly used as a pricing basis even though according to common understanding the optimal price of a technology should reflect the value of the technology i.e. the present value of the future cash flow resulting from the implementation of the technology, not costs related to developing the technology (e.g. Gee 1979). Cost based pricing is clear and

according to some a fair way to set the price, even though it encourages for ineffectiveness and cost increase and leads many times to under or over pricing compared to market based pricing (Sipilä 2003, pp 58).

Nagle also sees that cost should not be used as a pricing basis, but rather that the costs are good to know for identifying the minimum price, having motivation to control the costs and calculating product contribution margins. But if product cost is used for pricing decisions, special attentions should be paid for the following points according to Nagle (1985, pp. 25-28):

1. Average total variable cost is not used as the estimate for the cost of a single unit. Incremental cost is many times more or less than the average variable cost.

2. Current value in assets is used instead of accounting depreciation formulas. The depreciation might not correlate with real value.

3. Single cost accounts are not automatically put as whole to irrelevant or relevant cost for pricing. Many costs, like some labor costs are not entirely incremental in nature.

4. Opportunity costs should not be overlooked. Opportunity costs are a relevant cost for pricing, even though they don't appear in financial statements.

Typically with cost accounting is referred to act as a tool in management accounting in internal reporting for supporting planning, make or buy decisions, profitability analysis, etc. managerial actions as well as a basis for pricing decisions (e.g. Drury 1996). However, cost allocation is needed also as a tool in financial accounting for fulfilling the legal reporting for financial statements in the form of stock valuation and income statement cost accounts (e.g. Kallunki and Kytönen 2007). Thus cost accounting or cost allocation systems don't necessary fit ideally to some industry areas, like the SW industry, if cost allocation is used more as input for the financial statements as for supporting management decisions. This is dicussed later in this chapter 4.

4.2.1. Cost accounting methods

The most common cost accounting methods are variable costing and absorption costing including it's variants job costing, process costing, standard costing and Activity Based Costing (ABC). Other costing methods are marginal costing, target costing and product life

cycle costing. They differ in the way they handle variable vs. fixed costs and direct vs. indirect costs. **Variable costs** are those costs, which are directly related to production volume, e.g. raw materials, production salary and energy costs, license fees and to some extent transportation costs. **Fixed costs** are those, which remain constant regardless of the production volume, at least in the short term. Typical fixed costs are Research and Development (R&D), factory depreciation and maintenance costs, procurement, Human Resources (HR) and administrative management costs like law and accounting services. **Direct costs** are those costs, which can be allocated directly to a specific product or service without complicated cost allocation formulas. Direct cost can be defined that they vanish if the product or service is no longer produced. **Indirect costs** are those costs, which cannot be allocated directly to any specific product or service. Typical indirect costs come from factory maintenance costs and support function like HR, law and accounting services. It is important that the concept of sunk costs is not mixed with other accounting cost concepts. **Sunk cost** means cost that have already been incurred and which cannot be recovered to any significant degree. Typical sunk costs are already installed investments. (e.g Drury 1996, Laitinen 2001)

Used cost accounting methods seem to be rather static inside companies and are not usually changed substantially to support new practices in manufacturing or operations (Banker et al., 2000; Clinton & Hsu, 1997; Durden et al., 1999; Yasin et al., 1997). And if some change is taking place, it usually appears as traditional cost accounting method expansion and information system enhancement instead of replacing the old cost accounting method with a new one (Fullerton & McWatters 2004). In addition to the used cost accounting method, also the decision maker's background and the way the cost accounting data is presented affects the cost based pricing decisions (Cardinaels 2007).

A surprisingly limited amount of studies exists on how to calculate and allocate costs for SW based products or features. The cost accounting analysis below is thus based mostly on general cost accounting theories.

4.2.2. Marginal costing

Marginal cost means the cost, which comes when one additional unit is produced. Marginal cost can be expressed as a derivate from total cost and quantity.

$$MC = \frac{dTC}{dQ} \qquad (2)$$

The cost is rarely fixed and depends on volume. If marginal cost is referred to as **accounting cost**, it includes only variable costs. This however is a bit misleading, since then marginal cost will have two different meanings. If marginal cost is referred to as an **economist cost**, as it usually is; it can also include fixed cost and typically has the shape of an U curve, when plotted as a function of volume. This is because in a traditional production plant there is an optimal production range. With low volume economies of scale is not achieved, but with too high production volume the production plant is overloaded and extra costs are coming from labor overtime, production bottlenecks, decreasing yield and finally costs from investing in a new production plant. In figure 3 graphs for basic production good in perfectly competitive markets is drawn. With certain price, the markets will buy all the units manufactured, which can be seen as linear total revenue and horizontal marginal revenue, which equals the market price. In this kind of situation it is most profitable to sell the amount of units, where the average cost is the lowest and the marginal cost doesn't exceed the market price. (Drury 1996, pp 1999)

Marginal costing is mainly used to illustrate macro economical events and is not as often used in micro economics as individual company cost accounting. This is the case also with the MTN industry. Marginal cost calculation is not very suitable for MTN and especially not suitable for pricing basis for an individual feature, because cost curves for a single feature are very difficult to estimate. This would require that all costs could be allocated to specific products, including overheads, which is quite tricky, as we will later see. Also the straight line revenue curve is not realistic and should be fitted to real demand. This would require that the price elasticity for a single feature would be calculated; a very challenging task again.

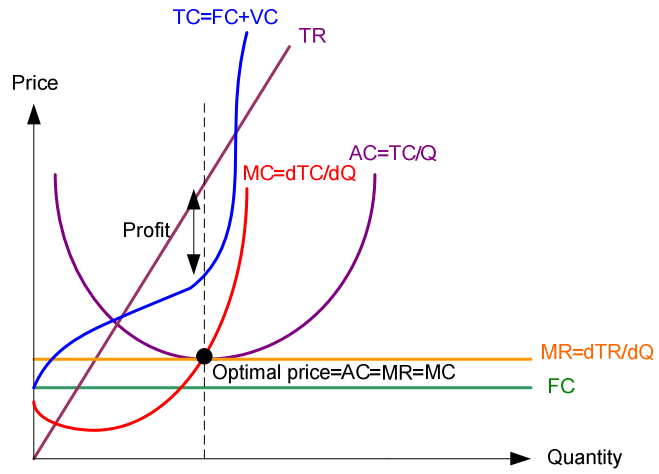

Figure 3 Traditional economist cost and revenue curves: C=Cost, R=Revenue, M=Marginal, T=Total, V=Variable, A=Average (Drury 1996 Marginal Costing theory, modified)

The economist approch is not very suitable for analyzing the demand, revenue and cost curves for individual additional featues as such. However, it can be used to some extent for analyzing the total demand for whole products, which then inderctly affect also to the additional feature pricing decisions. In oligopolistice markets, which the MTN indusrty represents, the demand curve can been seen as "kinked" (Sweezy 1939). Kinked demand is based on oligopolistic game theory, explained in more detail in chapeter three, where it is assumed that competitors will not follow each other to raising prices, but will react quickly to price reductions. This leads to a situation, where the price elasticity reacts intensively to a price increase, when customers move to use competitor products. In case price is reduced, the price elasticity is not that strong and demand is not increased that much since competitor will follow the new price levels inside the industry.

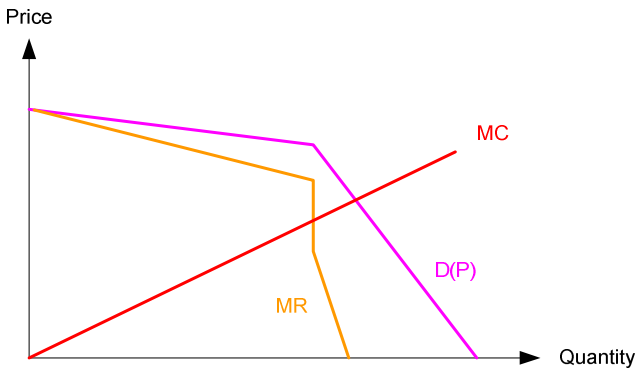

Figure 4 Kinked demand (Sweezy 1939)

4.2.3. Variable costing

Variable costing calculates only the variable costs for manufactured products. Stock valuation thus has only variable costs included. Fixed costs are deducted annually from the income statement or activated under different balance sheet accounts like R&D (Drury 1996, pp 199-210).

Especially with the MTN industry the variable costing curves are somewhat different from the theoretical economist case described in figure 3. The total revenue curve (Figure 5 TR_Accounting) in theoretical variable costing can also be treated as a straight line, like in case of economist total revenue. This however is not a realistic in practice because the MTN markets are limited, and will not buy all the units offered. On the other hand the different vendors have different MTN products despite standardization. They differ in technical features and also have quality, compatibility and reputation aspects aside the selling price, which affects the demand. Thus, when the total revenue curve (Figure 5, TR_Demand) is drawn from demand base, we will get a total revenue curve which will saturate at a certain price level, where no one is willing to buy any more of the product. The traditional variable cost curve is a straight upward line or maybe has some curve with high volumes, because of overcapacity in production. However, no fixed costs are included unlike in the economist marginal cost curve. The traditional variable cost curve can be applied to HW (Figure 5, VC_HW), but for SW the variable cost curve (VC_SW) is an almost flat line, because SW can be copied almost unlimited with only minimal additional expenses. The fixed cost (Figure 5, FC) remain constant, until extra production plants or R&D sites are needed and the cost curve champs a step up. Total costs (Figure 5, TC_HW and TC_SW) can be calculated as the sum of fixed costs (Figure 5, FC_HW and FC_SW) and variable costs (Figure 5,

VC_HW and VC_SW). In both HW and SW fixed costs are high, because of the complex technology and huge R&D investments needed to develop the MTN features. There also can be increase in fixed costs, when volumes grow enough, because of the need for additional R&D sites, sales offices and/or production plants.

If the additional feature consists both of HW and SW, the variable costs increase along with the volume, when material and labor cost increase. But in case the additional feature consists of only SW, which is quite often the case, the variable cost is zero or close to zero and increases only very slowly if any along with the volume. Of course delivering SW also brings some costs despite its intangible nature in form of transaction, possible packaging and delivery costs. But to register these costs, enough sophisticated cost accounting systems would have to be in use. Also transaction and delivery costs cannot be valued in stocks, which means that there has to be parallel cost accounting methods, both for legal and management reporting purposes.

From figure 5 we see that the variable costs might be used as a cost basis for HW related features, if the variable costs can be calculated exactly by the cost accounting system and the volumes are high enough. However, fixed costs are typically relatively high also with HW and thus breakeven analysis is probably a better way to use costs as a pricing basis than adding just a marginal on top of the variable cost. This way fixed costs are included on some level to the sold feature, even though the fixed cost estimation would not be exact. For SW the variable costing is not reasonable because faulty estimated fixed costs will not be compensated by variable costs (since there are no or very limited variable costs).

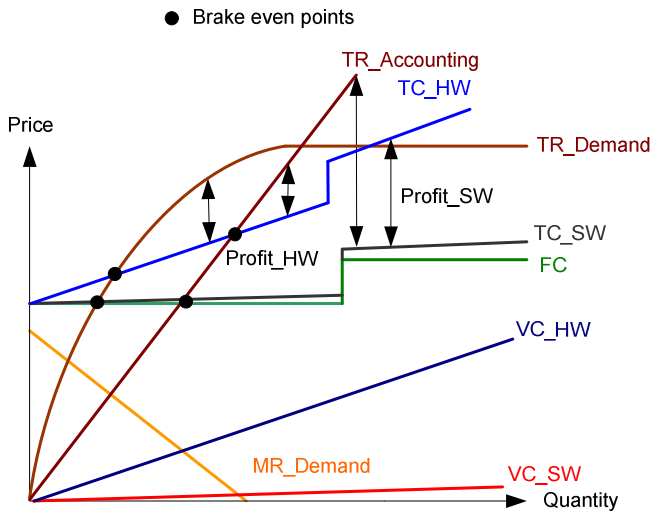

Figure 5 MTN cost and revenue curves, C=Cost, R=Revenue, M=Marginal, T=Total, V=Variable, A=Average, F=Fixed (Drury 1996 Variable Costing theory, modified for separating HW and SW)

4.2.4. Absorption cost

In **absorption costing** some or all fixed overheads are allocated to individual products and are included in production cost. Later in this chapter different methods, which can be used for overhead allocation, are explained. When overheads costs are allocated to individual products the profit is a function of both sales volume and production volume, i.e. stock changes affect the profitability because fixed overheads are included in stock value. In practice this means that in case there is a large unsellable stock, the fixed costs might be over valuated in the balance sheet, when prices of the sold items fall. On the other hand absorption costing might give a more logical profit calculation in seasonal sales, when allocated overheads are reported in that period, when sales occur. However in many cases it is easier to plan the make or buy and product mix decisions, if variable costs and fixed costs are separated, and this is one reason, why absorption costing is not that popular. (Drury 1996, pp 199-210)

Still absorption costing justifies its position in the cost accounting field, since overheads are playing an increasingly big role in the cost structure of companies in general but also in production related industry. Foster and Gupta (1994) examined marketing and found out that marketing costs have become a significant part of fixed overheads in many industries. The possible support of existing accounting systems for marketing decisions making was found quite limited in many cases. Boer and Jeter (1993) studied a variety of manufacturing

industries for the years 1899 through 1987 and noticed that labor was no longer a significant cost and that overheads were becoming the most significant cost also in manufacturing operations. Traditionally it has been believed that absorption costing based pricing systemically gives higher price orders than marginal or variable costing based pricing, but according to some studies this is not always the case (Waller *et al.* 1999).

In the MTN industry the fixed costs come mainly from R&D, support functions and fixed factory costs. One important thing related to fixed costs is that from which phase of the new product lifecycle the fixed cost are allocated to products cost and from which part to general costs, which are explained later, when the concept of life cycle costing is discussed. With many additional features the factory costs are not relevant compared to other fixed costs, if the feature is based mainly on SW. The fixed overheads are possible to allocate to a certain MTN technology release, to some extent to certain individual product of a MTN release but very difficult to allocate to a specific feature of an individual product. For example, the program cost for developing a year 2007 release UMTS BS can be quite logically calculated. Also the costs of developing the transmission unit for the BS might be in some extent logical. But what happens when the cost centers and program costs are related to several product modules. For a single feature it is very difficult to allocate the costs, since cost center granularity doesn't reach that far. Of course the costs can be estimated, when the additional feature is planned, but if the estimated costs cannot be compared to occurred costs, cost as a pricing basis is not very useful.

Another thing is, if the programs are designed that way, that the amount of additional features is quite limited and already in the design phase cost separation of additional features is emphasized. But then it is questionable if they remain additional features, but rather separate modules or products, when the smallest sold entity is increased, like in case of different SAP-R/3 modules. One solution for handling the overheads for absorption costing or other cost accounting method, is to design the organization itself so, that it concentrated on the features rather than bigger programs.

To be able to calculate the overheads, the organization structure according to chapter 4.1.1 case company interview findings could be also emphasized. If feature teams are used inside the R&D organization, realized implementation working hours are easier to allocate as fixed costs or overheads.

4.2.5. Standard costing

Standard costing is the most simple of absorption costing methods. In standard costing on top of variable costs fixed costs divided with production amount over the time period fixed costs have occurred are added. The problem is that production amounts can vary, which can give different costs for some product depending on the production batch when fixed costs are high. Thus it is not a very suitable method in the MTN industry.

4.2.6. ABC

Activity Based Costing (ABC) was first used as an improved tool for cost based pricing (Cooper 1989), switched later to profit and product mix prioritizing (Cooper, 1990; Cooper and Kaplan, 1991), and is now used also for capacity constraints situations (Cooper and Kaplan, 1992). In ABC costs are allocated based on unit level activities, batch related activities, product sustaining activities and facility sustaining activities. Every unit produced will get their share of costs, depending on how many activities they are involved in. Unit level activities are direct energy, material and labor costs. Batch related activities are those, that are related only to a specific batch. Typical costs are machine set-up costs, customer ordering and purchasing costs. Product sustaining costs are those related to supporting different products in the product line. These include making specifications, R&D costs and production design costs. Facility sustain activities are those costs, which are related to the whole site needed for producing the products including administration, accounting services and real estate costs. (Drury 1996, pp. 293-308).

Fine-tuned ABC can give quite good estimation for the products even in rather detail level, and in theory would be possible to be used as a pricing basis for additional features. This would require at least two things from the cost accounting system. First the ABC system should be implemented. ABC is still not a very common accounting system in many companies, especially in MTN industry. And secondly the ABC activities should be taken even beyond the traditional unit activity to be able to solve the cost related to certain feature.

For the MTN industry unexpected problems from using ABC may appear. In British Telecom was discovered that in their ABC system, problems arise from non-separable costs and in terms of joint costs shared between network components. By Non-separable costs are meant those costs which cannot be bundled together and treated as being able to be explained by single cost driver. (Bromwich & Hongf 2000). In the case of a Portuguese MTN company

there were technical problems associated with joint and common costs, which are significant for a MTN operator. Activities and cost allocations could not be determined properly in their ABC system and this lead to confusion amongst employees and arbitrary, subjective allocations, which caused reliability problems and employee resistance, which led to late and inaccurate allocations of times to activities (Major and Hopper 2005).

4.2.7. Target costing

In **Target costing** the cost calculation is done in a reversed order compared to other cost accounting methods. Where in other cost accounting methods it is assumed service or a product has been produced and depending on the production amount costs are allocated for unit level, in target costing first the allowed cost per unit is set, and production according to cost limits is planned. Target costing steps can be defined as (1) Define the Product (2) Set the Price and Cost Targets (3) Achieve the Targets (4) Maintain Competitive Costs.

Target costing does not relieve the company of the dilemma of somehow coping with problems related for fixed costs and overhead allocation. But it addresses the problems early enough so that processes can be fitted via budgets, working hour reporting control and other cost measurement methods for getting enough detailed reports to support reliable analysis between planned and realized costs. In theory if the reporting methods are planned accurate enough, the costs can basically be planned and followed even at SW feature level.

4.2.8. Avoidable costing

Avoidable cost as a pricing reference has its own problems. **Avoidable cost** can be defined as costs that will not be incurred if an activity is cancelled, for example a cost that can be saved by dropping a particular product line or department. Avoidable costs are difficult to address both in marginal cost accounting as well as in ABC. In marginal cost accounting it is difficult to define in the short run which fixed costs to allocate to particular products and which to leave in the common cost pool. Fixed costs and variable costs will together be responsible for the avoidable costs. ABC has three limitations for avoidable cost calculation. (i) The amount of cost pools is limited, which means that all the activities needed for creating a single product cannot be registered in all cases. (ii) The cost, which are not variable and linear for a certain activity, are difficult to address for a specific cost pool. (iii) Joint processes are tricky to handle, since for a individual product type the specific costs cannot be separated. In a joint

process the demand on a resource is determined by the maximum demand placed by the individual products and not by their sum. (Lucas 2003; Noreen 1991)

4.2.1. Other costing methods

In **Life cycle costing** it is calculated how much costs are accumulated from owning the product from purchasing the product, but also costs of training support personnel and the users of the system, costs associated with failures or outages (including reputation and recovery costs), floor space, electricity, development expenses, testing infrastructure, waste handling cost, etc. Life cycle costing fits better for buyers than for vendors. Life cycle costing is also referred as Total Cost of Ownership (TOC) as was revealed with the TeleB interview.

Job costing is an absorption costing method, which allocates on top of the direct material and direct labor costs the indirect overheads based on the share of the indirect costs. The more labor hours or material a specific job consumes the bigger share it gets for the total overheads (Drury 1996, pp 39). This can be applied to some extent to additional features consisting of HW, but for SW features it is difficult to define the jobs and direct costs, to which the overhead allocations would be based on.

Process costing is an absorption costing method, which allocates the overheads to each process by simply dividing the process total overhead with the amount of products the process has produced. Process costing is suitable for industries producing homogeneous products and where production is a continuous flow (Drury 1996, pp 39). Because of many different kinds of products and services, process costing is not very suitable for the MTN industry.

4.2.2. Costing summary

For calculating whole MTN products there are multiple methods, which are mostly suitable for calculating HW based additional features, where the reporting of used R&D resources is typically more straightforward than with SW. For SW features it is possible to apply ABC and Target costing, but it requires the reporting and management accounting systems to be designed in advanced to support detailed reporting of R&D resources even on a SW feature level.

Table 16 Summary of Chapeter 4.2: Costing methods suitability for calculating whole BS total unit cost and individual BS additional feature costs

Costing method	Cost variant	Suitable for MTN (BS) products	Suitable for additional HW MTN features	Suitable for additional SW MTN features
Marginal costing	Accounting cost	No	No	No
	Enconomic cost	No	No	No
Variable costing	N/A	Yes	Yes	No
Absorbtion costing	Job costing	Yes	With limitations	No
	Process costing	No	No	No
	Standard costing	Yes	With limitations	No
	Activity Based Costing	Yes	With limitations	With limitations
Target costing	N/A	Yes	With limitations	With limitations
Lifecycle costing	N/A	No	No	No
Avoidable costing	N/A	Yes	No	No

4.3. Operator perspective

For the Master's thesis one operator and one vendor were interviewed. Interviews are many times the only way to find tacit knowledge behind the processes and the behavioral patterns of companies. This was also the case with the MTN industry. Some characteristics of the MTN business can be concluded from articles, industry related publications and other public information, but other needs to be dragged out in other ways.

4.3.1. Interview, TeleA

The first interviewed operator is named as TeleA for this thesis. TeleA is a vertically integrated midsize European operator. According to TeleA network investments don't play that big part in mature operator's CAPEX and COPEX compared to a fresh operator, for which the network investment is without a doubt the most crucial expenditure account (CAPEX and OPEX are explained in chapter 2.2). Network CAPEX are significant also for mature operators. but consist not more than perhaps 30 % of the total costs. Other operating costs coming from customer and company management become more important after the operator has managed to get its business up and running. One important concept about investment expenditures is that they should be scalable on top of operator's current business. This means that the pricing policy should be designed in a way, which takes away the need for operators to pay huge new investments on regular basis, even though they have already invested a lot of money in the basic 3G network. New features coming with later releases

should be priced so that the operator has the possibility to earn profit from the initial investment, before it invests in a new technology or a new feature. For the operator it is more convenient to have a pricing policy, which is based on volume and the value of the sold feature. This would mean that the operator would pay for a specific MTN feature according to how much it creates income for the operator, measured e.g. by the amount of active subscribers, who are using the bought MTN feature. One benefit for the operator from this kind of a pricing policy is that the operator doesn't have to pay for the investment months or even years before the investments starts to produce real cash flow for the operator. Risk for the investment is shared between the vendor and the operator, which is also seen as a fair trade according to TeleA. TeleA uses NPV and cash flow calculations in their investment decisions, which also will favor the volume based "pay as you grow" pricing method. The goal is to keep the cash flow positive and stable from year to year. Because of this big investment spikes coming from an individual feature are not appreciated. There were actually some cases, where the operator would have invested in a certain MTN feature, but the investment decision was cancelled in the nick of time, just because the pricing offer from the vendor was set up wrongly from the operator point of view and was not corrected.

TeleA also emphasized that the vendor pricing policy should start form the far end of the value chain, meaning the end user. One way to measure the operator business is to measure ARPU. Another way to measure value is to measure $/MB. By $/MB is meant the amount of revenue the operator gets from each broadcasted Megabyte in their network from both voice and data calls.. The $/MB curve is ascending downward as a function of time and will go even lower in year to come. The vendors should plan their pricing strategy so, that when an operator invests in new capacity, a new feature or a new technology, there will still be a marginal between the $/MB value and feature or capacity cost the vendor is selling.

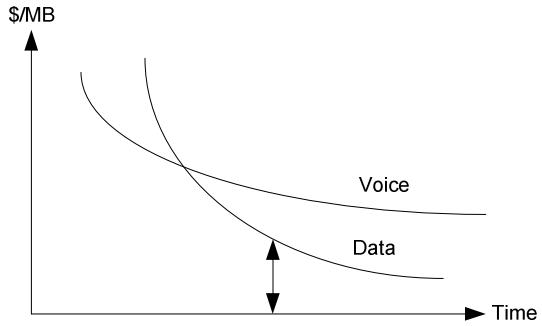

Figure 6 $/MB curves for voice and data

Sometimes the value for a specific feature is quite clear. If for example the feature will reduce the operator transmission OPEX by 50%, it is fair that this saving is dealt between the vendor and operator, i.e. the pricing basis for this kind of a feature would be 25 % of the operator transmission OPEX. But many times the value for a specific feature is impossible to calculate, like in the case of ISHO. Therefore according to TeleA, only those features, for which the exact value can be calculated, should be sold as an additional feature. Earned Euros are based on services and services are based on technology. MTN were compared to car industry, in where ABS has become such a standard accessory, that no one even considers ABS as something extra. The same applies to MTN, certain features are considered something extra neither by the operator nor by the end user. The operator doesn't feel that it should pay for something unnecessary when buying a bigger basic package, even if it would not use all the features included in the basic MTN package offerings. The "extra" features are considered to be thrown in, since the vendor can achieve economies of scale, when it doesn't have to put additional effort in selling every feature independently to every operator. In TeleA business processes every investment has to be rationed with a business case, which also favors that only calculable feature being sold as independent additional features. According to TeleA the packaging can be carried even further, so that the vendor sells only the service of broadcasting mobile data, becoming more a brand seller. The operator would lease the MTN equipment and maintenance from the vendor. And there are already cases showing this is happening in the MTN industry.

TeleA said that it appreciates clear and predictable pricing. At the end the investment decision goes to top management and they don't appreciate if technical staff has to explain for hours what the vendor pricing really contains and what it is all about. Too complicated pricing and playing with list price discounts will also not fool professional buyers and are seen as gimmick. Many times in a competitive bidding at the end there are two competing vendors, who will have similar roadmaps and quality. Then the total price will count, not the price of individual features. Otherwise price was not seen as the most important factor by TeleA, when a key MTN vendor is selected. Reputation and reliability were seen as the most important factors. Network quality should also be on a good level, especially if the network KPI values become public information, which can be used by other operators as a marketing weakness. What comes to roadmaps, they have good PR value, which can be used for getting extra publicity. For example the operator can publish a press release about a new feature it is supporting. But in revenue sense the roadmaps are not seen as that important factor by TeleA,

since for many new features there are not even compatible mobiles yet and also many of the old already installed features have not yet reached the critical subscriber mass, which would make them truly profitable. Of course the roadmaps have to be in some kind of alignment with competitors, since TeleA like almost every other Operator, is using equipment from at least two different vendors. If the operator wants to roll out a new feature, it has to wait as long as all the vendors in its network have implemented this feature.

4.3.2. Interview, TeleB

TeleB is a vertically integrated midsize European operator. According to the interview TeleB agrees with the OPEX elements presented in table 6. OPEX elements can be received by the controllers either directly from dedicated accounts or trough organizational structure, since many functions have dedicated cost centers. CAPEX can be calculated on a BS level accuracy, but individual features are not separated. Cost accounting is based on SAP, cost accounts and cost centers, where service operator and network operator businesses are separated. Cost accounting is affected also by regulation, since e.g. SLA contracts are regulated, which affects further to the internal pricing between the TeleB service operator and network operator businesses. The cost accounting is reached to subscriber level, ARPU is used for outside reporting, Average Margin Per User (AMPU) is used for internal reports and profitability calculations. Cost per minute or Mbit are not seen as relevant, since the network has still unused capacity at the moment. TeleB said that the cost structure comes from the fact that the network is build to fulfill target capacity and KPI requirements. The network operator side is divided into different subunits, e.g. processes, optimization and production of services, from which production of services is the biggest. The investments are calculated based on NPV with a 10 % discount rate, but also based on payback method and internal rate of return method. In calculations specialists inside the company are used, but also the vendor is involved in investment discussions for defining network performance, installation process, etc. In investments the Total Cost of Ownership (TCO) is emphasized and the CAPEX is playing a minor role.

Inside TeleB for a single feature can be calculated a value the by increased revenues or reduced costs. For smaller features the investment calculations are not done directly, they affect the investment calculations so that TeleB's target network KPI and capacity levels are achieved. TeleB said that for some cases, especially on the CN side, it might be suitable to calculate the effect of single features in more detail. In many cases a more feasible way to

determine the value for a single feature is to estimate how it affects the company reputation and the brand value. Even though there are some theoretical methods how to calculate brand value, TeleB sees that in practice at the end the total brand value is based more or less on estimations. However, for some parts the brand value is quite concretely visible. Firstly SIM subscriptions may be terminated and SLA contracts can be jeopardized, if operator brand and network quality deteriorates. And every time the network goes down to maintenance activities or due to network faults, the lost revenue is calculated. Site visits also cause a remarkable cost to the network maintenance. The network updates must be therefore carefully planned from both quality and maintenance point of views. TeleB felt that there were still too many updates and maintenance activities needed, which caused too many breaks to the network activity.

TeleB does investment programs every six months. HW and initial network SW CAPEX is activated to balance sheet as such, since the investment revenue horizon is over a year. Small SW updates are treated as network OPEX, but for bigger SW updates and essential new SW features the division between OPEX and CAPEX is judged case by case.

What comes to the MTN vendors, TeleB sees that reputation and quality go hand in hand and they directly affect to the operators own brand image. Vendor roadmaps are not seen to be that crucial as long as the operators own capacity and KPI target are achieved. TeleB has a good negotiation connection to the vendor side, never the less it usually takes several rounds to reach a satisfactory contract. According to TeleB discounts were not that common earlier and the vendors were counting on high swapping costs. As the negotiations proceed TeleB expects notable discounts, and in some cases that, additional features not crucial for the operator, are thrown in for zero price. TeleB sees that this is a natural reaction since TeleB itself faces declining ARPU for the investment needs for new higher bandwidth networks and from regulated leased network business, which leads to pressure for reducing network CAPEX and further in optimizing the procurement process.

During the negotiation process the total cost of the investment for TeleB is calculated, but on the other hand the vendor's costs structure for estimating the received offer and freedom of pricing range is estimated. In addition to CAPEX pressures in the current financial situation commitment for investments is tried to be avoided. TeleB says that they are trying to get rid of "bonus point mentality", which means that an offer, which gives volume discounts for future deals, are not appreciated. However, this could change during an economic uptrend.

Despite the tightened situation on the global economy and telecommunication sector according to the interview TeleB is interested in new value brining features in the MTN. For estimating the value for MTN vendor calculations about the operators received benefits, would be appreciated a suitable tool and business case simulation, if they existed. Also new pricing models are welcome; TeleB said that they have good experiences from leasing some of the NE from a third party. Thus pricing based on subscriber usage or leased NE from the MTN vendor might be worth considering.

4.4. Operator benefits

Based on the interviews and my 11 years of work experience in the MTN industry, I have grouped the additional features operator benefits into four categories. (i) Additional features can be sold as an independent service to the end user, creating additional revenue for the operator. At the moment location service and higher data rates are services, which have been predicted big growth in future years. (ii) Additional feature can reduce operator OPEX or CAPEX, like in the case of a new transmission solution, where leased line OPEX is reduced. (iii) Additional feature can provide better network quality in the form of Key Performance Indicator (KPI) values, like call dropout rate and over all cell data throughput. Mast Head Amplifier (MHA) for example makes the network more sensitive to RF signals and increases capacity as well as reduces unwanted call drop rate. (iv) Additional feature can actually be a must feature. Handover capability from UMTS to GSM is a must feature for UMTS networks, where GSM network is working parallel, which is the case in most commercial UMTS networks.

If the operators can sell their subscriptions with different pricing measures; price per minute/MB or a fixed monthly fee, also the vendors can price the features in various different ways. A feature can be priced and licensed e.g. per subscriber, per user, per TRX, per cell, per BS, per RNC, per MSC, per network or for a limited time period. Different possible hosting agreements make the pricing even more complex. Whatever the pricing measure is, it should reflect the value the feature bring for the operator and what analytical or other methods are used when the feature method is defined.

4.4.1. New business opportunities via additional features

It was revealed both from the MTN vendor as well as from the operator interviews that the operators respect mostly features, which are directly visible in the ARPU. One of the biggest reasons is probably that the value of the MTN feature is more convenient to evaluate with analytical methods. In ECOSYS project with an Excel based tool some operator business cases with traditional investment calculation methods were calculated; NPV, IRR, payback method (Smura *et al.* 2005). In the business cases the offered services naturally played an essential part in the investment calculations. However the calculations will get also here more difficult, when the whole service packet has to be analyzed and the different subscriber pricing options considered: flat rate pricing, usage/time based pricing or a combination of these. Especially flat rate pricing will dramatically changes the mobile services usage (Verkasalo 2008). For customer churn and pricing option correlation less research exists.

Table 17 Mobile services and service pricing (Smura et al. 2005, table modified with new service adverticed by operators)

Mobile service	Service description
Voice	Traditional voice calls over 2G or 3G, price per minute or per month for different call amounts depending on subscription type
VoIP	VoIP calls over 3G or 4G, pricing per MB or per month. Note that VoIP may be carrier also on top of basic data with proper application
Video Telephony	Video calls over 3G or 4G, pricing per MB or per month. Note that video calls may be carrier also on top of basic data with proper application
Downloads	Turnover from applications, music, games, geo services, etc. Handset related additional miscellaneous services and applications, which can be bought from operator. Price per download or per month
Transactions	Ringtones, images etc.
Security Services	Home and office security services with remote video capture and alarm information. Price per installation and month or per month.
Proprietary Services	Company specific services, like special online reports for transport companies, SMS tickets or SMS payments. Price per installation and by per month.
Data	Mobile data for lower data rates, price per MB or per month for different data amounts depending on subscription type
Broadband data	Mobile data for high data rates over 3G or 4G, price per MB or per month for different data amounts depending on subscription type. Note! Broadband data reduces the amount of separate VoIP, Video Telephony and Email service usage.
Streaming	Data, which requires streaming QoS, like video. Price per MB or per month for different data amounts
Push to Talk	Push-to-Talk calls (multiple users can communicate in a group like with walkie-talkies) over 2G or 3G, price per minute or per month for different call amounts depending on subscription type
SMS	Short Message Service over 2G, 3G or 4G networks, pricing per SMS or per month for different SMS amount
MMS	Multimedia Message Service over 2G, 3G or 4G networks, pricing per MMS or per month for different MMS amount depending on subscription type
Emails	Sending and receiving Emails via operator server, pricing per Email or per month for different Emil amount depending on subscription type

In the ECOSYS tool the operator business case is simulated by taking into account the revenues from subscribers, roaming charges and SLAs reduced with OPEX components, investments, depreciation and other CAPEX components as well as taxes. For calculating the value, a business case must usually be built to see e.g. how many NE are involved, how the population among urban and rural areas is spread, what are the estimated subscriber amounts, which kinds of services is used by the subscribers and how the OPEX and CAPEX are formed. The business cases usually have tens of different variables. Otherwise the business case would not reflect accurate enough the real life business cases. The different service and subscriptions types are limited in the ECOSYS tool, but basically in a similar tool more

complexity could be added for calculating the effect of different subscriber profiles. Also the ECOSYS Excel platform is not suitable for modeling complex multiple variable simulations, because debugging possibilities are limited and setting complex if clauses are not possible. Again it was a bit of a surprise that there seems to be limited amount of public MTN operator business modeling tools available, both in the commercial and in the research aspects. Many operators probably have their proprietary business modeling systems, but not necessarily, which was found in the interview with TeleB.

Another aspect related to calculating the business cases for a new service, is that they are highly context dependent, like the interviews and ECOSYS simulations have shown. Thus when setting a global reference price, it should somehow try to take into account the different operator environments via readymade segments or via existing real life operator business cases.

Based on the research and interviews; as a summary when an operator business case is evaluated for a new business opportunity it is recommended to

1. Segment the operators based on used subscription pricing methods (flat rate, volume based), available handsets and population geographical distribution, and NE install base (or HW upgrades needed or if a new feature can be updated with only a SW upgrade). Even among potential segments the business cases can vary significantly depending on the operator properties.

2. Evaluate if the additional feature can be sold as such as a new service, or will it be included part of existing subscription packages (this many times is the case with faster HSPA data rates). It should also be evaluated is the additional feature is likely to have a positive effect on the subscriber churn. Also sometimes it's reasonable to calculate a business case for multiple features at the same time.

3. Keep the calculation simple. It is impossible to take all the variable into account. A much higher effect will be in the segmentation variables in step 1, which will be shown in chapter 5.5. Only the most relevant costs should be included for the new features. From table 6 the cost components likely to increase via new service introduction are 2) Equipment software licenses 3) Sales and marketing, customer acquisition, 5) Customer care, 6) Charging and billing, 7) Service management, and 8) Network management. Reference values for calculation can be obtained from analyst

reports , company's own marketing intelligence and by asking them directly from customers e.g. in product manager customer meetings.

4. Calculate results in units, which are easily available, and whose value can be easiest verified to be in valid range. The pricing unit is easy to convert later on.

5. Perform sensitivity analysis and compare results among different segments. Un-potential segments can be left with less attention, if the feature is not likely to bring them remarkable value. Benchmark also past business cases to evaluate the soundness of the business case calculation results.

6. Compare results to market prices and the total price of BS equipped with basic SW. If the price exceeds the market price significantly or if the price starts to be in par with price of a BS, can be expected that customers will not accept the price and for avoiding pricing risks the price has to be lowered and the business case calculation re-evaluated, as can been seen in chapter 5.5.

4.4.2. Reduced OPEX or CAPEX via additional features

The most important Operator CAPEX elements are listed in tables 1-4 and OPEX elements in tables 6-7. Value of an additional feature, which clearly increases revenue or reduces CAPEX or OPEX, is possible to estimate with traditional investment calculation methods. In some very simple cases the business case can be simplified significantly and the value of CAPEX or OPEX reduction can be calculated with few formulas. CAPEX can be calculated rather easily e.g. if a feature enables more TRX to be connected to a single BS, the calculation is somewhat straight forward. Then it should be estimated in how many new BS sites the solution could be used and how many of these sites could be implemented also with co-siting. Also the saved CAPEX compared to traditional co-site solution should be calculated. The actual value can be calculated by comparing the CAPEX differences, when the feature would be installed in an existing BS, and less new traditional and co-site site installations would be needed. Another area where CAPEX calculation will remains decent, is when they affect clearly to one of the NE element installation CAPEX elements (for BS listed in table 4). One example would be to reduce the need for additional power supply installations. For many NE related CAPEX calculations the effect has to be included over several NEs. For example if a feature allows using larger BS cells, it has to be considered both in BS and RNC CAPEX. Also how the population is distributed between urban and rural areas has to be considered.

For OPEX decrease of BS power consumption gives rather clear calculable value. But calculating the cost savings of reduced need for e.g. leased line transmission gets more complicated quit quickly. For example the amount of BS, the distance between BS and other NE nodes, traffic and service distribution affect the overall final results. Thus many times it would be more convenient to use similar business case modeling tools with OPEX/CAPEX reduction features as with new ARPU increasing service MTN features. The value would be achieved by comparing the investment calculations, e.g. NPV, results with both the feature effect included in calculations and when the feature effect is not included.

The problem in reduced OPEX or CAPEX value calculations is again the lack of common tools, which would be accepted to be reliable both in vendor and operator side. Otherwise the effort is spent of introduction the tool is used to calculate the OPEX or CAPEX savings and not the feature itself, which should bring the saving benefits. In the ECOSYS tool for example are already tens of different input variables and still it is too simple tools for simulating more detailed OPEX and CAPEX calculations or different subscriptions pricing types.

4.4.3. Improved KPI via additional features

MTN KPIs are achieved from the network via performance counters. Each NE measures its own activities, e.g. call drops, total data throughput and the amount of different mobile services. The NE groups the measurement events under different classes. For calls drops could be classified under different root causes and mobile services under different QoS. The NE element reports the results as counter values to Operation and Maintenance (OAM) entity, where the counter values are calculated with dedicated formulas into KPI values. For example Call dropout ratio KPI is the Dropped calls counter value divided with Attempted calls counter value. Typically there are hundreds or thousands of counters, from which tens of different network KPIs are calculated. The operators typically follow network KPI closely and benchmark KPIs between different vendors and different MTN SW releases.

Quality has many times been neglected in the traditionally used investment calculations, and also the ECOSYS tool takes the MTN quality issues into account only indirectly. Still the operators follow the network KPI carefully and immediately notice if a new SW release show KPI degradation. Some quality impacts are easier to model analytically, e.g. how much money is saved when the operator doesn't need to go on a BS site to perform recovery

actions after malfunction or reply. It is also possible to calculate money saved when customer complaints are reduced, let's say due to poor coverage. But in general the exact value of quality is indeed more difficult to calculate compared to direct revenues and costs. Quality affects so many aspects; operator brand, end user network usage, operator competition and finally also operator listed stock prices. Thus it is a bit surprising that so little research has been done to evaluating the value of quality. Especially while considering that the KPI data many times is created automatically into an operator maintenance database.

To limit the scope of this thesis, the improved KPIs are analyzed via End user benefits in chapter 4.5 and reduced OPEX in chapter 4.4.2. However, it would be an interesting research topic to analyze how certain KPIs and operator revenues or profits correlate.

4.4.4. Must have additional features

For a must feature it is not reasonable to calculate the value separately. This became evident through the operator interviews and form pricing theory. It is easier to just sum the price of this kind of a feature in the total MTN price and evaluated the feature as a solid part of the network, not as an individual entity. However, the company strategy and pricing traditions might force that this kind of must have features to be still sold separately. In these cases price setting might get a bit difficult, since there is no support from any analytical methods and also the market price might be missing, if other vendors are not selling the feature as a separate license.

Table 18 Summary of chapter 4.4: Additional feature properties as needed support from HW and SW, and offered benefits for operators, x*= in some contries required by regulation, x = at least GSM-WCDMA HO can be considered mandatory, x*** = support for spectrum license can be considered mandatory (MTN feature technical details e.g. Holma & Toskala 2011 & 3GPP Standards 2011)**

Additional feature properties/ Additional feature type	Mostly SW	SW and HW	Mostly HW	New service to the end user	Improved KPI	Reduces OPEX or CAPEX	Must feature
Higher WCDMA HSPA data rates via higher order Quadrature Amplitude Modulation (QAM) and Multiple In Multiple Out (MIMO) methods	o			x			
Different QoS service profiles (voice, data, video, etc.) and multiple simultaneous QoS link support for both radio and transmission interfaces	o			x			
Mobile battery lifetime increasing smart signalling and scheduling features (mobile is not active unnecessary)	o				x		
Signal power control and interference reduction algorithms for improving signal quality and offering better cell data rates	o				x		
Broadcast services for broadcasting commercial and warning information over whole network, like Zunami warnings, mobile TV and news	o			x			x*
Support for IP transmission in 3G (in 4G IP transmission is included in the basic SW)	o					x	
Cell based location services (GPS based location services require only minor support from BS)	o			x			x*
Extended call capacity license	o					x	
Network security features (mostly related to IP backhaul between NEs)	o					x	x*
Extended cell range (typical cell range in 3G is max 20 km)	o					x	
Carrier Frequency synchronization from IP transmission network (normally frequency synchronization source requires separate GPS antennas)	o					x	
Handover capability between different radio technologies (e.g. between WCDMA and LTE)	o			x**			x

Support for distributed antennas (antennas can be placed several km from the BS enabling e.g. efficient indoor coverage). Requires some minor HW changes, like optical fiber switches	o					x	
Support for centralized baseband processing (baseband hotels) for reducing site installation costs and slack baseband resources (more cells can share baseband processing resources from same pool). Requires some minor HW changes, like optical fiber switches	o					x	
Self Optimized Networks (SON) network auto configuration features, for reducing need for manual configuration of the network, e.g. automatic BS neighbor cell configuration for handovers	o					x	
Antenna tilting for increasing antenna beam flexibility		o				x	
Support for network tracing and diagnostics		o				x	
Minimization of Drive Tests (MDT) auto reporting features, which gather relevant network data automatically for optimization purposes so that operators don't have to manually collect it with expensive drive tests around the network coverage. Can be sold also as pure SW feature without any HW servers		o				x	
Higher cell transmission power in case of large cell ranges or high attenuation environments		o				x	
Different frequency variant for RF transmission		o					x***
Battery back-up unit for BS for protecting against power brakes			o			x	
Additional outdoor casing for weather/vandalism proof installations			o			x	
Alternating Current (AC) operating power module			o			x	
Installation accessories, like masts, bolts, plates, etc.			o			x	

4.5. End user benefits

The end user benefits are quite clear when the additional feature is related to higher data rates or a service, which can be mapped on top of a more sophisticated concept, such as location services or music distribution. With these kinds of additional features pricing is easy to derive all the way from the far end of the value chain by estimating the ARPU. But in the case of increased quality, the end user benefit faces similar problems as in case of the value for the operator. Existing tools like the ECOSYS cannot be used, because they have no variables, which would directly measure the end user perceived quality.

In chapter 4.4. was discussed about QoS from operator point of view, in where QoS os defined via technical properties such as data rates, data latencies and data error rates . When in the telecommunication standards different QoS profiles are defined, the end user is not interested in technical standards, but rather in Quality of Experience (QoE). There are many different definitions for QoE. ITU-T (2007) has defined it as a standard "The overall acceptability of an application or service, as perceived subjectively by the end-user", but in general QoE can be defined by how the end user experiences the network quality and usability. Like Brunetti *et al.* (2011), Kilkki (2008) also sees that QoE is provided by a combination of the MTN features and underlying applications. In Kilkki's framework different quality terms are used between different interfaces in human and technical domains, and between human and business domains. Quality of Service (QoS) is a pure technical domain the network offers to the application. Different QoS are listed in table 17. Whereas in the human domain the QoE is divided into two concepts; user experience and customer experience. User experience is something that the end user experiences while using the mobile phone via operating system or application. The most known method for measuring the quality is via Mean Opinion Score (MOS), which is discussed more on chapter 4.5.1. Where the network will have a more direct effect to experienced quality is in customer experience concept, which can be measured how much end users use the services offered by the network and much they swap the operator. The customer experience is highly depending on marketing; what is promised to the customer and how much the customers have to pay for it.

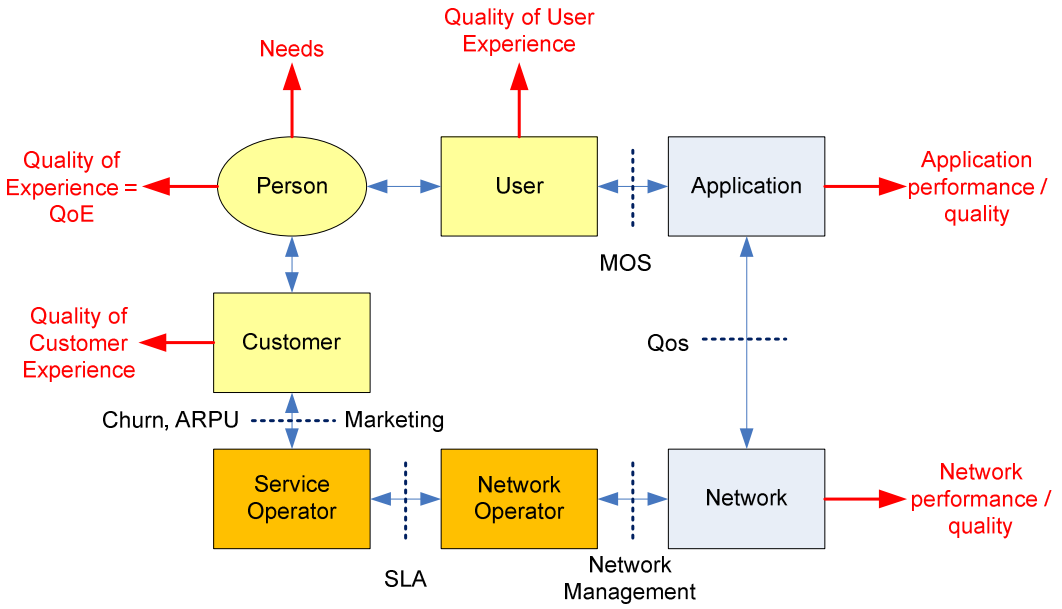

Figure 7 QoE linkage to MTN and Application charasteristics (Kilkki 2008, figure modified)

Finnie (2010) analyzed the QoE areas according to their relevance. If we look at Finnie's QoE areas, we can see that MTN has, a bit surprisingly, clearly a greater contribution to QoE, compared to the Application using the MTN platform for their services. Even if Finnie's studies would have some error margin, it can be said that MTN QoS capability and MTN scalability play the biggest role in the end user QoE. This is quite logical, since without reliable low latency data transmission, any suitable mobile applications for supporting the end user data needs cannot be built.

Table 19 MTN and Application contribution to QoE (Finnie 2010, table modified)

QoE area	QoE are description	Portion of QoE (%)	MTN contribution	Application contribution
Maintaining Bandwidth QoS	Variable levels to support HD/streaming video, latency/fluctuations, redundancy/availability, enabling seamless QoE across devices, load/demand balancing—day/week	23.9	High	Moderate
Platform Scalability	Adding capacity to meet demand, expanding into new markets, global reach across multiple networks/technologies, provisioning handsets, automated updates	17.4	High	Low
Leveraging Subscriber Data	Generating advertising revenue, using profiling capabilities to support languages/regional preferences, geographic/location-based services	15.2	Low	High
Identity Management & Authentication	Secure data transmission, permission control for collaboration/content management, privacy protection, cost of in-house management, spoofing/unauthorized messaging	13.1	High	Moderate
Managing Third Party Developers	Unified management support, standards-based development across browsers/platforms/applications (ERP/CRM), monitoring open standard platform development, integrating NFC functionality	10.9	High	Moderate
Content/ Transaction Security	License infringement, regulatory issues for distribution, non-compliance with minimum bank security standards	8.7	Moderate	High
Demand for Social Functionality	Integration of social tools/applications	8.7	Low	High
Competition from Network Providers	Competitive applications/services	2.1	Low	High

But how can the QoE areas be transformed to actual MTN characteristics? According to prior research there is no MTN subscriber specific frame for analyzing end user perceived quality on a character level. The closest thing is perhaps ISO quality standards, from which the ISO/IEC 9126 SW quality standards perhaps fit best to describing what MTN characteristics should be considered for the end user QoE. In table 20 the ISO/IEC 9126 SW quality standards are converted to MTN characteristics.

Table 20 ISO/IEC 9126 SW quality charasteristics converted into MTN charasteristcs (ISO/IEC 1999)

Characteristic	Subcharacteristics	MTN charasteristics
Functionality	Suitability, accuracy, interoperability, security, functionality	QoS profiles accuracy, Location services accuracy, Available applications, Support for mobile dedicated services, Inter RAN handovers, security and ciphering, Support for multiple QoS
Reliability	Maturity, fault tolerance, recoverability, reliability	MTN feature existence in live networks, Amount of devices able to communicate, Call and HO drop ratio, re-connect times, reliable call duration times
Usability	Understandability, learnability, operability, attractiveness, usability	Available documentation, Screen size, Application loading times, Technology penetration in groups or societies, Mobile ecosystems, Mobile Operating System general usability
Efficiency	Time behaviour, resource utilization, efficiency	Data rates, Needed processing power from mobile to support MTN features, Service connect times, network coverage, QoS coverage
Maintainability	Analyzability, changeability, stability, testability, maintainability	Fault indications with causes, automatic updates to newer mobile SW, Mobile SW stability for new MTN features, network updated for new MTN features,
Portability	Adaptability, installability, replaceability, coexistence, portability	Roaming, Ease of network settings installation, Ease of (dongle) driver installation, Multi SIM/Multi RAN support for mobiles, battery lifetime

Of course other proprietary frameworks can be used for checking which MTN feature characteristics affect end user perceived quality and QoE. But then comes the trickier part, investigating how the improved QoE will increase the amount of revenues the end user brings for the operator. As explained in chapter 2.2 the ARPU is decreasing, but so are also the MTN CAPEX and OPEX per MB. Even if according to Alcatel-Lucent studies 15 to 20 percent of subscribers show interest and willingness to pay for improved QoS, still most of the revenues are achieved from increasing the amount of subscribers and not from higher subscriber fees (Brunetti *et al.* 2011). Now the following questions arise: (i) How to measure the QoE or MOS. (ii) How to predict based on QoE or MOS the individual MTN (or applications) how much individual features will increase persons willingness to use mobile services. (iii) How to separate marketing, advertising, subscription pricing (fixed monthly fee or per MB), competition, general life-style trend changes, economic trends effects from the MTN/application feature effects, what comes for the usage of mobile services. (iv) How to predict how many new users are totally new service users and how many have been adopted from competitors.

4.5.1. Measuring QoE and MOS

The Quality of User Experience in figure 7 is derived from Mean MOS. Different MOS levels are defined in the ITU-T standard P.800. The idea of MOS is to map user's view of the quality of the network services to a physically measurable network parameter, like packet latency, call bit rate and packet error rate. Mapping is done by giving the MOS audience samples with different physical quality levels, and asking the audience to describe the quality.

Table 21 MOS levels (ITU-T 1996)

MOS	Quality	Impairment
5	Excellent	Imperceptible
4	Good	Perceptible but not annoying
3	Fair	Slightly annoying
2	Poor	Annoying
1	Bad	Very annoying

Currently there are no published standards, how the network basic KPIs, like call drop ratio, service connect times, etc. could be mapped to a MOS level. Batteram *et al.* (2010) proposed some KPIs, which could be used for different MTN services for calculating QoE and MOS, but did not have any reference values for actually linking the KPI to QoE or MOS. It is possible to build the MTN KPI MOS mapping tables in a laboratory environment, even though it is rather time consuming and laborious. However, even it remains to be seen, when this kinds of results are available, and how they can be converted into actual usage of service with good MOS/QoE.

Pohjola and Kilkki (2006) also have introduced alternative approach to MOS for defining end user value in MTN. For some MTN features time value could be used in estimating the end user value. Value is obtained if time spent in unwanted service phases, e.g. time setting up a call, time for loading web page content, time for network setting installation, re-connecting time in case of dropped call is reduced, and the time is used more in the "value adding phases, like reading a web page or communicating with voice. The time value can be calculated by comparing the time spent on some services and by comparing the price paid for these services: time value is time divided with price.

4.5.2. Predicting End User MTN usage

Verkasalo has studied the end user MTN service usage in multiple dimensions. In one of the studies Verkasalo analyzed for what services end users used mobile data (Verkaslao & Hämmäinen 2007) and how the time usage of different smart phone functionalities (e.g. MMS, web browsing, camera) was divided (2008) and which factors affect in the intention of using new smart phone features (Verkasalo *et al.* 2010). There have also been studies estimating the growth of mobile data (e.g. J. Orr and D. Shey 2009). But studies and results are lacking, how much mobile usage actually is increasing, when end user experienced quality increases. Funk (2006) and Saarikoski (2006) noticed how, especially in Europe, operators and service providers focused too much on the enterprise market overlooking end user. For MTN companies proprietary analysis probably exists about end user behavior, but at this point is seems that there are no public studies or methods available for predicting the relationships of QoE, MOS, user satisfaction and actual usage of mobile services. The most suitable methods seems to be just making correlation analyzes of the masses of KPI data and network usage to see which KPI value correlates to which increased network usage and ARPU/AMPU. Both are available from the MTN, but in analysis one should be careful not to violate the national privacy laws concerning subscriber data.

4.5.3. Separating factors affecting service usage

One factor, which affects the end user consuming behavior more than others, is perhaps the critical mass. The attractiveness of a mobile service for the end user increases as the amount of other users reaches the critical mass (e.g. Rohlfs 2001). According to Metcalfe's law from 1980 (Shapiro & Varian 1999, pp 185) and Reed's law (Reed 1999) as the amount of groups and connections increases, the benefits for fixed or mobile communication service increase exponentially, because the amount of connections and counterparts increase exponentially. However, practical studies are missing, on how end user experience improves from "the critical mass" and how it is correlated to the actual usage of mobile services. Same can be said of global lifestyle trends, operator brand and competition among operators. The effect of subscription price and marketing efforts for subscription base and customer churn has been studied more. This is discussed more in the next chapter. The problem still remains: critical mass and global trends might affect to service usage much more than the improvements, which additional features bring for the network. If there would be some methods to predict

how different factors affect service usage, they should be definitely be calibrated for the weight factor against reals user data statistics.

4.5.4. Subscriber churn and amount of new mobile service users

With subscriber churn is meant the amount of subscribers swapping during a certain time period the operator subscription. According to Wei & Chiu (2002) the average churn per month used to be > 2 % and per year approximately 30 %. There are big differences among geographical regions and the annual churn has been measured in USA to be 37 % and in Asia up to 48 % (Mattersion 2001). There are different methods to predict subscriber churn, from which the most important are the Decision tree approach (e.g. Neslin et al., 2006), Neural networks (e.g. Hwang et al. 2004) and Data mining (e.g. Hung et al. 2006). The details of these churn prediction methods are out of the scope of this thesis. What is important is that the common idea in the churn prediction methods is to predict if an individual customer churn is based on segmentation variables, like age of the subscriber, length of subscription contract, amount of monthly bill and subscription type. The churn is tested under different operator actions, of which operator marketing campaigns, competitor actions and subscription pricing are most common. However, MTN and mobile service quality is not taken into account that well in the churn studies. Thus the end user value and churn map difficult to any existing analytical method. Basic mobile service penetration already reaches100 % penetration in many western countries, but for broadband data the population has not yet matured (Verkasalo *et al.* 2010). Depending on the service the new subscribers are 100 % churned customers or also partly new service users. In some countries the operator will terminate the other subscription, when a subscriber swaps the operator, this information could be used in analyzing the ratio between churners and new service users. Another way could be some kind of customer surveys.

How could the effect of new MTN features be analyzed for increasing subscriber base? Analytically the most feasible method could be to perform a correlation analysis between KPI and subscriber base and ARPU, in similar manner as what suggested to be done KPIs and operator revenues or profits in chapter 4.3.3. From previous research any other analytical methods, which could analytically estimate the linkage between end user satisfaction and the amount of new subscriptions, did not come.

5. Pricing analysis

In chapter 5 different pricing strategies are formulated based on the pricing aspects, which come forth in the earlier chapters. Pricing strategies are analyzed from multiple dimensions based on the relevant pricing issues revealed during the research. Based on the analysis general guidelines of supporting pricing decision in different situations are formed. Also some simple pricing examples are made and analyzed to give deeper insight about the special pricing attributes related to MTN additional features. More detailed pricing examples would require either sophisticated tools or proprietary information, which are not publicly available according to the performed research.

It's difficult to find a correct optimal price with analytical pricing methods due to the complexity of the business case modeling. Therefore for each pricing strategy a method for finding a suitable price range is tried to find, which can be used as basis for fitting the price to match possible pricing risks, like aggressive competitor reactions or decreased demand. The possible price range is analyzed in chapter 5.2. The possible pricing units are analyzed in chapter 5.3.

Based on the analysis and comparison few pricing strategies, which are used as alternatives in chapter 5.4 sequence chart, are picked.

5.1. Pricing methods for reference price

In this thesis in Chapter 4 the pricing principles are studied from (i) the vendor costs, (ii) the operator benefits and (iii) the end user benefits perspective. The aim is to find a reference price, as stated in chapter 3, which creates "healthy and profitable customer ships, and maximizes steady demand, realized deals and profit for services and products manufactured with the target customer satisfaction". The reference price is the price used by sales department to start negotiations, but can be lowered due to competition and general price erosion. Based on the research and interviews in chapter 3 and 4 the analysis is split further: 1) Vendor costs are divided into (i) common marginal costs and (ii) full market costs. 2) Operator benefits are divided into (i) operator solvency, (ii) operator benefits, (iii) operator volume for used features and (iv) combined operator and vendor benefits. 3) End user benefits are clearly the most challenging approach and it is not split to any subcategories. The interviews and pricing theory indicated quite clearly that MTN vendor competition should be

considered in the pricing decisions. Therefore competition is analyzed by i) trying to define a market price with demand and supply and by ii) defining a market price through game analysis.

Based on the research and interviews; as a summary from chapter 4 when an operator business case is evaluated for OPEX and CAPEX calculations it is recommended to

1) Segment the operators based on NE install base and cost structure. Special attention should be paid to the cost element, where the additional feature is bringing savings

2) As with new business opportunities, keep the calculations simple. Concentrate only on the main CAPEX (tables 1-4) and OPEX (tables 6-7) where the additional feature is expected to have a relevant effect. It's good to notice, that while in some areas the CAPEX and OPEX costs are decreased, in other areas they might be increasing, e.g. OPEX components 2) Equipment software licenses, 8) Network management and 9) Product/ platform development presented in table 6 might be increasing via a new feature installation, even while some other CAPEX and OPEX elements are decreasing. Reference values for calculation can be obtained from analyst reports, customer meetings and company's own marketing intelligence.

3) To avoid the risk that the pricing system is difficult and confusing it is better to calculate the CAPEX and OPEX savings in a format which most clearly indicates the savings. E.g. with reduced transmission costs, calculated savings per BTS and with increased cell size/capacity per RX/TX (cell).

4) As with new business opportunities, perform sensitivity analysis and compare results among different segments as well for market prices and the against a basic BS price.

5) If results are not reasonable, lower the price or re-evaluate the business case calculation parameters.

Also chapters 3 and 4 gave needed input for building pricing strategy options, which are analyzed in more details in below chapters 5.1.1 to 5.1.13.

5.1.1. Individual marginal based pricing

In traditional cost based pricing there will be added a marginal in the price on top of the production costs. According to the interviews this kind of pricing is still seen in the MTN industry.

Strategy description: Based on traditional cost based pricing. For each feature a separate cost is calculated. Cost is calculated with the cost accounting method used by the MTN vendor, and divided among expected units sold. The price for each separate feature is based on cost added with a standard margin. The margin can vary with different segments. Overhead costs are shared between features or allocated only to some specific features. The same list price is applied to all operators globally.

Strategy analysis: According to the interviews and chapter 4.2 results it is quite clear that cost based pricing should usually be avoided. Cost based pricing can prevent setting the price below costs, but neglect the full earning power of ideal price. With too high price contracts are missed and with too low price extra earnings are not earned. This same applies, if prices are not adjusted to changes in the environment, but are based on old routines. In theory marginal cost and marginal revenue could be used for maximizing profit, but in practice marginal revenue and cost are not possible to solve. Even though at first cost might seem ideal for analytical calculations, in the chapter 4.2 it became quite obvious, that only the absorption cost accounting method and ABC methods are able to define cost at enough detail level due to the nature the SW cost structure. And even then enough detailed reporting methods are needed. Thus cost based price setting strategy is not recommended. However, cost calculation can be used to support other pricing strategies in estimating what the healthy minimum reference price, when it can be received from the finance or controller department. Especially if the features are implemented in feature teams, which makes the cost allocation and cost calculation easier compared to a matrix organization. In the interviews in chapter 4.1 it was revealed that when each matrix organization function is responsible for several features, workload reporting among features is not clear and feature implementation work load cannot be measured.

5.1.2. Common marginal based pricing

Since the cost for an individual SW components is many times difficult to calculate, in the interviews was mentioned that it would be easier to get the program costs instead.

Strategy description: For the entire product including additional features a cost is calculated. The price for the product is based on variable and overhead cost added with a standard margin. Additional features are priced so, that the combined price of basic products and additional features equals the cost plus margin. Individual additional features are ranked according to importance or work load. The same list price is applied to all operators globally.

Strategy analysis: If for an entire product a cost is calculated, it is easier to estimate how many deals it takes before R&D costs are covered. Nevertheless, cost based pricing should not be applied, even if the costs can be allocated in a more feasible manner. Like the case company interviews revealed, if the budget for an entire product is in line, it doesn't mean that all features which were originally planned for the product, would have been included. Some features many times are dropped out because of budget or time constraints. And also here the real work load of features might not be achievable due to limited working hours reporting accuracy at individual feature level. The additional features pricing based on importance doesn't necessarily correlate with customers seen importance or willingness to pay. Also competition and segmentation aspects are skipped totally. Thus this kind of a price setting strategy is not recommended. Similarly to Individual margin based pricing, the cost calculations of Common margin based pricing can be used for giving estimations for minimum reference price for other pricing methods.

5.1.3. Full market based pricing

According to pricing theory market price many times dictate the actual price of a product. Also in the interviews was seen that markets play a very important role when a suitable pricing strategy is chosen.

Strategy description: Additional feature price is based fully on competition and operator willingness to pay for a certain feature. Competitor prices are received from marketing intelligence and operator demand from marketing intelligence and Customer Relationship Management (CRM).

Strategy analysis: For some new technology there are no market prices available or the market prices are difficult to compare. E.g. some vendors include features in the basic offering, where as some vendors sell them separately as additional features. Also as described in chapter 2.2, reverse action, feature bundling and other differences in operator buying behavior many times make the market price very difficult to estimate and also rather volatile.

The interviews revealed that the operators also tend to analyze the total investment costs, where an individual feature price does not necessarily play that big of a role. Another aspect is that the benefits from features might be highly vendor specific, e.g. for one vendor the new SW might require the whole BS HW to be updated, but for the other it is enough just to activate the SW license key.

In chapter 3.2.1 it was explained that while the reference price is not meaningful to set to for compensating the competition and whole product life cycle, the reference price can only reflect a short time span due to many uncertainties related to markets. On the other hand markets do the "analytics" automatically, and no difficult algorithms are needed. However, unless there exists a clear market price for a specific feature, which cannot be affected via differentiation, branding or offering packaging, market based pricing should not be used. The reference price should be set so that it allows discounts when the product becomes more mature and price erosion starts to kick in.

5.1.4. Tradition based pricing

The interviews revealed that sometimes the pricing was based on tradition due to lack of resources for making complicated pricing analysis.

Strategy description: The additional feature price is based on historical prices. New features are compared to similar prices of old features and prices are set accordingly.

Strategy analysis: Traditional prices are the easy way. Why fix it if it is not broken. Traditional prices may also be easier to justify to the customer. However old prices don't correlate with any theoretical pricing guidelines, competition, value or costs. Or if they once have, the pricing basis is most probably already long outdated. Also marketing dynamics are totally ignored. Thus this kind of pricing should be used only as the last straw.

5.1.5. Operator solvency based pricing

Price discrimination is used widely for many consumer products, for example in giving discounts to children and student. In the interviews the operators felt that if they were facing declining ARPU, it should be visible also in the pricing. In price elasticity theory chapter was d the effect of pricing changes for demand.

Strategy description: For operators with less buying power features are sold cheaper to gain market share and for wealthier operators features are sold with higher price. Price correlates with operator's price responsiveness and price elasticity.

Strategy analysis: This approach can be seen as a version of the market based pricing, where skimming and penetration pricing strategies are combined, in where is highlighted the individual operator demand. However the problem arises from two dilemmas (i) how to calculate analytically the reference prices for one operator and after that (ii) what kind of method should be used for tuning the calculated reference price to match other operators' solvency. Actually it would seem better to set the global reference and inform the customer sales teams on how much the reference price can be lowered with the expense of lower service responsiveness. According to the case company interviews the customer teams know the customer better and can have a better understanding on how the final price should be set, compared to central pricing function. Also the reference price is no longer a reference price, if it varies and is case depended.

5.1.6. Full value based pricing

The pricing theory list as one of the key arguments for pricing the value the product or service brings to the customer. Also in the interviews value was highlighted as one the key elements.

Strategy description: For every feature the value for the operator coming either from increased revenue or decreased CAPEX and OPEX is calculated. The price is e.g. 50 % of the features calculated value.

Strategy analysis: In pricing theory value based pricing is considered to be the best solution. It is easy to justify to the customer and can be considered to have the best potential for maximizing profit in the limits of competing offers. However, also for value based pricing practical limitations make the transition from theory to practice very challenging. Sometimes the customer/operator perceived value is rather straight forward to calculate. E.g. if SW increases 50 % the BS call processing capacity, the value can be calculated by how much the operator saves money compared for new HW investment costs. According to the operator interviews this considered to be a fair pricing method. However, chapters 4.4.1 and 4.4.2 revealed that for many features complicated business modeling simulations would be needed and forming a proper analytical formula for getting the needed data for calculating reduced

operator CAPEX/OPEX will get difficult and the formula typically represents only one kind of operator segment. The interviews and prior research also revealed no common analytical tools existed, which could have been used for convincing the customers about increased value. To get a global reference price, first the customer should be segmented and relevant operator cost structure analyzed and second the value should be calculated for multiple segments, to see how big variations in the operator value can be seen. The most difficult case comes when the additional feature should increase operator revenue either by (i) a new business area or (ii) increased end user network consumption via increased end user experienced value.

As new business models are difficult to estimate even by the operators themselves, as explained by TeleB, then how it could be done by the MTN vendor. The case company business modeling specialists did agree with this. And it gets even more difficult to estimate how an end user will react to network improvement, like decrease call drop ratio, and either increase the network usage or change the operator, which was discussed in chapters 4.4 and 4.5.

Exact estimations of revenues or expenditures can fail, when there are tens of different variables, which need to be taken into account, when the business case is build. In the pricing phase the main point is to rationalize the value of the additional feature to the operators. If the estimation is faulty, the damage for customer relationships is not necessarily that bad, as long as the operator had agreed on the value estimations during the price negotiation phase. Usually the first price defined for an additional feature is used as a reference price, and it is adjusted in the future according to how demand, technology, competition, regulation and business concepts in general evolve.

Despite the challenges value based pricing should be used, when (i) the feature can bring measurable value for the operator (ii) the value calculation is simple enough and (iii) enough reliable common tools for modeling the operator business cases exist. As we have seen in chapter 4.4 the simulation tools tend to get pretty complicated even at the macro level, not to mention the micro level. Thus if the value needs to be communicated to the operator there should be a proper link of communication on how the MTN vendor can bring the value. Showing the value results of some proprietary tools does not convince the customer, unless the basis for value calculation is clearly explained and preferably also proved with real life

examples. Another thing that must be considered is how the pricing unit (per TRX, per BS, etc.) reflects the perceived operator value.

5.1.7. End user value based pricing

As value is seen as the key pricing component both by theory and interviews, raises the questions, where the values should be measured. There theory divides the value into both network provided QoS and end user perceived value QoE.

Strategy description: The feature value is estimated from the far end of the value chain as the price, which the subscriber is willing to pay for a specific service, increase in the service usage or swapping from a competing operator due to new services or better network usability.

Strategy analysis: End user value is a sort of a special case in the Full value based pricing. The operator receives value by increased revenues the more the end user subscribers use the network and are willing to pay for it. As described in the Full value based pricing strategy, operator business modeling is difficult. But end user behavior modeling and prediction is even more difficult. Chapter 4.5 describes some of the challenges related to end user behavior modeling and the lack of tools to model it. If there would be a tool available for modeling end user behavior, it would need to be calibrated against real subscriber behavior data. Also according to chapter 4.5, there should be a method how to separate network variables (low call drop ratio), mobile variables (iPhone good usability boomed the data calls) from marketing variables (increased advertisement) and general changes in perceived by a user (e.g. in data calls call drops don't affect user experience as much as in voice calls).

But even if no public tools for reliable modeling the end user behavior currently exists, of course it doesn't mean that it would be impossible to develop one. Mobile subscribers are the ones who pay for all the MTN development in the end, so they are the ones who should be pleased. So if there is a way and resources to model end user behavior and it effect to operator business, it should be used for features, which value cannot be calculated otherwise. Especially if the MTN features will reduce the time needed to perform unwanted actions; installing network parameters, waiting a web pages to open or time to access mails. Unfortunately in many cases there are no proper tools or competence for this. At the moment end user value based pricing is not recommended due to its complexity.

5.1.8. Game based pricing

The game theory is applied also in the pricing theory, and according to the interviews some vendors tried to use in the not that visible pricing methods for possible fooling the customer and competitors.

Strategy description: The additional features are split into small parts, aimed at making the total long term price estimating more difficult. In contracts some additional features are bundled and some sold with a higher price, for bargaining effect.

Strategy analysis: The operators have professionals in their procurement department and should not be easily fooled by pricing tricks. However, we are all human, and can be affected by psychology. In the chapter 4.1 interviews an example was given of how using this pricing method the MTN vendor was able sell with higher prices until it was suddenly changed, when more pressure was put on from the operator side. Also reverse actions make this approach difficult, since in reverse auctions the customer operator gives a rather detailed list, of what should be included in the offering, and the total price is what matters. All in all price gaming might work for some time, but in the long run it should not be used since it is neither recommended in any pricing theories nor had any success stories lately according to the interviews. The general pricing theories recommend using pricing methods, which can be justified for the customer and game based pricing hardly is one. Game based pricing is not recommended, since it will not justify a long term customer relationships.

5.1.9. Balance based pricing

The interviewed midsize operators' clearly pointed out that they wanted to share some of the investment risk with the network vendors, despite the operators usually have had clearly better profitability. Also hosting requests were revealed from the interviews.

Strategy description: Sold products and additional features are grouped into both vendor and operator business cases and prices for product and features are set as variables. A price combination, which would give both for the vendor and operator highest possible operating income or target budgets are achieved, is searched for.

Strategy analysis: This pricing strategy is sort of similar to the value based pricing with the aim of finding a "Nash Equilibrium" among the MTN vendor and the telecommunication

operator. The convenience in this kind of a method is that with it the needs from the vendor sales budget and the operator value can be combined.

Basically also in this method the operator business logic should be well known, and the value for the operator should be included with some features beyond to end user perceived value, in order to have calculable results. If MTN vendor incomes are used instead of sales budget, the cost structure should be well know, and as described in the cost based pricing methods, the cost structure is difficult to calculate unless there is separate program and project for the features, which would support the cost accounting system used at the vendor side. All in all balanced based pricing requires wide amount of resources and knowledge, and therefore it is suitable for cases in where a feature is custom made for a specific operator. Usually the operator needs are clear and the operator value is confirmed by the operator itself. Thus more emphasize can be put on calculating the extra revenues for the vendor itself from the feature sales added with additional sales from the product itself and reducing the costs of implementation costs.

5.1.10. Volume based pricing

In the interviews from both operator and vendor site was revealed that volume based pricing was already used by some vendors and that it was considered to be a fair pricing method from operator persperctive.

Strategy description: The price is based on the amount of operator subscribes or revenue for a specific feature. Related feature volumes can be used, if they are easily measurable.

Strategy analysis: In this strategy alternative the pricing risk is shared among the provider and the customer. Pricing could be considered to be rather fair from the operator point of view, even if this was not directly commented in the operator interviews. From an other viewpoint this kind of pricing makes the business case and value estimation less transparent, which the case company marketing manager also pointed out. Problems are likely to occur from the fact that price is defined retroactively and there should be a way to get reliable feature usage information from the customer. Volume should not be used as a primary pricing method, it should be rather considered as one alternative when the primary pricing unit is defined.

5.1.11. Combined value and marginal based pricing

From vendor interviews was revealed that there seemed to be a need for multiple pricing strategies depending on the feature properties. With costly big features the cost were sometimes neglected from vendor side, but on the other hand there was a momentum to use value as a pricing driver.

Strategy description: For the most expensive features development and production cost used for pricing is estimated. Other features are sold based on their value for the operators.

Strategy analysis: If a feature requires a big implementation effort, it can perhaps be developed in such a manner that implementation hours and other costs can be tracked more accurately than with smaller features. Big features could be implemented in feature teams, where people are dedicated to implementing only one feature and reporting costs to only one cost account. So in a cost tracing sense, for bigger features cost accounting might be easier than for smaller features. In the case company interviews it came clear that for some features the implementation costs were neglected, when the business case was planned, and the feature proved later to be too expensive for gaining customer demand. There is certainly need for tracking costs for big features for avoiding unprofitable business cases. But the questions arises should the costs be used for directly defining the reference price or rather than the minimum possible reference price. A minimum reference price can be used for analyzing if the business case reasonable and if the feature brings value, which exceeds the costs of delivering the feature. The general pricing theories certainly suggest using costs only for defining the minimum price.

5.1.12. Combined market and marginal based pricing

As explained in chapter 5.1.11, a single pricing strategy might not be enough. Aside value also market based pricing was raised as one of the key drivers in the interviews.

Strategy description: For the most expensive features development and production cost used for pricing is estimated. Other features are sold based on market prices.

Strategy analysis: The same analysis applies here for the costs as with Combined value and marginal based pricing. I.e. for big features costs should be calculated and used at least for defining the minimum possible reference price. Market price on the other hand is not suitable for all features, and thus this pricing method is not that useful.

5.1.13. Pricing method summary

Based on research concentrating on accounting theory, pricing theory, game theory, the MTN industry characteristics and end user subscriber behavior it can be summarized that:

1. Whenever possible the reference price should be set based on the value for the customer.

2. For expensive features the minimum price should be calculated based on implementation costs. For custom made features both customer and own business case should be checked for setting the optimal price.

3. If value cannot be calculated, it should be checked if it is suitable to find a market price for the feature.

4. If market price cannot be used it should be analyzed if an existing reference price for another existing feature can be used as benchmark.

5. If no existing reference price benchmark exists, other non-analytical methods for pricing, which did not come up in the research performed under this thesis, has to be applied. Possible methods could be aligning price with the sales budget, managerial judgment or defining a consensus price via related meetings or questionnaires. Also the company strategy could push certain features to be priced aggressively for creating critical mass for the feature. However, in these non-analytical methods the price will be based on a best guess, and possible pricing risks defined in table 14 might occur.

Table 22 Different pricing method suitability for MTN additional feature pricing

Usability for additional features/ Pricing method	Recommended for additional feature pricing	Justification for use/discard	Pre-requirements
Individual marginal based pricing	No	Costs are difficult to allocate for individual features and not recommended to use for pricing	N/A
Common marginal based pricing	No	Features may be dropped/added after initial program budgets and costs are not recommended to use for pricing	N/A
Full market based pricing	**Only in special cases**	**Competition forces to set the price to certain level**	**For the specific feature exists a clear static market price, feature is relevant part of the offering and no differentiation is possible**
Tradition based pricing	**Only in special cases**	**No resources or competence for setting a suitable reference price via any other method**	**There exists a recent reference prices for similar features (either in functionality or complexity), which can be benchmarked**
Operator solvency based pricing	No	Segmentation might bring too many business cases. Reference price should be common.	N/A
Full value based pricing	**Yes**	**Value is seen according to pricing theory as the best pricing principle**	**Feature value can be calculated with simple business case calculations and results can be applied for most operator segments**
End user value based pricing	No	End user value is extremely complicated to calculate and no common tools exists.	Guidelines how to handle feature pricing for features, which improve KPI and user experience.
Game based pricing	No	Not recommended by any pricing theories or studies. Doesn't support long term customer relationships	N/A
Balance based pricing	**Only in special cases**	**Support long term customer relationships. Contains value elements for both buyer and vendor -> Easy to justify for buyer**	**Feature is custom made for a specific operator and contains specific budget**

Volume based pricing	No	Difficult to get needed data from customers. Requires business case calculations to be done in advance with complicated estimations of end user behavior.	N/A
Combined value and marginal based pricing	**Yes**	**For expensive features the minimum price is important to calculate**	**Features are screened for the ones with big budgets and for those which are suitable for business case calculations. Other features are priced with other methods**
Combined market and marginal based pricing	No	Market price is suitable to be applied only for a limited set of features	N/A

5.2. Methods for analyzing a reference price range

Because the reference price is more a price recommendation than a strict requirement that should be followed throughout the product lifecycle, some guidance is needed on how big discounts can be given. Also when the business cases are calculated there should be some kind of a minimum reference price available for analyzing does the feature has any business potential. As the interviews revealed the situation should be analyzed as a whole for the company; some unprofitable features might boost the sales of other features or services. But in general if the additional feature value is less than the cost of developing it, it is wiser to leave it out from the portfolio.

Costs should be used as a primary basis for a minimum price according to the general pricing theory. The problems related to SW cost calculation have been analyzed in chapter 4.2. If fixed costs are allocated per sold unit, the allocated costs are highly dependent of sales volume. The estimated sales volume should somehow also be taken into account when costs are evaluated. From the case company interviews it became quite obvious that the sales budget plays an important role in the company management. Thus if the sales budget can be split into different features, it can be estimated how much sales has to be achieved for each feature. However, usually a sales budget will not define the sales amount in units but rather the sales in Euros, which might cause pressure among the sales organization to give discounts above guidelines in order to achieve targets.

Price sensitivity naturally affects the optimal reference price level. In table 14 some price sensitivity properties are listed, but price sensitivity can also be estimated based on marketing intelligence and past sales data from other similar features. But as explained in chapter 3.3, price sensitivity will only give rough estimations on how sales will behave with different prices. More important perhaps is product maturity. For older technology price erosion can be expected to be faster according to the S-curve. Also the feature type has an effect; even with older technology new concepts can sometimes be considered to be in the introduction or growth phase, where the reference price will remain longer relevant and no discounts are needed. Aside the S-curve also competition and changes in market conditions affect price erosion, as explained in chapters 2.2, 2.3 and 3.2.1. Via mergers, market withdrawal, government actions or operator actions, different offers and demand might be suddenly present for new high data rate or high capacity MTN features.

The reference price should also reflect the pricing risks; so that it would help to avoid the risks of the price creating unwanted harmful side effects. As a basic rule it can be set that the biggest risk in setting the reference price to a wrong level are

- Full market based pricing: Price will not reflect the company strategy and competitors might have better a cost structure causing unprofitable deals.
- Tradition based pricing: Prices will reflect the company strategy but may fit poorly to market conditions both demand and competitor reaction wise. Also the cost structure may not support the set price level.
- Full value based pricing: Even if the vendor side calculations would show the value for the customer, it does not mean that the customers will understand the value accordingly. Also there is a risk the value calculations will get complicated which will make price justification confusing. With value based pricing there is also the risk, that a new feature will bring so much value, that it will cannibalize the existing legacy features. Costs might also be under estimated.
- Balance based pricing: The main risk, when limited to custom made features, is perhaps that the market share among the customer will be lower than expected and that competitors get a bigger share by bundling features or by selling cheaper than expected.

- Combined value and marginal based pricing: The risks related to cost structure are lower, but risks related to demand and competition might be higher.

Table 23 Pricing risks for different pricing methods. Pricing risk raking based on subjective evaluation

Pricing method/ Pricing risk	Full market based pricing	Tradition based pricing	Full value based pricing	Balance based pricing	Combined value and marginal based pricing	Suggested effect to reference price
The demand is overestimated	Medium	Relevant	Relevant	Relevant	Relevant	-
Set price is over or under priced	Medium	Relevant	Medium	Low	Low	+/-
Competitor reactions are underestimated	Low	Relevant	Medium	Medium	Medium	+
Customer loyalty was underestimated	Medium	Medium	Low	Low	Medium	-
Price doesn't reflect chosen strategy	Medium	Low	Medium	Low	Medium	+/-
Price fails to profile as high cost and high quality or low cost and simple product	Low	Relevant	Medium	Medium	Medium	+/-
Pricing system is difficult and confusing	Low	Relevant	Relevant	Medium	Medium	0
Fixed costs are underestimated	Medium	Relevant	Relevant	Low	Low	+
Products cannibalization is underestimated	Medium	Relevant	Relevant	Low	Relevant	+
New pricing regulations is introduced by the authorities	Medium	Medium	Medium	Medium	Medium	+/-
Pricing gets negative publicity in the media	Low	Relevant	Low	Medium	Low	+/-

Additional feature value calculation was explained in chapters 4.4.1 and 4.4.2. The sensitivity analysis and segmentation results should be carefully considered. The suggested value of the additional feature might show in a totally different light when analyzed via another operator's perspective. Thus the reference price has to be either a compromise between values for potential operators, or then reference price should be flexible to support possible discounts if the price is initially set too high.

As a summary when the reference price is set for defining the price range the following points should analyzed:

- Cost used for defining the minimum price

- Whether the company has a suitable accounting system for allocating implementation cost for an individual feature
- Whether sales volume can be estimated accurately enough
- Whether the feature budget is high enough for justifying the additional effort for cost calculations

- Customer segments business cases and sensitivity analysis used for finding minimum and maximum price levels
  - The effect of business case to parameters changes
  - Whether customer segments give business cases give different results
- Company's pricing guidelines
  - Minimum and maximum prices for feature categories

And to what side of the price range the reference price should be set (+ = upper reference price, - = lower reference price)

- What is the product and feature maturity level
  - Introduction: Skim pricing +, Penetration pricing -
  - Growth: Differentiated price strategy +, Price leadership strategy -
  - Maturity: No clear price strategy
  - Decline: Retrenchment strategy +/-, Harvesting strategy +, Consolidation strategy -
- What kind of pressure the sales budget sets for the price
  - Sales budget high or behind target + (discounts might be expected)
- How markets and competition is estimated to change
  - Competitor price drivers change +/- (listed in table 10 and 11)

- New MTN technology drivers changes +/- (listed in table 8, higher acceptance allows higher prices)
- Operator cost control increases -
- Operator quality control increases +

- Can price sensitivity be estimated
  - Low price sensitivity +
  - High price sensitivity -
- What is the company's pricing strategy
  - Cooperative pricing strategy +, Adaptive pricing strategy + (discounts might be expected)
  - Opportunistic pricing strategy -, Predatory pricing strategy – (vendor initially sells with lower price)
  - High allowed discount rate +
- What risk is related to used pricing method and priced feature
  - Case depended according to table 23

5.3. Methods for analyzing a reference price unit

Pricing or accounting theory and research don't give any direct guidelines or methods on how the pricing unit should be set. Also the MTN industry differs rather much from other industry areas. Thus it is better to concentrate on the MTN industry characteristics, rather than general common guidelines. The biggest risk related to a wrong reference price unit selection is perhaps that it doesn't support the company's strategy or that the pricing system is difficult and confusing. So the primary drivers should be that the price reference units are aligned with the company's common pricing strategy and that they reflect the value or benefit the additional feature will bring for the customer. It should be possible to prove how much benefits feature is able to provide for the customers via simple calculations, without making complicated scaling and dimensioning for getting the price to match the proposed value. E.g.

if the price is set as a network wide license, it is difficult to estimate the business case, if value is calculated per BS or per cell. Also the pricing unit should somehow be logical and fit the additional feature properties. For HW related additional features the logical pricing unit is the HW unit. For SW, the logical unit is the place of the SW license, is it then BS, RNC or network wide. Naturally competition also affects the pricing unit. If price is wanted to be comparable with markets, the reference price should also be in unit comparable with market price.

Table 24 Additional feature typical usage (e.g. Toskala & Holma 2011)

Additional feature usage/ Additional feature type	Per Cell	Per BS	Per BS cluster/RNC	Network wide
Higher data rates			x	x
Different QoS services			x	x
Mobile battery lifetime			x	x
Improved signal quality			x	x
Broadcast services				x
IP transmission			x	
Cell based location services			x	x
Extended call capacity license		x	x	
Network security			x	x
Extended cell range		x		
Carrier Frequency synchronization			x	
Handover capability				x
Distributed antennas		x		
Centralized baseband processing			x	
Self Optimized Networks (SON)			x	x
Antenna tilting		x		
Network tracing and diagnostics			x	x
Minimization of Drive Tests (MDT)			x	x
Higher cell transmission power		x		
Frequency variant TX/RX	x			
Battery back-up		x		
Additional outdoor casing		x		
AC power module		x		
Installation accessories		x		

However, there are three things, which might make the pricing unit determination a bit problematic. (i) First, similar features are handled somewhat differently in WCMDA and LTE networks. In WCMDA many feature licenses are activated in RNC, whereas in LTE there is no RNC and all RAN licenses are BS specific. Thus RNC wide licenses cannot be used in LTE as such. One solution is to use similar LTE license pricing as in RNC, i.e. BTS cluster based. Or then convert both WCDMA and LTE pricing methods to cell or BS based. Certain limitations will also come from the SW license handling and validation, i.e. how the network validates that only valid SW licenses are used and a predefined SW license capacity is not exceeded. It requires special support from the installed NE SW, and it might be costly to change basic SW license functionality from these parts. (ii) Second, if the company starts to sell licenses only for a limited time period, which is a typical pricing method in the SW industry, and which would support the pay as you grow pricing method. Then the whole business concept changes more towards a leasing type business. Basically the pricing unit

could be the same. But if the SW license includes both fixed fees and annual additional license fees, pricing quickly becomes complicated and business case calculations require much more variables. (iii) Third, for a BS a wide range of configuration exists with cells varying between 1-16 cells and with BS hotel the concept of an individual BS becomes even more blurry, when part of the processing functionality is centralized into baseband processing servers. Thus the number of cells actually defines the network size more accurate than the amount of BS. Many times investment calculations are easier to be done on a BS granularity level. But still it might be better to use per cell pricing, since otherwise the customer might avoid SW license fees by building bigger BS configuration with more cells.

As a summary when the reference price unit is defined, the following points should be analyzed:

- Whether it reflects the feature value or the feature coverage (table 24)
- Whether it is aligned with company strategy and guidelines
- Whether it is not too complicated
- Whether the NE can support the SW license validation in selected units
- Whether it does not deviate the de-facto market pricing unit, especially if market price is used as reference
- Whether the pricing unit will not create unwanted market reactions

5.4. Additional feature pricing general guidelines

There are tens of different steps to be checked, when additional feature pricing is considered. Thus a checklist may be more suitable than a sequence chart, since a sequence chart would require too much space to fit into one screen or printable paper. Complicated and distributed sequence charts tend to be more suitable for programming reference than for decision reference. In line with chapters 5.1 – 5.3 the check lists can be defined as follows:

1. Check which pricing method fits best to the additional feature and company profiles (chapter 5.1). If no suitable method cannot be found, managerial judgment should be used

2. Calculate or estimate the suitable reference price range (chapter 5.2)

3. Evaluate to which point of the step 2 price range the reference price would be suitable to set (chapter 5.2)

4. Check if the initial pricing unit is suitable and re-calculate the reference price (chapter 5.3)

In theory also a sequence chart could be built to include all the steps, but then the sequence chart should be split into smaller parts. And for this it would be recommendable to have a tool with a drill down option, so that it would be easy to navigate between different sequence charts.

5.5. An additional feature pricing example

An example of a feature could be LTE 4x4 DL MIMO and 64 QAM UL, which will double the data rate in DL and UL directions. The feature will allow operators to sell higher data rate services to end users and thus value based pricing is recommended. It is assumed that operators want to have both features active, since there are supporting mobiles available. Thus it makes sense to do the business case calculation at the same time for both features. A new service is expected to be flat rate priced at 35 Euros, whereas the old data service is priced at 20 Euros.

Feature properties

- Flat rate pricing
- Vendor implementation budget 80 million Euros for this individual feature
- Total vendor SW release implementation budget 650 million Euros, from which overheads 150 million
- I.e. it can be roughly estimated that the SW feature with fixed overhead allocation will create 80 + 80/(650-150)*150 = 104 million implementation costs for the vendor

The operators are expected to launch the service in their entire LTE network. Operators are segmented into two categories.

1. An Asian operator with target country wide LTE coverage and tough competition:
    - Flat rate pricing
    - Both smart phones and dongles supporting higher data rates existing
    - 15 000 BS already installed. Target is to expand to 49 000 sites in eight years
    - The operator already has 5 000 000 data subscribers
    - If the new service is launched 300 000 new subscribers are expected
2. An European operator with lower competition and an urban area LTE coverage target:
    - Flat rate pricing
    - Both smart phones and dongles supporting higher data rates existing
    - 700 BS already installed. The target is to expand to 3 300 sites in eight years
    - The already operator has 150 000 data subscribers
    - If the new service is launched 5 000 new subscribers are expected

The business case is modeled by using different scenarios and sensitivity analysis for both operator segments. First scenario is called "Optimistic scenario", where the costs are expected to decrease annually. In the second "Higher cost scenario" customer related costs are 5 euro higher and do not decrease annually 3 %, as in the first scenario. Also it is expected that SW license price erosion will be only 10 % instead of 20 % in the first scenario Also an example "Single feature scenario" is calculated, if the feature 64 QAM UL is sold separately. In this case is expected that the customers are willing to pay only 3 Euros extra for the new service. For simplicity's sake it is expected that planning and maintenance costs will be the same. The relevant parameters for business case calculation are presented in table 26 and actual business case calculations in attachments.

The business case calculation is done based on traditional NPV, in where the **total cash flow** is discounted with selected interest rate over the seven year investment period. From cash flows are selected on the relevant ones, which are related to the analyzed feature, i.e. they would not occur if the feature would not be installed and bought by the operator. From total

cash flow **incoming cash consists both from revenues and savings reduced churn**. Revenues depend from network size, which acts as an input for the amount of subscribers, either new subscribers or existing ones upgrading the subscription for the new service. Here is assumed that marketing cost will not affect revenue. Reduced churn comes, when less end users will swap the operator, since it has become more attractive via the new offered feature. In the calculations additional churn without feature is set to 50 % of new users. I.e. instead of gaining new user, the operator would lose half of that potential to its competitors from its existing subscriber base. **Outgoing cash flow, i.e. negative cash flow, consists from SW licenses costs, other related for managing the new feature costs plus taxes**. These other feature related costs include Initial network planning cost, maintenance costs, sales and marketing and customer acquisition costs, customer provisioning costs, customer care costs as well as charging and billing cost. Depreciation costs are excluded, since they do not cause cash flows. Detailed parameter descriptions for the formulas exist in table 25.

Table 25 New service business case parameters

Parameter	Formula	Description
New subscriptions growth rate years 0-3	75+25*1,5^(1-(200000/Sales and marketing, customer acquisition costs years 0-3))	How much the amount of new service users is expected to grow. Growth depends on marketing effort
New subscriptions growth rate years 4-7	10+5*1,5^(1-(25000/Sales and marketing, customer acquisition costs years 4-7))	How much the amount of new service users is expected to grow. Growth depends on marketing effort
BS Amount	Subjective evaluation for the business case	How many BS operator has installed to be in use
Old data subscribers	(Previous year subscribers - Upgrades)*Network coverage increase*Annual old subscriber growth rate. (First year a input value)	How many legacy technology or lower data rate subscribers operator has
Upgrades	Old data subscribers*Annual upgrade rate	How many old data service subscribers will swap to new faster data service
New subscribers	Previous year New subscribers*New subscriptions growth rate (First year a input value)	How many new service subscribers operator receives either from competitors or as totally new users
Saved churn	New subscribers*Additional churn without feature	How much more churn would occur without new service, because customer would swap to competitors
New service fee	New service fee*Tarif erosion	How much one subscriber pays for the new service subscription
Upgrade fee difference	(New service fee-Old data service fee)*Tarif erosion	How much additional revenues are gained, if old subscribers update their subscription
Saved churn fee	Old data service fee*Old service margin*Tarif erosion	How much revenue each old data service subscriber bring to the company
Revenues	N/A	Groups revenue components
New subscriptions revenues	New subscribers*New service fee	How much total revenues are gained from the new service subscriptions
Subscription upgrades revenues	Upgrades*upgrade fee difference	How much more revenues are gained when subscribers upgrade to a more expensive subscription
Churn saves	Saved churn*Churn saves	How much theoretical revenue is saved, because subscribers will not swap to competitor

Revenues + savings	New subscription revenues + Subscription upgrade revenues + Churn saves	How much additional revenues the new feature brings, compared if it would not be installed
Costs	N/A	Groups cost components
SW license	Costs per new BS installation divided with Price erosion of SW license	How much money has to be spent each year for the SW license for the new feature
(Depreciation cost)	1/5 of past five year SW license fees	During how many years the SW license is depreciated. Affects cash flows via taxes
Initial network planning cost	Costs per new BS installation divided with costs erosion rate	How much the planning, parameter setting, etc. Costs, when new feature is activated for the BTS
Maintenance costs	Costs per BS per year divided with costs erosion rate	How much additional troubleshooting and other maintenance costs for new feature
Sales and marketing, customer acquisition costs	Costs per 500 BS per year	How much marketing effort is put to 500 BS cluster
Customer provisioning costs	Costs per new subscriber divided with costs erosion rate	How much money has to be spend for activating the new service for a subscription
Customer care costs	Costs per subscriber per year divided with costs erosion rate	How much money has to be spent on help desk, etc.
Charging and billing cost	Costs per subscriber per year divided with costs erosion rate	How much money is spent in collecting billing data and sending invoices
Total costs	Sum of costs, excluding SW license	How much accounting costs have occurred
EBIT	Revenues + savings - costs	How much taxable income new feature brings
Taxes	EBIT*Tax rate	How much more taxes has to be paid, when new feature has been installed
Total cash flow	Revenues and savings reduced with negative cash flow from of SW licenses, costs and taxes (excluding depreciation costs, since it does not cause cash flow)	How much incoming or outgoing cash flow is generated with due the new service
Discounted cash flow	Total cash flow divided with discount rate	What is the annual cash flow present value
NPV	Sum of discounted cash flows	What is the investment total value for the operator
Vendor NPV	Sum of discounted SW license fees reduced with implementation cost cash flows	What is the investment value for the vendor for developing this feature, if it is sold only to one operator

The investment calculations reveal three main findings. i) The new service is very valuable to the customers, if it can be sold as new service and a BS install base and slack resources exists, so that the customers does not have to invest in additional BS HW to get the SW feature on the field. ii) Operator segmentation highly affects to the investment calculations and iii) the effect of segmentation is higher than the effect of sensitivity analysis (i.e. different cost scenarios). For operator 2 the NPV remains positive even with a 95 000 Euro SW license per BS and for operator 1 with 33 000 Euro SW license per BS in an optimistic business case scenario. With sensitivity analysis the operator 1 investment calculations remain positive with a 19 000 Euro SW license per BS, when customer costs are 15 Euro higher per year and SW license erosion is 10 % instead of 20 %.

Table 26 Investment calculations for different SW feature prices for different operator business cases. Numerical calculations are included in attachments (* Only SW license price is changed)

Scenario	SW license price per BS	Operator 1 NPV	Operator 2 NPV
Optimistic	33 000	2 161 229	2 043 744 089
Optimistic with higher SW price*	95 000	-89 837 124	68 998 645
Higher costs	19 000	1 161 827	1 680 980 067
Single feature	5000	838 337	737 193 456

In a NSN white paper (NSN 2010) the 4+4+4 (three sector 12 cell) LTE BS CAPEX is estimated at 400 000 Euros and the price is linear to the amount of cells. Thus for one cell the CAPEX is 400 000/12= 33 333 Euros. Actually even if the investment calculations are easiest to be done at BS granularity for the higher data rate features, pricing is more conveniently done at cell level for easier comparison, better coverage parity and general market pricing custom as explained in chapter 5.3. If we assume that in the investment calculations the BS have in average 5 cells, we get a prince range for the Euro SW licenses enabling higher data rates between 19 000 for the 95 000 per BTS, which would already be a very significant part of the overall BS CAPEX compared to the SW license fee of 5*33 333 = 166 665 Euro investment price. Thus it would raise pricing risks related to overestimating demand, and underestimating competitor reactions and customer loyalty. Also there would be the risk that pricing gets negative publicity when vendors try to rip off its customers through expensive SW upgrades to an existing high CAPEX BS install base. Also the 95 000 price would make

sense to a very special segment of operator customers with large install base. The 33 000 Euro BTS wide SW license will be 6 600 Euros per cell and the 19 000 Euros BTS wide SW license price 3 800 Euros per cell. Lower prices will attract also smaller operators and reduce pricing risk, and the proportion of the overall CAPEX remains descent. If the pricing strategy favors differentiation pricing, let's says based on quality and service arguments, and if it is new technology in the introduction or growth phases, it makes sense according to pricing theory to set the price in higher end of the pricing range. Possible predatory reactions and price erosion can be compensated later with discounts. If the UL and DL features are usually sold together, but priced independently, it makes value pricing and value calculations more difficult. In a single feature scenario it is expected that a UL feature alone would be possible to sell only with 3 Euros higher price and that marketing efforts are also reduced. The SW license price for a positive NPV for the smaller operator is 5000 Euro per BS or 1000 Euro per cell. Thus according to this investment calculation example the SW license prices could be e.g. 5 500 Euro per cell for the LTE 4x4 DL MIMO SW feature and 1000 Euro per cell for the LTE 64 QAM UL SW feature.

If we assume that the implementation budgets are realistic and overheads can be allocated, we can also calculate the NPV for the feature for the vendor.

Table 27 Vendor NPV calculations for different SW feature prices for different operator business cases. Numerical calculations are included in attachments (* Only SW license price is changed)

Scenario	SW license price per BS	Vendor NPV for Operator 1	Vendor NPV for Operator 2
Optimistic	33 000	-59 885 706	842 913 682
Optimistic with higher SW price*	95 000	-104 000 000**	2 621 963 632
Higher costs	19 000	-72 210 197	517 518 435

Table 27 shows that for a small operator the NPV for a big feature is negative, but even one big customer will cover the implementation OPEX for the vendor. Another thing is of course how well the budgeted OPEX will match the occurred costs as explained in chapter 4.2.

6. Conclusions

Pricing is one of the most essential parts behind almost any company's financial performance, and thus pricing should be a key part of the company's strategy. Pricing is affected by more factors than many other business functions, starting from the beginning of the value chain as costs and ending at customers as perceived value. Pricing is also tightly connected to both internal as well as external factors. External factors are coming from competition, regulations and overall business environment, whereas internal factors rise from the accounting system and the company's cost structure. The importance of pricing, as well as its underlying complexity makes pricing one of the most challenging parts of operative management. The complexity is even further increased in the MTN industry, phasing with difficult technology, vast amount of different parameter and network configurations and the extremely varied customer segments. This master's thesis revealed that when pricing is extended beyond product level to additional features, the intangible nature of SW and highly varying properties of the additional features makes the traditional cost based pricing methods as well as economic price sensitivity based methods more or less useless.

For the actual main research question the finding was that as a general rule is that the price should reflect the additional feature's value, but sometimes the value is very difficult to measure and also competition, strategy and pricing risk set certain limitations. Pricing should be analyzed case by case based on the additional feature properties and reflected against key customer segments' business cases. Typically business cases are highly sensitive to parameter changes but even more sensitive to customer segments. When selecting a suitable pricing method, marketing theories and methods play a more significant role, taking into account competition, product properties and product lifecycle. Some of the marketing theories can be used as such, but others require MTN industry specific appliance. When the actual price range is defined, typically are needed management accounting methods for building the business case, where the price is one variable. However, for certain MTN features it is not suitable to use business case based pricing and thus marketing theories will dominate in the reference price setting.

For the secondary research question was found that for MTN additional features an absolute normative method, sequence chart or formula to define the exact price cannot be given. The other findings were that (i) vendor costs are not considered to be the main driver for pricing,

and should be considered mostly in big customized features. Most emphasis should be put to (ii) operator benefits and value. (iii) With current models end user benefits are usually difficult to estimate for individual features, and will not stand as a sustainable basis for pricing. Current public tools are mostly for network macro level business case simulations and are not that suitable to be used for supporting individual feature pricing. Additional features properties are the main driver when selecting a suitable method for estimating a suitable reference price. MTN customer knowledge is needed when the customer business case is calculated. The business case calculations are usually rather sensitive and despite sensitivity analysis the business case estimations will give misleading results, if the input variables based on the individual customer are chosen wrong.

During the research both the interviews and literature supported the findings. However, one must keep in mind that the literature is typically common in nature, not taking into account industry specific norms, not to mention industry product sub features. Whereas in the interviews were concentrated specifically on the sub feature, instead of common product pricing. Thus the interviews supported more in finding solutions for the problematic sub feature cases, and finding answers for the research questions.

Due to the industry specific characteristics, which were not known prior to the study, there was no really any other way to start the research, except by semi structured interviews. With more research resources could have been arranged a second interview round with the formed pricing method proposals, and ask comments from related parties.

For future research would be recommended how network quality and end user perceived value are visible in operator financial performance. And also how quality and end user perceived value are achieved via additional features, or will via network optimization and maintenance have a bigger role in value creation. Currently there are no suitable models or tools to model the value of additional features, which could link i) how network quality and end user perceived value are visible in operator financial performance or ii) how to separate the value effect between additional features and network optimization and maintenance actions. Due to the extremely complex relationships between end user value or operator financial performance and telecommunication additional feature properties traditional hypothesis based correlation analysis methods might not be suitable. Instead could be used Bayesian analysis for revealing possible hidden connections between MTN features, network maintenance and the financial results.

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Glossary

1G	First Generation
2G	Second Generation
3G	Third Generation
4G	Fourth Generation
3GPP	3rd Generation Partnership Project
3GGP2	3rd Generation Partnership Project 2
A/D	Analogue to Digital
ABC	Activity Based Costing
AC	Authentication Centre
AC	Alternating Current
AM	Amplitude Modulation
AMPU	Average Margin Per User
APSK	Amplitude and Phase-Shift Keying
ARP	Auto Radio Puhelin
ARPA	Advanced Research Project Agency
ARPU	Average Revenue Per User
ASK	Amplitude-Shift Keying
ATM	Asynchronous Transfer Mode
B2B	Business to Business
BS	Base Station
CAPEX	Capital Expenditures
CN	Core Network
CN-O	Core Network Operator
CRNC	Controlling RNC
DC	Direct Current
EDGE	Enhanced Data Rates for GSM Evolution
EGPRS	Enhanced General Packet Radio Service
EIR	Equipment Identity Register
FSK	Frequency-Shift Keying
GGSN	Gateway GPRS Support Node
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications

HHO	Hard Handover
HO	Handover
HR	Human Resources
HSPA	High-Speed Packet Access
HW	Hardware
IEEE	Institute of Electrical and Electronics Engineers
IMEI	Mobile Station Equipment Identity
IP	Internet Protocol
IRR	Internal Rate of Return
IS-95	American Interim Standard 95
ISHO	Inter System Handover
kbps	kilo bit per second
KPI	Key Performance Indicator
LTE	Long Term Evolution
Mbps	Mega bit per second
MDT	Minimization of Drive Tests
MIMO	Multiple In Multiple Out
MN-O	Mobile Network Operator
MOS	Mean Opinion Score
MS	Mobile Station
MSC	Mobile Services Switching Centre
MS-O	Mobile Service Operator
MTN	Mobile Telecommunication Network
MVI-O	Mobile Vertically Integrated Operator
MVN-O	Mobile Virtual Network Operator
NE	Network Element
NMT	Nordisk Mobiltelefon
NPV	Net Present Value
NSN	Nokia Siemens Networks
OBSAI	Open Base Station Architecture Initiative
OPEX	Operating Expenditures
OSS	Operating Systems Support
PCM	Pulse Code Modulation
PDC	Personal Digital Cellular

PM	Phase Modulation
PSK	Phase-Shift Keying
QAM	Quadrature Amplitude Modulation
QoE	Quality of Experience
QoS	Quality of Service
QPSK	Quaternary Phase Shift Keying
RAN-O	Radio Access Network Operator
RNC	Radio Network Controller
RNS	Radio Network Subsystem
RXTX	Transmitter Receiver
R&D	Research and Development
SGSN	Serving GPRS Support Node
SHO	Soft Handover
SIM	Subscriber Identity Module
SON	Self Optimized Networks
SRNC	Serving RNC
SW	Software
TCP	Transmission Control Protocol
TD-SCDMA	Time Division Synchronous Code Division Multiple Access
TN-O	Transmission Network Operator
UMTS	Universal Mobile Telecommunications System
UTRAN	UMTS Terrestrial Radio Access Network
VLR	Visitor Location Register
VoIP	Voice Over IP
WAP	Wireless Application Protocol
WCDMA	Wideband Code Division Multiple Access
WiMAX	Mobile Worldwide Interoperability for Microwave Access
WLAN	Wireless Local Area Network

Attachments

Operator interview questions:

1. What kinds of CAPEX and OPEX are the operator network investments consisting of?
2. What investment method is used?
3. How the value of a single feature can be analyzed from an operator point of view?
4. Is the whole network activated to the balance sheet or just parts of it (activation of SW based addition features)?
5. What is the best pricing basis for operators (market price, vendor costs, operator value or cost savings, end user benefits, operator solvency, traffic volume or usage)
6. What are the essential factors in an offering (price, quality, features, roadmap, and reputation)?
7. How should the offering be formed? Every feature separately or more comprehensive packets?
8. What is the operator's opinion of price discrimination?
9. How essential is the used pricing method in an offering or does the final price affect more?
10. Are discounts an essential part of pricing?

Table 28 Optimistic business case scenario parameters (yellow and orange cell parameter values are changed in other business case scenario calcultions)

Parameter	Value	Unit
New subscriptions growth rate years 0-3	105	%
New subscriptions growth rate years 4-7	15	%
Annual old subcriber growth rate	5	%
Annual upgrade rate	15	%
SW license per BS	33000	Euro per BS
Initial network planning cost	500	Euro per BS
Maintenance cost	400	Euro per BS per year
Sales and marketing, customer acquisition costs years 0-3	350000	Euro per 500 BS per year
Sales and marketing, customer acquisition costs years 4-7	25000	Euro per 500 BS per year
Customer provisioning costs	45	Euro per new customer/upgrade per year
Customer care costs	75	Euro per customer per year
Charging and billing cost	50	Euro per customer per year
Depriciation	20	%
Taxes	30	%
New service fee	35	Euro per month
Old service fee	20	Euro per month
Tariff ersosion	15	%
Additional churn without feature	50	% of new users
Old service margin	50	%
Price erosion of SW license	20	%
Discount rate for NPV	11	%
Costs erosion	3	%

Table 29 Operator 1 investment calculation for Optimistic business case scenario

Year	0	1	2	3	4	5	6	7
BS Amount	700	900	1 300	1 700	2 100	2 500	2 900	3 300
Old data subscribers	150 000	172 125	221 898	258 980	285 526	303 371	314 080	318 981
Upgrades	22 500	25 819	33 285	38 847	42 829	45 506	47 112	47 847
New subscribers	5 000	13 162	38 926	104 222	148 056	202 696	270 396	353 846
Saved churn	2 500	6 581	19 463	52 111	74 028	101 348	135 198	176 923
New service fee	35	30	25	21	18	16	13	11
Upgrade fee difference	15	13	11	9	8	7	6	5
Saved churn fee	10	9	7	6	5	4	4	3
Revenues								
New subscriptions revenues	2 100 000	4 698 888	11 812 103	26 882 158	32 460 206	37 773 632	42 831 522	47 642 683
Subsciption upgrades revenues	4 050 000	3 950 269	4 328 672	4 294 250	4 024 249	3 634 400	3 198 290	2 760 965
Churn saves	300 000	671 270	1 687 443	3 840 308	4 637 172	5 396 233	6 118 789	6 806 098
Revenues+savings	6 450 000	9 320 426	17 828 218	35 016 717	41 121 627	46 804 266	52 148 601	57 209 746
Costs								
SW license	23 100 000	5 280 000	8 448 000	6 758 400	5 406 720	4 325 376	3 460 301	2 768 241
(Depriciation cost)	0	4 620 000	5 676 000	7 365 600	8 717 280	9 798 624	6 043 699	5 679 759
Initial network planning cost	350 000	450 000	650 000	850 000	1 050 000	1 250 000	1 450 000	1 650 000
Maintenance costs	280 000	349 515	490 150	622 296	746 329	862 609	971 482	1 073 281
Sales and marketing, customer acquisition costs	490 000	630 000	910 000	1 190 000	52 500	62 500	72 500	82 500
Customer provisioning costs	1 017 500	501 593	1 409 502	2 918 031	1 911 785	2 224 879	2 611 949	3 080 254
Customer care costs	375 000	958 409	2 751 864	7 153 320	9 865 944	13 113 541	16 983 945	21 578 196
Charging and billing cost	250 000	638 939	1 834 576	4 768 880	6 577 296	8 742 360	11 322 630	14 385 464
Total costs	2 762 500	3 528 456	8 046 092	17 502 527	20 203 854	26 255 889	33 412 506	41 849 695
EBIT	3 687 500	5 791 971	9 782 127	17 514 189	20 917 774	20 548 376	18 736 095	15 360 051
Taxes	1 106 250	1 737 591	2 934 638	5 254 257	6 275 332	6 164 513	5 620 828	4 608 015
Total cash flow	**-20 518 750**	**-1 225 621**	**-1 600 511**	**5 501 532**	**9 235 722**	**10 058 488**	**9 654 965**	**7 983 795**
Discounted cashflow	-20 518 750	-1 104 163	-1 299 011	4 022 673	6 083 856	5 969 223	5 161 939	3 845 462
NPV	**2 161 229**							

Table 30 Operator 2 investment calculation for Optimistic business case scenario

Year	0	1	2	3	4	5	6	7
BS Amount	15 000	25 000	35 000	45 000	46 000	47 000	48 000	49 000
Old data subscribers	5 000 000	7 437 500	9 293 156	10 663 897	9 729 029	8 871 922	8 086 663	7 367 708
Upgrades	750 000	1 115 625	1 393 973	1 599 585	1 459 354	1 330 788	1 212 999	1 105 156
New subscribers	300 000	1 023 723	2 934 424	7 724 666	9 080 774	10 669 909	12 531 467	14 711 421
Saved churn	150 000	511 861	1 467 212	3 862 333	4 540 387	5 334 954	6 265 734	7 355 710
New service fee	35	30	25	21	18	16	13	11
Upgrade fee difference	15	13	11	9	8	7	6	5
Saved churn fee	10	9	7	6	5	4	4	3
Revenues								
New subscriptions revenues	126 000 000	365 469 057	890 450 877	1 992 442 301	1 990 892 623	1 988 404 008	1 985 019 490	1 980 780 646
Subsciption upgrades revenues	135 000 000	170 690 625	181 286 246	176 822 072	137 122 570	106 286 014	82 346 785	63 771 795
Churn saves	18 000 000	52 209 865	127 207 268	284 634 614	284 413 232	284 057 715	283 574 213	282 968 664
Revenues+savings	279 000 000	588 369 547	1 198 944 391	2 453 898 987	2 412 428 425	2 378 747 737	2 350 940 488	2 327 521 105
Costs								
SW license	495 000 000	264 000 000	211 200 000	168 960 000	13 516 800	10 813 440	8 650 752	6 920 602
(Depriciation cost)	0	99 000 000	151 800 000	194 040 000	227 832 000	230 535 360	133 698 048	82 628 198
Initial network planning cost	7 500 000	12 500 000	17 500 000	22 500 000	23 000 000	23 500 000	24 000 000	24 500 000
Maintenance costs	6 000 000	9 708 738	13 196 343	16 472 550	16 348 162	16 217 045	16 079 698	15 936 594
Sales and marketing, customer acquisition costs	10 500 000	17 500 000	24 500 000	31 500 000	1 150 000	1 175 000	1 200 000	1 225 000
Customer provisioning costs	34 050 000	47 592 867	92 852 501	205 736 091	48 613 122	56 695 501	65 717 083	75 816 676
Customer care costs	22 500 000	74 542 926	207 448 184	530 187 245	605 111 224	690 296 785	787 118 003	897 129 844
Charging and billing cost	15 000 000	49 695 284	138 298 790	353 458 163	403 407 483	460 197 857	524 745 335	598 086 562
Total costs	95 550 000	211 539 815	493 795 818	1 159 854 049	1 097 629 991	1 248 082 188	1 418 860 119	1 612 694 676
EBIT	183 450 000	376 829 732	705 148 573	1 294 044 938	1 314 798 434	1 130 665 549	932 080 369	714 826 430
Taxes	55 035 000	113 048 920	211 544 572	388 213 481	394 439 530	339 199 665	279 624 111	214 447 929
Total cash flow	**-366 585 000**	**-219 187**	**282 404 001**	**736 871 457**	**906 842 104**	**780 652 445**	**643 805 506**	**493 457 899**
Discounted cashflow	-366 585 000	-197 466	229 205 422	538 794 058	597 364 983	463 279 230	344 204 714	237 678 148
NPV	**2 043 744 089**							

Table 31 Optimistic business case scenario with high SW license price parameters (yellow cell parameter value changed)

Parameter	Value	Unit
New subscriptions growth rate years 0-3	105	%
New subscriptions growth rate years 4-7	15	%
Annual old subcriber growth rate	5	%
Annual upgrade rate	15	%
SW license per BS	95000	Euro per BS
Initial network planning cost	500	Euro per BS
Maintenance cost	400	Euro per BS per year
Sales and marketing, customer acquisition costs years 0-3	350000	Euro per 500 BS per year
Sales and marketing, customer acquisition costs years 4-7	25000	Euro per 500 BS per year
Customer provisioning costs	45	Euro per new customer/upgrade per year
Customer care costs	75	Euro per customer per year
Charging and billing cost	50	Euro per customer per year
Depriciation	20	%
Taxes	30	%
New service fee	35	Euro per month
Old service fee	20	Euro per month
Tariff ersosion	15	%
Additional churn without feature	50	% of new users
Old service margin	50	%
Price erosion of SW license	20	%
Discount rate for NPV	11	%
Costs erosion	3	%

Table 32 Operator 1 investment calculation for high license price Optimistic business case scenario

Year	0	1	2	3	4	5	6	7
BS Amount	700	900	1 300	1 700	2 100	2 500	2 900	3 300
Old data subscribers	150 000	172 125	221 898	258 980	285 526	303 371	314 080	318 981
Upgrades	22 500	25 819	33 285	38 847	42 829	45 506	47 112	47 847
New subscribers	5 000	13 162	38 926	104 222	148 056	202 696	270 396	353 846
Saved churn	2 500	6 581	19 463	52 111	74 028	101 348	135 198	176 923
New service fee	35	30	25	21	18	16	13	11
Upgrade fee difference	15	13	11	9	8	7	6	5
Saved churn fee	10	9	7	6	5	4	4	3
Revenues								
New subscriptions revenues	2 100 000	4 698 888	11 812 103	26 882 158	32 460 206	37 773 632	42 831 522	47 642 683
Subsciption upgrades revenues	4 050 000	3 950 269	4 328 672	4 294 250	4 024 249	3 634 400	3 198 290	2 760 965
Churn saves	300 000	671 270	1 687 443	3 840 308	4 637 172	5 396 233	6 118 789	6 806 098
Revenues+savings	6 450 000	9 320 426	17 828 218	35 016 717	41 121 627	46 804 266	52 148 601	57 209 746
Costs								
SW license	66 500 000	15 200 000	24 320 000	19 456 000	15 564 800	12 451 840	9 961 472	7 969 178
(Depriciation cost)	0	13 300 000	16 340 000	21 204 000	25 095 200	28 208 160	17 398 528	16 350 822
Initial network planning cost	350 000	450 000	650 000	850 000	1 050 000	1 250 000	1 450 000	1 650 000
Maintenance costs	280 000	349 515	490 150	622 296	746 329	862 609	971 482	1 073 281
Sales and marketing, customer acquisition costs	490 000	630 000	910 000	1 190 000	52 500	62 500	72 500	82 500
Customer provisioning costs	1 017 500	501 593	1 409 502	2 918 031	1 911 785	2 224 879	2 611 949	3 080 254
Customer care costs	375 000	958 409	2 751 864	7 153 320	9 865 944	13 113 541	16 983 945	21 578 196
Charging and billing cost	250 000	638 939	1 834 576	4 768 880	6 577 296	8 742 360	11 322 630	14 385 464
Total costs	2 762 500	3 528 456	8 046 092	17 502 527	20 203 854	26 255 889	33 412 506	41 849 695
EBIT	3 687 500	5 791 971	9 782 127	17 514 189	20 917 774	20 548 376	18 736 095	15 360 051
Taxes	1 106 250	1 737 591	2 934 638	5 254 257	6 275 332	6 164 513	5 620 828	4 608 015
Total cash flow	**-63 918 750**	**-11 145 621**	**-17 472 511**	**-7 196 068**	**-922 358**	**1 932 024**	**3 153 794**	**2 782 858**
Discounted cashflow	-63 918 750	-10 041 100	-14 181 082	-5 261 703	-607 586	1 146 562	1 686 147	1 340 387
NPV	**-89 837 124**							

Table 33 Operator 2 investment calculation for high license price Optimistic business case scenario

Year	0	1	2	3	4	5	6	7
BS Amount	15 000	25 000	35 000	45 000	46 000	47 000	48 000	49 000
Old data subscribers	5 000 000	7 437 500	9 293 156	10 663 897	9 729 029	8 871 922	8 086 663	7 367 708
Upgrades	750 000	1 115 625	1 393 973	1 599 585	1 459 354	1 330 788	1 212 999	1 105 156
New subscribers	300 000	1 023 723	2 934 424	7 724 666	9 080 774	10 669 909	12 531 467	14 711 421
Saved churn	150 000	511 861	1 467 212	3 862 333	4 540 387	5 334 954	6 265 734	7 355 710
New service fee	35	30	25	21	18	16	13	11
Upgrade fee difference	15	13	11	9	8	7	6	5
Saved churn fee	10	9	7	6	5	4	4	3
Revenues								
New subscriptions revenues	126 000 000	365 469 057	890 450 877	1 992 442 301	1 990 892 623	1 988 404 008	1 985 019 490	1 980 780 646
Subsciption upgrades revenues	135 000 000	170 690 625	181 286 246	176 822 072	137 122 570	106 286 014	82 346 785	63 771 795
Churn saves	18 000 000	52 209 865	127 207 268	284 634 614	284 413 232	284 057 715	283 574 213	282 968 664
Revenues+savings	279 000 000	588 369 547	1 198 944 391	2 453 898 987	2 412 428 425	2 378 747 737	2 350 940 488	2 327 521 105
Costs								
SW license	1 425 000 000	760 000 000	608 000 000	486 400 000	38 912 000	31 129 600	24 903 680	19 922 944
(Depriciation cost)	0	285 000 000	437 000 000	558 600 000	655 880 000	663 662 400	384 888 320	237 869 056
Initial network planning cost	7 500 000	12 500 000	17 500 000	22 500 000	23 000 000	23 500 000	24 000 000	24 500 000
Maintenance costs	6 000 000	9 708 738	13 196 343	16 472 550	16 348 162	16 217 045	16 079 698	15 936 594
Sales and marketing, customer acquisition costs	10 500 000	17 500 000	24 500 000	31 500 000	1 150 000	1 175 000	1 200 000	1 225 000
Customer provisioning costs	34 050 000	47 592 867	92 852 501	205 736 091	48 613 122	56 695 501	65 717 083	75 816 676
Customer care costs	22 500 000	74 542 926	207 448 184	530 187 245	605 111 224	690 296 785	787 118 003	897 129 844
Charging and billing cost	15 000 000	49 695 284	138 298 790	353 458 163	403 407 483	460 197 857	524 745 335	598 086 562
Total costs	95 550 000	211 539 815	493 795 818	1 159 854 049	1 097 629 991	1 248 082 188	1 418 860 119	1 612 694 676
EBIT	183 450 000	376 829 732	705 148 573	1 294 044 938	1 314 798 434	1 130 665 549	932 080 369	714 826 430
Taxes	55 035 000	113 048 920	211 544 572	388 213 481	394 439 530	339 199 665	279 624 111	214 447 929
Total cash flow	**-1 296 585 000**	**-496 219 187**	**-114 395 999**	**419 431 457**	**881 446 904**	**760 336 285**	**627 552 578**	**480 455 557**
Discounted cashflow	-1 296 585 000	-447 044 313	-92 846 359	306 684 666	580 636 378	451 222 578	335 515 235	231 415 460
NPV	**68 998 645**							

Table 34 High cost business case scenario parameters (yellow cell parameter values changed)

Parameter	Value	Unit
New subscriptions growth rate years 0-3	105	%
New subscriptions growth rate years 4-7	15	%
Annual old subcriber growth rate	5	%
Annual upgrade rate	15	%
SW license per BS	19000	Euro per BS
Initial network planning cost	500	Euro per BS
Maintenance cost	400	Euro per BS per year
Sales and marketing, customer acquisition costs years 0-3	350000	Euro per 500 BS per year
Sales and marketing, customer acquisition costs years 4-7	25000	Euro per 500 BS per year
Customer provisioning costs	50	Euro per new customer/upgrade per year
Customer care costs	80	Euro per customer per year
Charging and billing cost	55	Euro per customer per year
Depriciation	20	%
Taxes	30	%
New service fee	35	Euro per month
Old service fee	20	Euro per month
Tariff ersosion	15	%
Additional churn without feature	50	% of new users
Old service margin	50	%
Price erosion of SW license	10	%
Discount rate for NPV	11	%
Costs erosion	0	%

Table 35 Operator 1 investment calculation for high cost business case scenario

Year	0	1	2	3	4	5	6	7
BS Amount	700	900	1 300	1 700	2 100	2 500	2 900	3 300
Old data subscribers	150 000	172 125	221 898	258 980	285 526	303 371	314 080	318 981
Upgrades	22 500	25 819	33 285	38 847	42 829	45 506	47 112	47 847
New subscribers	5 000	13 162	38 926	104 222	148 056	202 696	270 396	353 846
Saved churn	2 500	6 581	19 463	52 111	74 028	101 348	135 198	176 923
New service fee	35	30	25	21	18	16	13	11
Upgrade fee difference	15	13	11	9	8	7	6	5
Saved churn fee	10	9	7	6	5	4	4	3
Revenues								
New subscriptions revenues	2 100 000	4 698 888	11 812 103	26 882 158	32 460 206	37 773 632	42 831 522	47 642 683
Subsciption upgrades revenues	4 050 000	3 950 269	4 328 672	4 294 250	4 024 249	3 634 400	3 198 290	2 760 965
Churn saves	300 000	671 270	1 687 443	3 840 308	4 637 172	5 396 233	6 118 789	6 806 098
Revenues+savings	6 450 000	9 320 426	17 828 218	35 016 717	41 121 627	46 804 266	52 148 601	57 209 746
Costs								
SW license	13 300 000	3 420 000	6 156 000	5 540 400	4 986 360	4 487 724	4 038 952	3 635 056
(Depriciation cost)	0	2 660 000	3 344 000	4 575 200	5 683 280	6 680 552	4 918 097	5 041 887
Initial network planning cost	350 000	450 000	650 000	850 000	1 050 000	1 250 000	1 450 000	1 650 000
Maintenance costs	280 000	360 000	520 000	680 000	840 000	1 000 000	1 160 000	1 320 000
Sales and marketing, customer acquisition costs	490 000	630 000	910 000	1 190 000	52 500	62 500	72 500	82 500
Customer provisioning costs	1 130 000	574 045	1 661 490	3 542 902	2 390 812	2 865 828	3 465 338	4 209 249
Customer care costs	400 000	1 052 972	3 114 082	8 337 734	11 844 487	16 215 667	21 631 700	28 307 690
Charging and billing cost	275 000	723 918	2 140 932	5 732 192	8 143 085	11 148 271	14 871 794	19 461 537
Total costs	2 925 000	3 790 935	8 996 504	20 332 828	24 320 884	32 542 266	42 651 331	55 030 976
EBIT	3 525 000	5 529 491	8 831 715	14 683 889	16 800 744	14 262 000	9 497 269	2 178 770
Taxes	1 057 500	1 658 847	2 649 514	4 405 167	5 040 223	4 278 600	2 849 181	653 631
Total cash flow	**-10 832 500**	**450 644**	**26 200**	**4 738 322**	**6 774 160**	**5 495 676**	**2 609 137**	**-2 109 917**
Discounted cashflow	-10 832 500	405 985	21 265	3 464 620	4 462 349	3 261 416	1 394 951	-1 016 259
NPV	**1 161 827**							

Table 36 Operator 2 investment calculation for high cost business case scenario

Year	0	1	2	3	4	5	6	7
BS Amount	15 000	25 000	35 000	45 000	46 000	47 000	48 000	49 000
Old data subscribers	5 000 000	7 437 500	9 293 156	10 663 897	9 729 029	8 871 922	8 086 663	7 367 708
Upgrades	750 000	1 115 625	1 393 973	1 599 585	1 459 354	1 330 788	1 212 999	1 105 156
New subscribers	300 000	1 023 723	2 934 424	7 724 666	9 080 774	10 669 909	12 531 467	14 711 421
Saved churn	150 000	511 861	1 467 212	3 862 333	4 540 387	5 334 954	6 265 734	7 355 710
New service fee	35	30	25	21	18	16	13	11
Upgrade fee difference	15	13	11	9	8	7	6	5
Saved churn fee	10	9	7	6	5	4	4	3
Revenues								
New subscriptions revenues	126 000 000	365 469 057	890 450 877	1 992 442 301	1 990 892 623	1 988 404 008	1 985 019 490	1 980 780 646
Subsciption upgrades revenues	135 000 000	170 690 625	181 286 246	176 822 072	137 122 570	106 286 014	82 346 785	63 771 795
Churn saves	18 000 000	52 209 865	127 207 268	284 634 614	284 413 232	284 057 715	283 574 213	282 968 664
Revenues+savings	279 000 000	588 369 547	1 198 944 391	2 453 898 987	2 412 428 425	2 378 747 737	2 350 940 488	2 327 521 105
Costs								
SW license	285 000 000	171 000 000	153 900 000	138 510 000	12 465 900	11 219 310	10 097 379	9 087 641
(Depriciation cost)	0	57 000 000	91 200 000	121 980 000	149 682 000	152 175 180	97 419 042	65 238 518
Initial network planning cost	7 500 000	12 500 000	17 500 000	22 500 000	23 000 000	23 500 000	24 000 000	24 500 000
Maintenance costs	6 000 000	10 000 000	14 000 000	18 000 000	18 400 000	18 800 000	19 200 000	19 600 000
Sales and marketing, customer acquisition costs	10 500 000	17 500 000	24 500 000	31 500 000	1 150 000	1 175 000	1 200 000	1 225 000
Customer provisioning costs	37 800 000	54 467 392	109 452 465	249 792 646	60 793 886	73 028 471	87 188 482	103 605 498
Customer care costs	24 000 000	81 897 828	234 753 897	617 973 245	726 461 882	853 592 711	1 002 517 397	1 176 913 652
Charging and billing cost	16 500 000	56 304 757	161 393 305	424 856 606	499 442 544	586 844 989	689 230 710	809 128 136
Total costs	102 300 000	232 669 977	561 599 667	1 364 622 498	1 329 248 311	1 556 941 171	1 823 336 589	2 134 972 286
EBIT	176 700 000	355 699 570	637 344 724	1 089 276 489	1 083 180 114	821 806 566	527 603 899	192 548 820
Taxes	53 010 000	106 709 871	191 203 417	326 782 947	324 954 034	246 541 970	158 281 170	57 764 646
Total cash flow	**-161 310 000**	**77 989 699**	**292 241 307**	**623 983 542**	**745 760 180**	**564 045 286**	**359 225 351**	**125 696 533**
Discounted cashflow	-161 310 000	70 260 990	237 189 600	456 251 388	491 255 330	334 733 424	192 056 542	60 542 792
NPV	**1 680 980 067**							

Table 37 Single feature business case scenario parameters (yellow and orange cell parameter values changed)

Parameter	Value	Unit
New subscriptions growth rate years 0-3	100	%
New subscriptions growth rate years 4-7	14	%
Annual old subcriber growth rate	5	%
Annual upgrade rate	15	%
SW license per BS	5000	Euro per BS
Initial network planning cost	500	Euro per BS
Maintenance cost	400	Euro per BS per year
Sales and marketing, customer acquisition costs years 0-3	200000	Euro per 500 BS per year
Sales and marketing, customer acquisition costs years 4-7	15000	Euro per 500 BS per year
Customer provisioning costs	45	Euro per new customer/upgrade per year
Customer care costs	75	Euro per customer per year
Charging and billing cost	50	Euro per customer per year
Depriciation	20	%
Taxes	30	%
New service fee	23	Euro per month
Old service fee	20	Euro per month
Tariff ersosion	15	%
Additional churn without feature	50	% of new users
Old service margin	50	%
Price erosion of SW license	20	%
Discount rate for NPV	11	%
Costs erosion	3	%

Table 38 Operator 1 investment calculation for single feature business case scenario

Year	0	1	2	3	4	5	6	7
BS Amount	700	900	1 300	1 700	2 100	2 500	2 900	3 300
Old data subscribers	150 000	172 125	221 898	258 980	285 526	303 371	314 080	318 981
Upgrades	22 500	25 819	33 285	38 847	42 829	45 506	47 112	47 847
New subscribers	5 000	12 857	37 143	97 143	136 579	185 057	244 324	316 435
Saved churn	2 500	6 429	18 571	48 571	68 289	92 529	122 162	158 218
New service fee	23	20	17	14	12	10	9	7
Upgrade fee difference	3	3	2	2	2	1	1	1
Saved churn fee	10	9	7	6	5	4	4	3
Revenues								
New subscriptions revenues	1 380 000	3 016 286	7 406 657	16 465 569	19 677 425	22 662 620	25 432 513	27 997 958
Subsciption upgrades revenues	810 000	790 054	865 734	858 850	804 850	726 880	639 658	552 193
Churn saves	300 000	655 714	1 610 143	3 579 471	4 277 701	4 926 657	5 528 807	6 086 513
Revenues+savings	2 490 000	4 462 054	9 882 534	20 903 890	24 759 976	28 316 157	31 600 978	34 636 664
Costs								
SW license	3 500 000	800 000	1 280 000	1 024 000	819 200	655 360	524 288	419 430
(Depriciation cost)	0	700 000	860 000	1 116 000	1 320 800	1 484 640	915 712	860 570
Initial network planning cost	350 000	450 000	650 000	850 000	1 050 000	1 250 000	1 450 000	1 650 000
Maintenance costs	280 000	349 515	490 150	622 296	746 329	862 609	971 482	1 073 281
Sales and marketing, customer acquisition costs	280 000	360 000	520 000	680 000	31 500	37 500	43 500	49 500
Customer provisioning costs	1 017 500	488 267	1 346 803	2 699 949	1 735 928	1 985 717	2 294 118	2 665 372
Customer care costs	375 000	936 200	2 625 803	6 667 461	9 101 141	11 972 409	15 346 331	19 296 809
Charging and billing cost	250 000	624 133	1 750 535	4 444 974	6 067 427	7 981 606	10 230 887	12 864 539
Total costs	2 552 500	3 208 115	7 383 291	15 964 680	18 732 325	24 089 841	30 336 317	37 599 501
EBIT	-62 500	1 253 939	2 499 243	4 939 210	6 027 650	4 226 316	1 264 661	-2 962 837
Taxes	0	376 182	749 773	1 481 763	1 808 295	1 267 895	379 398	0
Total cash flow	**-3 562 500**	**77 757**	**469 470**	**2 433 447**	**3 400 155**	**2 303 061**	**360 975**	**-3 382 267**
Discounted cashflow	-3 562 500	70 052	381 032	1 779 316	2 239 788	1 366 755	192 992	-1 629 097
NPV	**838 337**							

Table 39 Operator2 investment calculation for single feature business case scenario

Year	0	1	2	3	4	5	6	7
BS Amount	15 000	25 000	35 000	45 000	46 000	47 000	48 000	49 000
Old data subscribers	5 000 000	7 437 500	9 293 156	10 663 897	9 729 029	8 871 922	8 086 663	7 367 708
Upgrades	750 000	1 115 625	1 393 973	1 599 585	1 459 354	1 330 788	1 212 999	1 105 156
New subscribers	300 000	1 000 000	2 800 000	7 200 000	8 376 837	9 741 421	11 323 167	13 156 034
Saved churn	150 000	500 000	1 400 000	3 600 000	4 188 418	4 870 710	5 661 583	6 578 017
New service fee	23	20	17	14	12	10	9	7
Upgrade fee difference	3	3	2	2	2	1	1	1
Saved churn fee	10	9	7	6	5	4	4	3
Revenues								
New subscriptions revenues	82 800 000	234 600 000	558 348 000	1 220 389 200	1 206 882 047	1 192 960 343	1 178 665 413	1 164 036 332
Subsciption upgrades revenues	27 000 000	34 138 125	36 257 249	35 364 414	27 424 514	21 257 203	16 469 357	12 754 359
Churn saves	18 000 000	51 000 000	121 380 000	265 302 000	262 365 662	259 339 205	256 231 611	253 051 376
Revenues+savings	127 800 000	319 738 125	715 985 249	1 521 055 614	1 496 672 223	1 473 556 750	1 451 366 381	1 429 842 067
Costs								
SW license	75 000 000	40 000 000	32 000 000	25 600 000	2 048 000	1 638 400	1 310 720	1 048 576
(Depriciation cost)	0	15 000 000	23 000 000	29 400 000	34 520 000	34 929 600	20 257 280	12 519 424
Initial network planning cost	7 500 000	12 500 000	17 500 000	22 500 000	23 000 000	23 500 000	24 000 000	24 500 000
Maintenance costs	6 000 000	9 708 738	13 196 343	16 472 550	16 348 162	16 217 045	16 079 698	15 936 594
Sales and marketing, customer acquisition costs	6 000 000	10 000 000	14 000 000	18 000 000	690 000	705 000	720 000	735 000
Customer provisioning costs	34 050 000	46 556 432	88 156 923	189 665 396	41 445 508	47 979 004	55 171 850	63 117 092
Customer care costs	22 500 000	72 815 534	197 945 141	494 176 496	558 203 309	630 227 625	711 223 042	802 279 443
Charging and billing cost	15 000 000	48 543 689	131 963 427	329 450 997	372 135 539	420 151 750	474 148 695	534 852 962
Total costs	91 050 000	200 124 393	462 761 834	1 070 265 439	1 011 822 518	1 138 780 424	1 281 343 285	1 441 421 090
EBIT	36 750 000	119 613 732	253 223 415	450 790 176	484 849 705	334 776 326	170 023 097	-11 579 023
Taxes	11 025 000	35 884 120	75 967 025	135 237 053	145 454 912	100 432 898	51 006 929	0
Total cash flow	**-49 275 000**	**43 729 612**	**145 256 391**	**289 953 123**	**337 346 794**	**232 705 028**	**117 705 448**	**-12 627 599**
Discounted cashflow	-49 275 000	39 396 047	117 893 345	212 011 224	222 220 782	138 099 108	62 930 139	-6 082 189
NPV	**737 193 456**							