Tim C.M. de Koning

Billing for content services in an evolving mobile industry

About the billing processes and division of roles in the mobile value network

Tim C.M. de Koning

Billing for content services in an evolving mobile industry

About the billing processes and division of roles in the mobile value network

APPENDIX: INTERVIEW REPORTS

Billing for content services in an evolving mobile industry

About the billing processes and division of roles in the mobile value network

Master thesis project[1]
Thesis submitted in partial fulfilment of the requirement for the degree of Master of Science in Systems Engineering Policy Analysis and Management

Faculty of Technology, Policy and Management
Section Information and Communication Technology
Delft University of Technology

Delft, September 2007

Author:

Tim C.M. de Koning[2]

Graduation committee:

Dr. W.A.G.A. (Harry) Bouwman (Chairman), Delft University of Technology
Ir. G.A. (Mark) de Reuver, Delft University of Technology
Dr. Ir. W. (Wolter) Lemstra, Delft University of Technology
MSc. R. (Richard) van de Sanden, KPMG IT Advisory
Ir. B.L.G. (Bart) Bastiaans, KPMG IT Advisory

1 Course name: SPM5910 SEPAM Master Thesis Project
2 Student number: 1102125
E-mail: timdekoning@gmail.com

Preface

Internet on the mobile phone is starting to take shape and is slowly migrating to become an integrated part of the Internet experience. Currently mobile operators (e.g. Vodafone, KPN mobile, T-mobile, Orange) hold a central position in the network provisioning of mobile content services to the end-user. For several years role divisions have been proposed in literature that places other actors such as content providers central in this value network and the first signs of a shift towards other role divisions are currently visible. A general aspect of this position in the value network is the billing relation with the customer. In this study we investigated how this billing for content services will be performed in potential future role divisions in the value network, taking into account the interactions with developments in technology and information. We concluded that although several of the role divisions proposed in literature may become a reality, due to several constraints some role divisions are more likely than others.

This study concerns a master thesis project and completes the Systems Engineering, Policy Analysis and Management master of the faculty of Technology, Policy and Management of Delft University of Technology. The study was facilitated by KPMG IT Advisory. The main empirical part of the study entailed interviews with actors active in the mobile Internet industry such as operators, content providers, and SMS service providers. The reports of these interviews are included in a separate appendix. Besides this thesis report, the master thesis project also includes writing a scientific paper. This paper is included in this report before the appendixes.

There are many people that have contributed to this study. I like to thank in particular the members of my graduation committee: Harry Bouwman, Mark de Reuver, Wolter Lemstra, Richard van der Sanden and Bart Bastiaans. First of all I thank my first supervisor Mark de Reuver. Mark guided me in solving some of the critical problems I came across. I very much appreciate his detailed and critical comments, encouragement and useful suggestions for improving the draft versions of this thesis.
I also thank my daily supervisors Richard van der Sanden and Bart Bastiaans. I am grateful for the freedom they gave me in defining and organizing the research project. I also thank them for reading and commenting on draft versions of this thesis. Their suggestions on interesting cases and their feedback both on the process and the content of this project really contributed to improving the study and the thesis. Bart, I really enjoyed our discussions on the technological infrastructures in telecom. Furthermore I acknowledge the broad knowledge, the hospitality and pleasant working environment within the team of IT Advisory in The Hague and Rotterdam.
I thank Wolter Lemstra for his sharp questions, constantly forcing me to keep focused on what I actually wanted to accomplish. Our discussions and his clear vision really helped me in my research.
Harry Bouwman, the chairman of my graduation committee, gave valuable advice. I really liked his critical approach from a theoretical point of view.
I am also grateful for the help of the interviewees from the various firms. The information and insights from the pleasant conversations during these interviews were of vital importance to my study.
I also thank Diana for her feedback, and support, and Pim for the fruitful discussions on our research projects.
Last but not least I like to thank my parents for both enabling and stimulating my education.

Delft, September 2007

Tim C.M. de Koning

Executive summary

Internet on the mobile phone is starting to take shape. Content services from the regular Internet increasingly become available on the mobile phone. Not only the content services of the Internet and mobile Internet are converging, also actors active in both worlds increasingly cooperate to produce end-user value. This convergence highlights the discrepancies between these two worlds. Actors, used to the freedom of the regular Internet have to face the restrictions that operators in the mobile domain can place on them based on their dominant position in the value network. These restrictions enable the operator to charge high billing fees and according to several industry participants, hamper the fast and easy deployment of new services.

The mobile network operator currently has a central position in the mobile value network and controls the end-user relation and related billing processes. However, the first signs of changes in this control are visible and role divisions in which other actors obtain the customer contact and billing relation may become a reality. These role divisions have been proposed in literature for several years now. From literature, basically five role division archetypes can be identified in which the differentiating factor is the actor assuming the role of customer contact, having the billing relation to this customer. In the five archetypes respectively the mobile operator, content aggregator, content provider, the independent billing aggregator and the Internet Service Provider have direct customer contact. We speak of archetypes here as they lay down extreme situations which enable us to study the industry through more isolated relations whereas it is expected that multiple models will proliferate and coexist.

The emergence of these archetypes can at present hardly be distinguished empirically and it remains unclear how they will concretely be shaped. This research has targeted this knowledge gap by analyzing how the models could become a reality in the Netherlands in terms of the underlying business processes, more specifically how the billing processes will be shaped. The billing processes evidently differ among the various role divisions but are also subject to change due to interrelated developments in technology and information. For example, new technology such as the IP Multimedia Subsystem (IMS) can enable new service concepts (in this case for example charging and billing based on QoS characteristics) impacting the actors fulfilling roles. This relation between value network role divisions and business processes was the first aspect dealt with in this study. Through a study into the abundant amount of scientific literature on value networks, business processes and the small amount of literature on their interrelationship we approached this knowledge gap. To enable dealing with this complexity within the scope of this research we created a conceptual framework. This framework demarcates our theoretical focus to the informational and technological resources that actors fulfilling roles in the industry contribute to the billing processes.

We identified the roles involved in the mobile Internet industry as used in literature as the starting point to lay down the current division of these roles involved in the billing for content services to end-users. Subsequently we analyzed the billing processes through two different business process modelling methods, complementing the conceptual framework. We have a broad view on billing consisting of charging for usage, both of the network resources and the price of the content service, placing these charges on the customer bill, collecting this bill and accounting the revenues among the involved actors. We found that especially the control of technological resources such as the operator's data network, billing systems, Short Message Service Centre (SMSC), and Internet access gateways enable the operator to control these processes. Content is at present provided in two different ways; on-portal and off-portal. On-portal refers to the provisioning of content services on the portal of the operator whereas off-portal refers to a scenario in which a third party provides the portal and content service outside the operator domain. On-portal the dominant billing method in the Netherlands is WAP billing, also termed content billing. Off-portal the dominant method is Premium Rate SMS (PRSMS) billing. The main difference between these two methods is that WAP billing uses a direct interface to the billing system whereas PRSMS billing depends on the communication of charging information through the SMSC. The latter has more overhead, requires terminating and re-establishing the session and provides lower revenue to the content aggregators and providers.

Both methods place the operator entirely in control of the customer (billing) relation. However, developments visible at actors fulfilling roles in the value network and the increasing technological capabilities (e.g. more intelligent devices) point to changes in this control. Both the entry of new actors introducing new billing resources and the developments in technology, pricing, billing methods and

mobile devices challenges the current resource barriers imposed by the mobile operator. These facilitate developments towards the theoretical archetypes mentioned earlier. Through a literature study, complemented with interviews with industry participants we discussed the feasibility of the archetypes using the information and technology perspective of our framework. Due to the explorative character of our research and the creativity inherently present in the process of designing business process models we evaluated our designs based on criteria. We identified five criteria from literature related to the business process components of our framework. These are activities (customer usability), technology (interoperability and leverage of legacy), and information (information quality).

It turned out that the operator centric model is expected by most interviewees to remain dominant, as currently only few alternatives are available or expected that can match the usability and market reach of the operator's billing methods. Especially billing the end-user for the network resource usage will predominantly remain operator-centric. The only development really challenging this relation is the proliferation of Mobile Virtual Network Operators (MVNOs). Currently already some 40 MVNOs are active in the Netherlands. They predominantly provide voice and SMS services. This is about to change and although MNOs may still provide the charging information (i.e. Charging Data Records), the customer demographic information and collection of the bill is facilitated by the MVNO. On the longer term the IMS will enable more differentiated billing in terms of QoS and strengthen the position of the mobile operator in charging for network resource usage and the provision of more advanced services.

In terms of billing for the price of content, WAP billing will become available off-portal, which makes the position of the mobile operator stronger. Alternatives provided through other billing constellations will emerge and will challenge the operator dominance in billing. We discuss these through the different archetypes.

The content aggregator centric archetype is difficult to realize by the actors currently fulfilling this role in the mobile domain as they are operating purely business to business. Large technology providers are assuming this role to expand their reach in the media business. These actors contribute new and valuable resources, which enable similar billing models as in use on the regular Internet.

The content provider centric archetype can take three directions in terms of the specification of this role. First, content providers will use advertisement based models, especially for content that on the open Internet can insufficiently differentiate to provide premium value. This type of model is considered to be outside our scope as there is no longer any billing relation to the end-user. Second, content providers can add mobile users to their current subscriber base. This will probably be the dominant method to exploit customer contact by actors fulfilling the content provider role. However, this model is rather limited to subscription based billing in contrast to event-based billing. Hence the billing processes are reduced to identifying the end-user as "content services are billed in the subscription" (i.e. flat fee). Establishing the identity of the end-user remains a problem as this is still controlled by the operator. When the identity is not provided on a wholesale basis and the technological capabilities of the user device do not enable identification, a login can be used. The third option to establish customer contact by a content provider and bill accordingly is to start an MVNO. In this model the actor providing content can offer its own portal and related payment methods at the Mobile Virtual Network Enabler (MVNE). Although the latter makes entry to the mobile market rather easy, it still requires a large resource contribution, making it a viable alternative only to the largest providers.

The billing aggregator centric archetype is already extensively used on the regular Internet and the payment methods available here are increasingly available on the mobile device, emerging from both independent specialized actors and financial institutions. When the validation of the user identity can be established, payment providers can offer these services. However, the customer usability of the services remains low compared to other billing solutions. Furthermore, these services are at present not targeted at micro payments as the revenue share that can be delivered to content providers on small event-based billing transactions using these services is relatively low.

Finally the Internet Service Provider (ISP) centric archetype can basically be supported by two types of ISPs; (1) the ISPs owning network infrastructure in the fixed domain, and (2) the ISPs acting as resellers in the fixed domain. The second type of model is rather similar to the content provider – MVNO centric model and is not further elaborated. ISPs from the first type have, in the Netherlands, not yet offered any wholesale billing services to other actors. However, this is a realistic possibility; ISPs could easily hook up their billing systems to the current business to business content aggregators

of the mobile domain. This would place all interoperability issues at the latter actors as well as maximize the leverage of the ISP's legacy systems. When the ISP connects its billing systems to the current mobile aggregators and WAP billing providers, subscribers of the ISP can bill content services on their account at the ISP. The WAP billing method as currently offered by MNOs could also be offered by the ISPs, making them strong competitors to the current mobile operators.

In analyzing the mobile Internet industry roles and billing processes both descriptively and explorative through our framework we gained insights on the applicability of our perspective. The descriptive part focussed purely on identifying the current billing processes and the control of information and technology by the actors performing the critical roles. To this end the framework provided a usable perspective and demarcation. The focus on developments and possibilities in information and technology to enable alternative business processes turned out to be sufficiently capable of assessing the process feasibility. Furthermore, as a means to structure our explorative research in the highly dynamic industry we found it valuable. However, when using the framework explorative, the focus on information and technology turned out to be constraining. Aspects could be added to the framework to capture resources of more intangible nature. Examples are the importance of an established user base and brand name. Hence, the resources attributed to specific roles in our framework could be expanded beyond information and technology to provide a broader perspective on the resource base.

Furthermore, we feel an aspect is missing in between the role and the process activities in our framework, when applying it to explore future scenarios.

Assuming a specific role in the value network relates to performing specific functions. These functions can be performed in several ways using different informational and technological resources. The selection of the specification of the functions in terms of resources is a strategic choice. An aspect or layer could be added to our framework that incorporates strategic choices and thereby sharpen the perspective of our framework. Further research should target this aspect.

In the domain under study we assessed role divisions based on information and technology resources from which we concluded on the feasibility of these role divisions. Results of this research should be interpreted in this respect. We did not regard other business processes than billing (and their relations) and did not regard the financial viability. Further research into the domain should focus on these two aspects. First, the billing processes should be studied as part of the overall process architecture of the involved actors. This could for example be based on business architectures. Second, an assessment of the financial viability of the discussed role divisions should be performed. An approach that could be highly complementary to the approach taken here is for example the e^3-value method.

Index

PREFACE ..... **III**

EXECUTIVE SUMMARY ..... **V**

INDEX ..... **IX**

LIST OF FIGURES AND TABLES ..... **XI**

1. INTRODUCTION **1**

1.1 BACKGROUND 1
1.2 RESEARCH FOCUS 3
1.3 RESEARCH GOAL AND RESEARCH QUESTIONS 5
1.4 RESEARCH METHODS AND DELIVERABLES 6
1.5 THESIS OUTLINE 10

2. THEORETICAL BACKGROUND **11**

2.1 INTRODUCTION 11
2.2 INTER-ORGANIZATIONAL NETWORKS 11
2.3 BUSINESS PROCESSES 19
2.4 THE GAP BETWEEN BUSINESS PROCESSES AND THE VALUE NETWORK 25
2.5 CONCLUSIONS 27

3. BILLING IN THE MOBILE INTERNET INDUSTRY **31**

3.1 INTRODUCTION 31
3.2 THE MOBILE INDUSTRY EXPRESSED IN FIGURES 31
3.3 THE MOBILE INTERNET VALUE NETWORK 33
3.4 BILLING RELATED ROLES 39
3.5 BILLING PROCESSES IN THE MOBILE INTERNET VALUE NETWORK 42
3.6 CONCLUSIONS 51

4. EXPLORATION **53**

4.1 INTRODUCTION 53
4.2 FIGURES ON THE FUTURE MOBILE INDUSTRY 53
4.3 NEW SERVICES 54
4.4 VALUE NETWORK ROLE CHANGES 55
4.5 DEVELOPMENTS ON THE BILLING PROCESS LEVEL 61
4.6 CONCLUSION 67

5. SPECIFICATION OF ANTICIPATED ARCHETYPES **71**

5.1 INTRODUCTION 71
5.2 THE MNO CENTRIC MODEL 71
5.3 THE CONTENT AGGREGATOR CENTRIC MODEL 74
5.4 THE CONTENT PROVIDER CENTRIC MODEL 76
5.5 THE PAYMENT PROVIDER CENTRIC MODEL 80
5.6 ISP CENTRIC MODEL 82
5.7 CONCLUSION 85

6. CONCLUSIONS **89**

6.1 INTRODUCTION 89
6.2 THEORY 89
6.3 BILLING IN THE MOBILE INTERNET VALUE NETWORK 90
6.4 DEVELOPMENTS IN THE VALUE NETWORK AND UNDERLYING BILLING PROCESSES 91
6.5 SPECIFICATION OF THE ROLE DIVISION ARCHETYPES 92
6.6 INTEGRATION AND PROJECTION 96

7. REFLECTION **97**

7.1 RESEARCH FOCUS 97

7.2 RESEARCH METHOD 97
7.3 VALIDATION OF FINDINGS 100
7.4 FURTHER RESEARCH 101
REFERENCES 103
SCIENTIFIC PAPER 111
APPENDIX 1 THE WCA FRAMEWORK 125
APPENDIX 2 RELATIONS AMONG BUSINESS PROCESS THEORY 127
APPENDIX 3 RELATING VALUE NETWORKS TO BUSINESS PROCESSES 128
APPENDIX 4 TELECOMMUNICATIONS' INFRASTRUCTURE UNRAVELLED 130
APPENDIX 5 BEARER CHARGING METHODS 133
APPENDIX 6 CHARGING PARAMETERS 134
APPENDIX 7 VALUE BASED PRICING 135
APPENDIX 8 INTERVIEW ANALYSIS 137
APPENDIX 9 IDEF-0 ANALYSIS OF BILLING PROCESSES 141
ABBREVIATIONS 145

List of figures and tables

Figures

Thesis

Figure 1.1 Research framework....5
Figure 1.2 Research methods flow diagram....6
Figure 1.3 Companies connected to roles....9
Figure 1.4 Thesis outline....10
Figure 2.1 Theories explaining motivations for network formation....12
Figure 2.2 Porter's value chain (Porter, 1990: 41)....15
Figure 2.3 Porter's value system (Porter 1990: 43)....15
Figure 2.4 Resources as sources of sustained competitive advantage (Barney, 1991: 112)....17
Figure 2.5 the WCA framework of Alter (Alter, 1999)....20
Figure 2.6 Enterprise architecture layers (based on Jansen, 2006)....21
Figure 2.7 BPM techniques classification framework (Aguilar-Savén, 2004: 146)....22
Figure 2.8 Examples of IDEF-0 and RID....23
Figure 2.9 Conceptual framework....29
Figure 3.1 ARPU developments (source: Sharma, 2006)....31
Figure 3.2 Wireless Data ARPU per country (source: Sharma, 2006)....32
Figure 3.3 Dutch technology uptake (van Veen, 2007)....32
Figure 3.4 Dutch operators in figures (Netsize 2007a: 129)....33
Figure 3.5 Revenues and data share of Dutch operators (Netsize, 2007a: 130)....33
Figure 3.6 Telecom value chain, simplified (Based on Lemstra, 2006)....34
Figure 3.7 The mobile Internet industry and its segments (Soininen, 2005: 3)....35
Figure 3.8 Content services and applications value network (Soininen, 2005)....35
Figure 3.9 Mobile operators in EU countries (Kiiski, 2006: 3)....37
Figure 3.10 Current dominant role division in the mobile industry....41
Figure 3.11 IDEF-0 model basic view of billing for resource usage....44
Figure 3.12 IDEF-0 first decomposition of network resource usage billing process....45
Figure 3.13 IDEF-0 model basic view of PRSMS billing for content services....47
Figure 3.14 IDEF-0 first decomposition PRSMS content service billing....48
Figure 3.15 RID of off-portal PRSMS billing for content services....49
Figure 3.16 IDEF-0 model basic view of WAP billing for content services....49
Figure 3.17 IDEF-0 first decomposition WAP billing for content services....50
Figure 3.18 RID of on-portal PRSMS billing for content services....50
Figure 4.1 MNO, MVNE and MVNO (www 19: Lasalle, 2006)....60
Figure 4.2 Paypal processing flow (Paypal, 2007)....63
Figure 4.3 The IP Multimedia Subsystem (van Otterlo, 2007)....66
Figure 5.1 MNO centric archetype....72
Figure 5.2 Off-portal operator centric model....72
Figure 5.3 Content aggregator centric archetype....74
Figure 5.4 Content aggregator centric model....75
Figure 5.5 RID of content aggregator centric model....75
Figure 5.6 Content provider centric archetype....76
Figure 5.7 Adding the end user to an existing relation....77
Figure 5.8 MVNO – Content provider centric model....78
Figure 5.9 RID of MVNO - CP centric model....79
Figure 5.10 Payment provider centric archetype....80
Figure 5.11 Payment provider centric model....80
Figure 5.12 RID of payment provider centric model....81
Figure 5.13 ISP centric model....82
Figure 5.14 ISP (fixed operator) centric model....83
Figure 5.15 RID of ISP centric billing processes....84
Figure 6.1 Conceptual framework....89
Figure 6.2 Off-portal operator centric model....93
Figure 6.3 Content aggregator centric model....93
Figure 6.4 Content provider centric model; Adding the end user to an existing relation....94
Figure 6.5 Content provider centric model; assume the MVNO role....94

Figure 6.6 Payment provider centric model 95
Figure 6.7 ISP (fixed operator) centric model 95
Figure 6.8 Development path of billing in the mobile content industry 96
Figure 7.1 Conceptual framework 98
Paper
Figure P 1 Framework for studying business processes in a value network 113
Figure P 2 On-portal billing for the price of content 115
Figure P 3 Off-portal billing for the price of content 116
Figure P 4 PRSMS billing for content services 116
Figure P 5 Expected directions in billing role divisions 122
Appendixes
Figure A 1 WCA framework (Adapted from Alter, 1999) 125
Figure A 2 Adaptations to the WCA framework (Reijers and Mansar, 2005: 293) 126
Figure A 3 Business process theories related 127
Figure A 4 Relations between value network and business processes 128
Figure A 5 Current dominant GSM, GPRS and UMTS network architecture in Europe 130
Figure A 6 Consumer willingness to pay for online music (KPMG, 2006b) 135
Figure A 7 IDEF-0 decomposition of Content aggregator centric model 141
Figure A 8 IDEF-0 decomposition of Content provider/ MVNO centric model 142
Figure A 9 IDEF-0 decomposition of billing processes in billing aggregator centric model 143
Figure A 10 IDEF-0 decomposition of the billing processes in the ISP centric model 144

Tables

Thesis
Table 2.1 Motivations for network formation 13
Table 2.2 Inter-organizational network classification criteria (Riemer et al, 2001) 14
Table 2.3 Resource types based on Das and Teng (2000) and Montalvo et al (2004) 16
Table 2.4 Criteria to evaluate inter-organizational business processes 25
Table 3.1 Terminology used in the telecom and IP worlds (Koutsopoulou et al, 2004: 51) 39
Table 3.2 Summary of roles 41
Table 3.3 Summary of roles in content service provisioning 51
Table 3.4 Summary of roles relevant in billing for content services 51
Table 3.5 Overview roles on- and off-portal 52
Table 4.1 Developments visible in roles currently active in the mobile Internet Value network 59
Table 4.2 Roles entering the mobile Internet Value network 61
Table 4.3 Developments in billing methods 64
Table 4.4 Pricing of content 64
Table 4.5 Developments in pricing 65
Table 4.6 Technological developments: platforms and middleware 66
Table 4.7 Technological developments: devices 67
Table 5.1 Summary of operator centric model 72
Table 5.2 Summary of anticipated content aggregator centric model 75
Table 5.3 Summary of anticipated content provider - MVNO centric model 78
Table 5.4 Summary of anticipated payment provider centric model 81
Table 5.5 Summary of the anticipated ISP (fixed operator) centric model 84
Table 5.6 Summary of archetype interpretations 86

1. Introduction

1.1 Background

Currently the first services on the third generation of mobile systems known as UMTS are being offered throughout Europe (Kallio et al, 2006). To enable the offering of these services to consumers[3], huge investments in licenses and infrastructure were made. Returning these investments is crucial for the sector which is an important driver of economic growth and a potential source of strategic advantage for the region (Bauer et al, 2004). To return the investments additional Average Revenue Per User (ARPU) is required especially since the current trend is towards decreasing ARPU for voice, due to competition (Tilson and Lyytinen, 2006; Kuo and Yu, 2006). A major driver of additional ARPU can be the introduction of new value adding services (Ary et al, 2005; Farley and Capp, 2005; Cushnie et al, 2000; Tilson and Lyytinen, 2006; Peppard and Rylander, 2006) and hence operators are increasingly looking at the possibilities to exploit data traffic (Praveen Tanguturi and Harmantzis, 2006).

Effective and efficient billing is considered critical in the offering of these services (Bhushan et al, 2002; Ryan, et al. 2004). As the success of new services depends on billing it is crucial that these processes are effectively and efficiently organized. However, with the convergence of the telecommunications and Internet sector many new actors are involved (Cuevas et al, 2006; Tilson and Lyytinen, 2006; Barnes, 2002), making these processes more complex.

Operators have traditionally been the focal point for the billing services and have been the first line of contact with the consumer (Sabat, 2002; Peppard and Rylander, 2006). Also in the shift towards the first data oriented services in the 2,5nd generation of mobile systems, known as GPRS and I-mode, the mobile operator remained in this position. This enables operators to behave strategically as they can, through their billing systems exert an influence on the actors involved in service provisioning. For example at DoCoMo, in their successful I-mode services, Value Added Service Providers (VASPs) only obtained access to their billing and location services if it was an officially selected party. Consumers could use “unofficial” sites but the proprietors of these sites did not have access to DoCoMo’s billing and location services and Internet menu on the portal (Bauer et al, 2004; Soininen, 2005). Furthermore, this control of the billing functionalities enables the operator to determine its own fees as only little competition exists. The current SMS billing solutions dominant in the Netherlands are not very efficient and operators charge high tariffs for the service (Garner et al, 2006).

With the increased personalisation of services in the third generation networks and customer requirements towards charging transparency (Butyka et al, 2004), a single bill (Koutsopoulou et al, 2002; Ryan et al, 2004; Buellingen and Woerter, 2004) and single sign-on, i.e. authenticate once (Farley and Capp, 2005; Cuevas et al, 2006), the billing platforms are becoming more important. Content providers recognize this and the inherent restrictions that MNOs can impose on them through their platforms. Several of these providers are starting to demand more openness and transparency in MNOs’ platforms to deal with these developments. For example the “Open Mobiel Internet” initiative in the Netherlands aims to open up MNO’s service platforms to increase the speed and ease at which new services can be deployed (OMI, 2006).

The actors involved in this initiative attribute the disappointing uptake of Mobile Internet in the Netherlands to the walled garden model used by operators. The walled garden approach can be regarded as the intention of mobile operators to fence off any services and information provisioning to end users that are not part of the operator’s portfolio or selected content and partners. The OMI stresses its desire to make the telecommunications world as open as the regular Internet (OMI, 2006). Of the seven goals specified by this alliance one goal more specifically targets billing; “Services, such as identification, location based services and payment services need to be available both on-net [i.e. on the operator’s portal] and off-net [i.e. when using services away from the operator’s portal]” (OMI, 2006: 1).

[3] Without inclining any gender bias, in the remainder of this thesis we refer to the consumer, customer or the end-user in the masculine form.

The walled garden approach has traditionally grown in the mobile sector but its current proliferation can be attributed to the fact that operators fear the openness of the Internet. In the openness of the Internet mobile operators may become what Cuevas et al (2006) term "just another bit pipe". This would make their business role identical to the Internet Service Providers (ISPs) in the wired world (Peppard and Rylander, 2006), in which pricing is mainly based on flat rate tariffs and focussed at connection fees (Zhang and Liu, 2005; Odlyzko, 2000). Thus, although MNOs have made the lion share of the investments in UMTS, it is uncertain whether MNOs will be collecting the additional ARPU of new services as their revenue may be reduced to transport revenues or flat fees only, which do little justice to the expected benefits of new services on UMTS.

1.1.1 Alternative role divisions

With the current dynamics in the value network, such as the migration of the mobile Internet to the regular Internet, new role division models are possible and required. The different roles are visible in the three models defined by the UMTS Forum (UMTS Forum, 2002).

The first is the Network Operator centric model; the operator sets the prices and handles the payments while content is primarily bought through wholesale. This model can be used to increase the ARPU of the operator while dealing with primarily two external actors; the content providers and financial institutions (Butyka et al, 2004). As Ary et al, (2005) state, this model is most convenient for the user but places full control at the operator. Although the operator-centric model has already frequently been applied in for example GPRS and I-mode, it is likely that other models will also proliferate (Koutsopoulou et al, 2007).

The second model defined by the UMTS forum is the Content Aggregator centric model. A content aggregator aggregates content of multiple content providers and can hence provide a broader service portfolio. In this model several content providers have agreements with an aggregator that interacts with the user, providing most of the added value through portals other than the MNO's (e.g. simplicity, payment aggregation, authentication, security). The Network Operator is paid separately for the access charges or based on agreements with the content aggregator (Butyka et al, 2004; Ary et al, 2005).

The third model is the Content Provider centric model. The customer has direct contact with many content providers that settle access and transport charges with the operator that will earn only access and airtime charges (Butyka et al, 2004). The content aggregation role is performed by the content provider who offers a broad portfolio of services. This model provides a great deal of freedom to content providers and the services offered, it has a large administrative overhead as each content provider must have its own billing and accounting functionality (Ary et al, 2005) and additional effort of the end user is required.

Many other actors are eager to become this focal point for payment and authentication which is a very enviable position for a company (Farley and Capp, 2005; Gulati et al, 2000; Buellingen and Woerter, 2004; Shapiro and Varian, 1999). This position enables companies to gain details on customers that are vital in the provisioning of more advanced and personal services. Hence, many actors want to have as close a relationship to the end-user as possible (Soininen, 2005) which is facilitated through the billing relation that also enables them to charge fees to other actors for this process. Current Internet Service Providers already have a billing relationship with clients and have experience on the Internet. With the convergence of the mobile Internet and the regular Internet, the ISPs could expand their billing relation of their current customers to include mobile Internet in their portfolio (Farley and Capp, 2005; Bhushan et al, 2002). Additional to the three role divisions of the UMTS forum, the ISP-centric model can be considered a fourth type.

The billing role can also be fulfilled by a specialized independent provider (Farley and Capp, 2005; Bhushan et al, 2002) such as PayPal or Wallie who already deal with transactions on the regular Internet. Financial institutions are also interested in expanding their financial services by introducing services such as mobile payment (Bhati Salvi and Sahai, 2002). For example the Dutch bank "Rabobank" started offering mobile services as a Mobile Virtual Network Operator (MVNO). Additional to the fact that the financial institutions have experience with financial transactions, the telecom billing services would fit nicely into a financial institution's (future) service offerings and their banking licenses provides several opportunities that operators do not have. The scenario in which an independent actor specialized in billing enters the market and establishes the billing relation with the customer is a fifth role division model.

The differences between on the one hand the closedness of the telecom world and the openness of the Internet world on the other are also visible in the propositions on the billing platforms for the next generation of mobile services of the IETF and the 3GPP. In the models of the 3GPP, representing the telecom world, operators hold the key role in network connectivity and service provisioning (Koutsopoulou et al, 2004). The model of the 3GPP is aligned with the operator-centric model. In the propositions made by the IETF, representing the Internet world, direct agreements between content providers and customers are anticipated (Koutsopoulou et al, 2004). This latter model is aligned with the content provider centric model. Given these different propositions it remains unclear which actors will perform which roles in the future value network and hence also the organizational setting under which the billing processes in the next generation of mobile services will be deployed.

1.1.2 Billing processes

Not only the organizational setting under which the billing processes will be deployed remains unclear, also other factors play a role here. Role divisions on the value network level only lay down what actually is done by which actors performing specific roles. It does not concern how this is done which is the level of the business processes (Gordijn and Tan, 2001). Therefore to assess role divisions a more specific focus on how billing is actually performed through the billing processes in the mobile value network is required. On a business process level there are several factors relevant with respect to billing which predominantly relate to technology and information.

First the feasibility of the theoretical role divisions depends on the legacy systems that are in place at the actors currently fulfilling roles in content service provisioning. This legacy is usually tailored to suit the current relations and will be difficult to change. This is especially the case at operators whose entire mindset must change before other role division models possible (Peppard and Rylander, 2006). Current legacy patch work at operators makes it difficult to quickly and cost effectively deploy innovative services as silos must first be integrated (Nokia, 2006b). Effectively the billing processes are not implemented or designed based on a Greenfield situation. They will have to migrate from their current organization towards other models. Hence in the more elaborate specification of the billing processes in any role division, the current organization of the billing processes must be known. This is a challenging task and crucial knowledge to companies involved in the industry (see e.g. KPMG 2006a).

Second, ongoing developments enable and require changes in the billing processes. Several generic and more specific trends can already be identified. On a service level, services are becoming more personal; potentially location based and can be offered in bundles (Bhushan et al, 2005; Kuo and Yu, 2006). In terms of the value network we refer to the currently visible and anticipated changes at actors fulfilling roles in the mobile content service industry. These are already partially reflected in the role division scenarios. However, these are on a very generic level and restricted to laying down the role that will interact with the customer and are not connected to actors fulfilling these roles. It remains unclear how these actors see their future role and how this fits into the five role divisions scenarios. Several trends directly affecting the billing processes are the integration of pre-paid and post-paid billing (Bhushan et al, 2005), the emergence of composite services (Bhushan et al, 2002) and the additional parameters involved in packet-switched technology (Butyka et al, 2004). Furthermore, the growth of m-commerce (Barnes, 2002), increasing targeting of Internet payment methods on the mobile channel, and the increasing targeting of advertisers on the mobile device influence the manner in which billing will be performed. Two other developments taking place are the increasing intelligence and capabilities of mobile devices (Nokia, 2006 a,b) and introduction of new middleware and platforms (Kormentzas et al, 2006).

1.2 Research Focus

To recapitalize, the mobile network operator's eagerness to remain the consumers' focal point for billing and identity management contrasts with the demands for openness imposed by other actors active in or entering the mobile content industry. Five role division models can be identified from literature that reflect these discrepancies and illustrate potential changes.

Many authors (e.g. Koutsopoulou et al, 2007; Koutsopoulou et al, 2004; Bhushan et al, 2005; Butyka et al, 2004;) have laid down technological architectures and information models for specific role divisions or combinations of role divisions. However, an overview of the billing processes in terms of the

activities and both technology and information throughout the several potential role divisions lacks. The mobile network operator currently controls the critical informational and technological resources which make it difficult for other actors to build a customer relation and bill accordingly. Hence it remains unclear how other models would concretely be shaped and how they are affected or enabled by current legacy or developments in the industry.

There is an abundant amount of literature available on role divisions and technology and information architectures in the mobile industry. The relation between the two is however far from clear. The relation between business processes and the value network can be regarded as a refinement relation; the value network view defines on a high level what should be done by whom whereas the process view further defines how this should be done (Dijkman et al, 2003). There are strong differences between on the one hand the value network level and on the other the business process level as they basically refer to completely different aspects of the involved organizations (Gordijn et al, 2000). This makes it difficult to determine their interdependencies. These interdependencies should be known before any statements can be made regarding the feasibility of role division models. The amount of literature available on this subject is very small. Only a few approaches exist but these are rather rigid or do not regard information and technology but strictly focus on value exchanges (e.g. Pijpers and Gordijn, 2007). A pragmatic perspective or approach towards dealing with this theoretical gap lacks from current literature.

1.2.1 Knowledge gaps

From the above primarily four knowledge gaps can be identified. We discuss them shortly. First, the relation between a role in the value network and the underlying enabling business process activities, technology usage and control of information are ambiguous and hardly studied in literature. The relations between the role divisions on the value network level and the process level are unclear; this is a first identified knowledge gap.

Second, the current arrangement of the billing processes throughout the different roles in the value network fulfilled by several companies is highly complex and involves many legacy systems and relations. These must be known as they constitute the starting point for the migration to other types of billing role divisions in the mobile content value network Hence the current organization of the billing processes and the technology and information in use here is a second identified knowledge gap.

Third, understanding of the current situation is insufficient for exploring future scenarios. In a more elaborate illustration of these scenarios in terms of the business processes, anticipated changes and developments on both the process, technological and value network level must be incorporated. Hence the third knowledge gap concerns the developments that are already visible and expected on both the value network and business process (billing) level.[4]

We already introduced the fourth knowledge gap in the former paragraph. It concerns the actual organization of the billing processes in the role division models. Essentially the customer contact can reside at actors fulfilling different roles. This only provides a generic direction and not a concrete role division or feasible business processes. Hence, the more concrete discussion of the billing processes throughout all involved roles can be considered a fourth knowledge gap. Essentially it entails the synthesis of earlier mentioned knowledge gaps on the current and expected potential future situations.

1.2.2 Relevance and perspective

The first knowledge gap is of specific scientific interest due to the lack of lack of literature on the alignment and relations between business processes on the one hand and the value network (roles) on the other. We analyze this relation from a multi theoretic perspective and use a pragmatic approach to deal with this gap. We apply this approach on the mobile domain which provides insights into the applicability of this approach and potential required modifications.

The perspective we assume in this study is holistic, meaning we study the industry and participants and processes in it from a high level, not assuming the perspective of any actor active in the mobile Internet value network. Hence the perspective we take is rather observatory to capture a broad spectrum.

[4] Evidently the definition of this knowledge gap directly relates to our perspective on the exploration of future billing processes. We discuss this perspective further in section 1.4 and reflect on it in chapter 7.

Therefore the results of this study concerning the domain are relevant for all actors involved in the industry under study to see their role and activities in a broader perspective, but are especially applicable to actors specialized in the overview of the industry and its relations. Hence this work is applicable by advisors such as the facilitator of this research as it enables more tailored advice to their clients based on these actors' overall current and potential future position concerning billing in the industry.

1.3 Research goal and research questions

Based on the identified knowledge gaps in section 1.2.1, the goal of this research is formulated as follows:

> *To identify feasible billing processes and related options for control of information and technology in the several role divisions in mobile content service provisioning.*

The following question is extracted from the goal stated above:

> *What are the options that organizations have in the realisation of the billing processes in terms of the control of information and technology in the several role divisions in mobile content service provisioning?*

To ensure timely delivery of our research results and report we have made several delineations. The first is that we predominantly regard the relations among the industry participants and the end-user in terms of content services and related billing. Roaming scenarios are not part of the relations within our scope. Second, we do not regard user-to-user scenarios but only user to business relations. This means that interconnection between operators, peer-to-peer services, and user generated content are not within our scope. Third, we specifically regard the billing for content services on mobile devices. This means that we do not get into much depth on mobile payment (related to physical assets), but focus on online micro-payment. Fourth we only regard content services and hence do not discuss any voice related services and related developments such as VOIP offerings. Concerning our geographical scope we regard role divisions that are relevant on a global scale but their specification in terms of the underlying billing processes focuses primarily on the Dutch situation where we acquire most of our empirical data.

The research question is divided into sub-questions to structure the research. These questions, directly related to the four knowledge gaps discussed earlier, are:

Q1. What are value networks and business processes and how can both be analyzed and related?
Q2. How are end-user content services currently billed in the mobile Internet value network?
Q3. What are the developments in the mobile Internet industry in terms of roles and billing processes?
Q4. What are feasible designs of the billing processes in terms of the role divisions, process activities and the control of information and technology?

Each question is answered in a specific chapter in this thesis. The structuring of the different steps in this research in a framework not only aids in obtaining the research goal stated above but also helps in the communication of the process (Verschuren and Doorewaard, 1999). The research framework is shown in Figure 1.1.

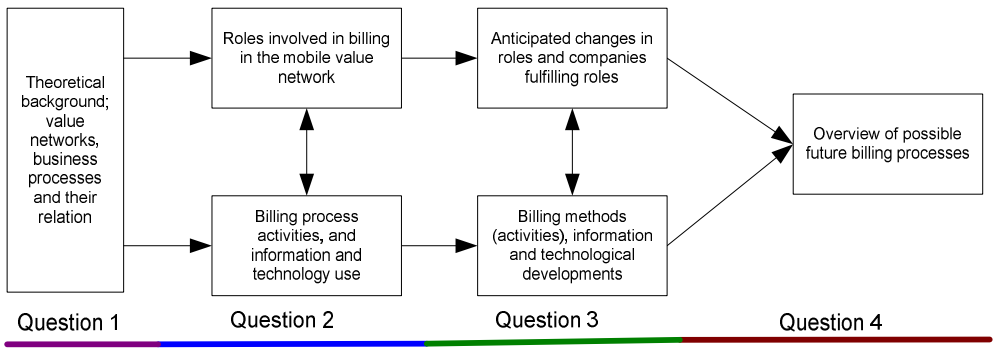


Figure 1.1 Research framework

This framework lays down the focus of analysis throughout the research questions. At the first question the theoretical relation between the value network and business processes is the focus. The resulting framework helps in the analysis of the roles and billing processes in the current mobile Internet value network. This provides the starting point for anticipated developments on both levels of analysis which are the basic premises for the specification of the anticipated future billing processes.

1.4 Research methods and deliverables

To illustrate our research methods we have created a diagram that structures the relevant aspects in answering these questions. In Figure 1.2 we show the data requirements, research methods and desired output related to the research questions. On top of each block the data requirements are shown. Inside the blocks we show the research method and at the bottom of the block the deliverable of the method is shown. Each deliverable provides the required input for the next method and related question until the final result is visible. The relation between the deliverables of the methods and the research questions is shown in colours.

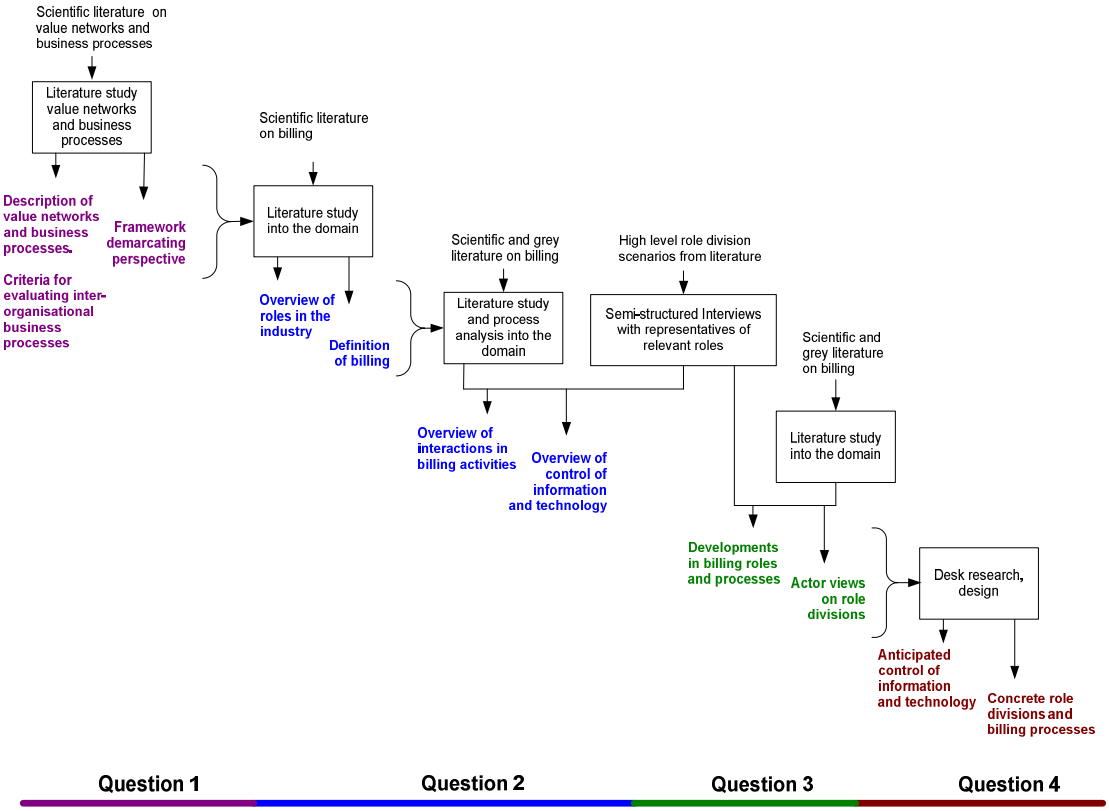


Figure 1.2 Research methods flow diagram

Question 1

We answer the first question by studying scientific literature on business processes and value networks. Within scientific literature there is an extensive amount of research available on value networks (e.g. Allee, 2000a,b; Gulati, 1998; Riemer et al, 2002). Also the diverse fields within business processes are extensively discussed in scientific literature such as Business Process Management or Business Process Modelling (BPM) (e.g. Weske et al, 2004; Tsalgatidou and Junginger, 1995), Business Process Analysis (BPA) (e.g. Castano et al., 1999) and Business Process Redesign (BPR) (e.g. Attaran, 2004; Paper and Chang, 2005; Tsalgatidou and Junginger, 1995). The relation among the two fields is very complex and hardly studied in literature. Only few authors explicitly deal with this relation (e.g. Pijpers and Gordijn, 2007; Bergholz et al, 2003). Furthermore, from our analysis of scientific literature we identify criteria for the analysis of inter-organizational business processes. These are used to evaluate our designs in question 4. We use the definition of evaluation of (Verschuren and Hartog, 2005: 744), as having “to compare facts, i.e., processes, plans and products of designing, with a touchstone or a set of criteria.”

Based on an analysis of the extensive amount of literature available on value networks and business processes and the moderate amount of literature on their relation we provide the following deliverables:

- Descriptions of the concepts business processes and value networks
- A framework that provides focus in the analysis of business processes and value networks and their relation.
- Selection of modelling methods that enable the analysis and visualization of the concepts structured in the framework.
- Criteria for the evaluation of business inter-organisational business processes

Question 2
To answer question 2 we study the billing processes in the current value network. Based on a study of scientific literature we provide two deliverables:

- An overview of the roles in the industry
- A definition of billing and the high level activities it incorporates

We apply this knowledge to specify the concepts demarcated in the theoretical framework through the selected modelling methods. Additional data and knowledge required here are obtained from both scientific and grey literature and interviews. This provides the following additional deliverables:

- An overview of the interactions in the billing activities
- An overview of the control of relevant information and technology by actors based on their roles

As visible in the figure we applied interviews to analyze the current role division and billing processes as well as to explore developments and their impact on billing processes in other role divisions.

Question 3
This question concerns the identification of the relevant value network developments for future billing processes. To explore future developments, the scientific discipline of futurology offers many methods. Aaltonen and Sanders (2006) structure 23 of these methodologies in four categories: quantitative, qualitative, normative and exploratory. Quantitative and qualitative are considered self-evident. Normative in futures studies refers to specific values, desires, wishes or needs in the future (Ratcliffe, 2000). Exploratory refers to the possibilities, not directly taking into account norms and values (Aaltonen and Sanders, 2006). To satisfy our research goal that regards our interest in *feasible* future billing *processes*, we explore qualitatively. This focus still provides many different methods. According to Aaltonen and Sanders (2006) combinations of methods are preferred for future exploration.

There are several starting premises in the research methods which basically come down to the extent to which history, the present situation and visible developments are taken into account. Given the importance of legacy in the industry we focus on the present situation and visible developments that may challenge this legacy. The combination of insights in the present situation and visible developments enable the extrapolation to future scenarios. The implications of this perspective are discussed in chapter 7. We use role divisions as scenarios to visualize feasible future billing processes. They are specified on the basis of scanning the environment to identify trends for which a broad range of sources should be used (Abels, 2002).

These sources are scientific and grey literature on billing and the mobile Internet value network and interviews with stakeholders in the industry. We discuss primarily three fields of development: (1) directions in future services, (2) the ideas the different actors have on the billing processes and their role(s) in the value network, and (3) the relevant trends in the aspects demarcated in our framework; i.e. value network roles, and business processes supported by technology and information. The deliverable here is:

- An overview of the developments in billing processes and roles

We use these insights and the five role division archetypes identified in this introduction to gain empirical knowledge to complete the identified developments and insights into the feasibility of the five archetypes. We use these extremes as a means to communicate with stakeholders in the industry in our interviews to identify how these archetypes would potentially concretely be shaped. Hence the primary deliverable here is:

- Empirical views on the high level role divisions from literature

The interviews are reported in interview transcripts that are validated on their interpretation through having the interviewees check the documented results of the interviews. The interview methods and rationales are further discussed in a separate paragraph as this method requires a very thorough setup.

Question 4
We use the knowledge of the conceptualization and analysis of the current situation and identified developments in the industry to interpret the theoretical role division archetypes from literature. We design feasible specifications of the archetypes on the basis of domain exploration from scientific and grey literature and interviews. This integration of a large diversity in findings into a concrete artefact challenges the designer. The design of systems is increasingly considered both an art and a science (Rechtin, 1992; Maier and Rechtin, 2000; Nightingale and Rhodes, 2004). This introduces some ambiguity and uncertainty. Hence once established, the artefact must be assessed on its value; evaluation is required (Verschuren and Hartog, 2005). Evaluating the artefact or product of the design involves finding out what are the results and value of the designing process are (Verschuren and Hartog, 2005). To this end we established criteria to evaluate the actual feasibility of the processes, i.e. the artefacts we design. The deliverables here are:

- An overview of the concrete role divisions and billing process activities on the basis of the archetypes
- The related anticipated control of information and technology relevant in the process activities
- The billing processes in feasible specifications of the archetypes

1.4.1 Interviews

As the answers to our research questions require empirical knowledge other than evident from grey literature, we require a method for obtaining this data in the industry. Due to the explorative, qualitative nature and depth of this data, interviewing appears to be well suited (Hart, 2005).

We use semi-structured interviews as they allow a more open discussion of the subject under study while ensuring structure and depth. The use of this type of interviews requires a thorough managing of the interview process as the depth at which specific subjects are discussed should be kept in line with the research question. Following Rubin and Rubin our interviews "… will appear to be guided conversations rather than structured queries" (Rubin and Rubin u.q. Yin, 2003: 89). Therefore we have primarily two jobs; (1) follow the line of inquiry, and (2) ask questions in an unbiased manner (Yin, 2003).

To ensure we discuss all relevant aspects in our interviews we use a list with the topics relevant throughout the interviews of which specific topics more concretely apply to certain actors and hence are discussed more thoroughly. Furthermore to aid the topics we cover we use the 5 role division archetypes to obtain data on the different directions in role divisions relevant in our research. To ensure a good managing of the interview process we prefer face to face interviews and therefore primarily conduct our interviews at the location of the interviewee, i.e. at offices throughout the Netherlands.

1.4.1.1 Selection of the respondents

In the introduction we have already identified several roles relevant in the light of billing for content services in the mobile value network. In chapter 3 we further discuss our analysis of the current value network from which we obtained that the following roles are of primary importance in content service provisioning:

1 Content provider
2 Content aggregator
3 Portal provider
4 Mobile network operator
5 Mobile Virtual Network Operator
6 Application and Service provider
7 Billing and collections (BCP) provider
8 SMS service provider
9 Technology platform developer

When considering the developments currently visible in the industry many roles are changing and increasingly performed by different actors emerging from other industries. We discuss this in chapter 4.

For now it suffices to note that one additional role becomes relevant, namely the Internet Service provider, which was already evident from the archetypes. Combined with the nine roles mentioned earlier, ten roles can be identified. Although also financial institutions and specialized payment providers can be seen as a new role, we basically regard these roles as specialisations of the BCP role.

Due to the explorative nature of this study it is not specifically relevant to select significant numbers of specific actors in the interviews but to capture as broad a field as possible. This means that we rather interview more actors performing different roles in the network than many performing similar roles, which evidently creates more certainty on the expectation of this specific role but lacks a broader perspective. Although the number of actors we interview in each specific role is rather small, we obtain substantial amounts of information. As Hart (2005: 357) states: "Interviews are an obtrusive method which can generate substantial in-depth qualitative information usually from a small number of respondents". Given the scope and goal of our research we have selected the companies in our interviews in such a way that each role is represented at least once and the roles we regard as more critical at least twice. In the latter case we intended to make the selection of companies fulfilling roles that were represented multiple times as heterogeneous as possible to create maximum scope.

As a first step towards obtaining this goal we have created a large list of companies that we divided based on their role(s). After establishing this list we picked those companies that can be considered important players in the roles they fulfil. We also selected actors of smaller sizes such as Hyperleap to see whether this would provide additional insights. Evidently smaller companies may be more flexible in filling new or existing specific gaps the industry. Furthermore we selected only companies physically present in the Netherlands. As a third step we contacted the relevant persons within KPMG to discuss our intention to contact these actors. As a final step we contacted these companies. This went either by mail, in case we already had the required contacts from sources within KPMG, Delft University of Technology, or cross connections among interviewees, or through the telephone to inform who we should contact in the light of our research. We used two important criteria here. The first was that the interviewees should be able to assess their companies' role in the industry, the second that they also have sufficient knowledge of the billing processes that potentially reside at their company. The result of these efforts is shown in Figure 1.3 where we have denoted the companies we have conducted interviews based on their roles.

	content provider	content aggregator	portal provider	mobile network operator	MVNO	ASP	BCP	SMS/ WAP billing provider	Technology platform developer	Internet Service provider
2WayTraffic	■	■				■				
Anonymous								■		
Ericsson									■	
Hyperleap	■									
Infospace		■				■				
Netsize		■				■		■		
Orange	■	■	■	■			■	■		
Scarlet					■					
Sportsplaza	■									
T-Mobile			■	■			■	■		
Vodafone	■	■	■	■			■	■		
Wallie							■			
XS4All					■		■			■

Figure 1.3 Companies connected to roles

In a separate appendix we have placed the interview transcripts of the interviews we performed at the companies mentioned in the figure above, and the topic list and interview questions. In these transcripts the roles of these companies are shown and the representatives of the companies are mentioned including their function. Furthermore, evidently also a more elaborative description of the companies' activities and ideas on future scenarios and billing are discussed.

1.4.2 Exploration as an iterative process

In the former paragraphs we showed that we used interviews and grey literature to obtain empirical data and insights on developments in the industry. In Figure 1.2 this is represented in a flow diagram where the interviews are related to questions 2 and 3. This provides clarity on the different steps in our research but fails to show the iterations in the usage of literature and interviews in the different research steps. Our exploration consists of a scan of the environment, i.e. the mobile Internet content service industry. Starting points for this exploration were extracted from literature being the basic roles, and information and technology in use. We use the interviews to reveal additional insights and feedback on

how this industry functions and evolves. On the basis of these new insights and the feedback we further focus in our literature study and (re)assess interesting cases. The findings of this consequent literature study are used in later interviews to deepen interesting aspects. Hence, the literature study and empirical data collections are used both complementary and to refine further focus in the different phases, which can not easily be separated.

1.5 Thesis outline

In the following chapter the first research question is dealt with. This means that several theoretical fields will be discussed and a framework is created to structure the study of the domain in later chapters. Subsequently in chapter 3 we analyze the current mobile value network and the billing relations that reside in it. After defining the current situation in chapter 3 we explore directions and ideas of actors fulfilling billing critical roles in the industry and the trends in services, billing methods and technology in chapter 4. In chapter 5 we present our specification of the billing processes in the role division archetypes identified earlier which logically results in our conclusion in chapter 6. Finally in chapter 7 we reflect on our research. This structure is illustrated in Figure 1.4.

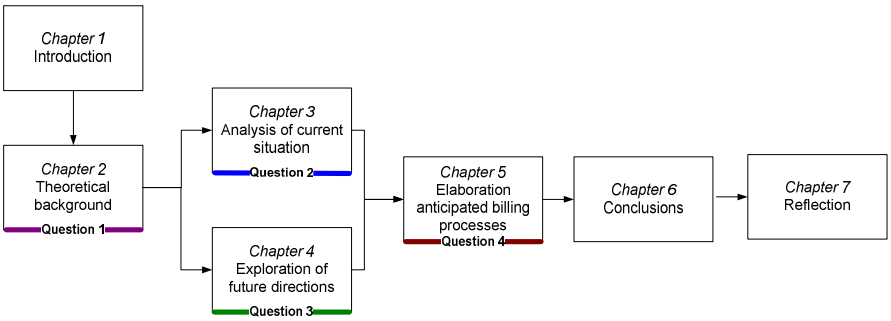


Figure 1.4 Thesis outline

2. Theoretical background

2.1 Introduction

In this chapter we answer the first research question by elaborating on the theories relevant in the analysis of the domain and subject under study, namely billing for content services in the mobile Internet industry. Within the scope of our research the analysis of this industry targets two levels, and the relations, dependencies and the (theoretical) gap between these levels. These levels are respectively the value network (organizational cooperation and interaction of roles) level and the business process (operational) level.

First we discuss organizational networks, their types and the rationales for their existence in section 2.2, after which we turn to value networks as focus of analysis in 2.2.3. Subsequently we discuss business process in terms of the concept, their design, and analysis and modelling in section 2.3. In section 2.4 we use the theory we discussed on the two levels of analysis to identify the theoretical gap and the concepts we use to deal with it. Finally in section 2.5 we present our conclusions that hold the answer to the first research question and the framework that demarcates our perspective in this study.

2.2 Inter-organizational networks

A central question in the knowledge economy is how value is created? Traditionally the question of value creation would be answered by pointing to the value chain (Porter, 1985, 1990). This requires an answer to the question what value actually is. Value is defined by Tapscott et al (2000: 29) as "the benefit that a user gains from a good or service". However, to speak of a good or service as only contributions of value is rather narrow. Given the increasing focus on the intangible nature of value, which we discuss later in this chapter, we use the definition of Allee here that broadly incorporates this aspect. Allee defines value as: "a tangible or intangible good or service, knowledge, or benefit that is desirable or useful to its recipients so that they are willing to return a fair price or exchange." (Allee, 2000a: 28).

The developments in communication and information science and the trends towards globalization have enabled new ways in which companies can operate and create economic value. New inter organizational relations are formed which has lead to the so-called "Networked Economy" and new roles and relationships among companies (Riemer et al, 2001). As Kijl et al, (2005: 18) state; "The borders of organizations are becoming more transparent and organizations, enabled by ICT, cooperate in changing constellations." Given these developments the amount of roles and relationships and their diversity is extensive making the analysis of industries and their networks complex (Osterwalder and Pigneur, 2003).

When speaking of roles it must be clear what exactly is understood by a role as it not similar to a specific actor or firm. The UMTS forum limits the definition of a role according to the following characteristics (UMTS Forum, 2002: 3):

- Roles define the functions and responsibilities that are carried out.
- A role model does not imply the business or operational scope of organizations. One organization can operate one or several roles.
- In the light of the domain under study here a "service provider" is not a role but rather an organization that has one or more roles such as billing or content provisioning.

To understand the complexity in inter-organizational networks we first describe the rationales for their proliferation. After the definition of inter-organizational networks we focus on network types and analysis of the service industries as the main fields of analysis in this research are the telecommunications and Internet industries.

2.2.1 Inter-organizational network rationales

The trend towards inter-organizational networks can be regarded the result of both general trends and more firm specific motives (Riemer et al, 2002). Some of these general trends are new ways of communication and information processing, globalization of markets, changing customer needs and fragmented markets, and the increasing information intensity, importance of knowledge (Riemer et al, 2002) and changing regulations.

In a firm specific view reasons for the formation of organizational networks are embedded in the understanding of the behaviour and differences in profitability of firms. Generally, most literature on this subject focuses on economic and strategic motivations of firms to enter networks (Garcia-Pont and Nohria, 2002). In the analysis of these motives several approaches can be identified. A major distinction can be made in the scope of analysis; it can be rather atomistic, with approaches focussing on autonomous firms aimed at creating competitive advantage, or more relational in which the (social) position and role in the network of the firm is seen as a source of competitive advantage (Gulati et al, 2000) and facilitates the search for strategic partners (Garcia-Pont and Nohria, 2002). The different approaches are related in Figure 2.1.

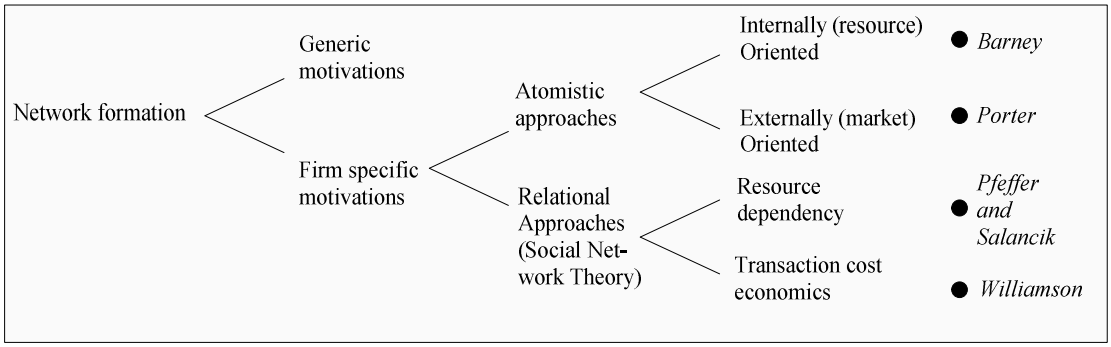


Figure 2.1 Theories explaining motivations for network formation

In the more atomistic approaches two major sources of competitive advantage can be identified: external industry sources (e.g. Porter, 1985, 1990) or a firm's internal resources (e.g. Barney, 1991).This is aligned with what Riemer et al, (2002) describe as market-based and resource-based motivations. Market-based approaches analyze the firm's market environment and the competitive position in this environment; hence they are termed "outbound". The resource-based view is more "inbound" oriented, this approach starts from the firm's resource portfolio as a source of competitive advantage and tries to augment these capabilities through a network (Riemer et al, 2002). Clearly the general trends towards networking are strongly related to the firm specific motivations. For example the increasing intensity in information exchange and importance of knowledge as a resource relate to a firm's desire to network with other firms that can provide learning and knowledge.

In the relational approaches the focus is on the strategic advantages and economic implications of having a specific role in a network. Whereas the more atomistic approaches discussed above see the firm as part of the market in which it competes and maximize the use of its resources, the relational approaches see the firm as part of its network. The social aspect is important here. Actors consider a specific location as valuable (e.g. the point of customer contact) and will join a network to obtain similar positions as their direct competitors. Thus, according to this view the fact that alliances are formed by actors in the industry influences the choices of other actors; network formation is perceived as a social process (Garcia-Pont and Nohria, 2002). The position in the network can be considered an additional source of competition since firms will experience competition from actors occupying a similar position. However, firms can mitigate this by tying to each other (Garcia-Pont and Nohria, 1999). As Gulati states; "This heightened competition between firms occupying similar network positions, not merely similar market positions, is missed in more traditional approaches." Gulati (1998: 204). This competition can be interpreted as the striving for independence of other actors' resources. This is one of the major premises Resource Dependency Theory (Ulrich and Barney, 1984).

Another approach that focuses more on the relations between firms and more specific their economic relation is the field of transaction cost economics (TCE). TCE intends to optimize the economic relationships a firm has with the firms in its environment. It states; "transaction cost theory is about minimizing the transaction costs to obtain efficient equilibrium between a type of transaction and an organizational structure and the related use of a specific institutional arrangements which coordination suits with an transaction is determined by the nature of the transaction" (Hazeu, 2000).

From the different approaches to understanding the reasons for the proliferation of networks a great deal of different motivations can be extracted on different levels of aggregation. As we remained on a rather high level in our discussions above we provide a more specific list here to illustrate the large

spread in motivations. Though it is not our intention to be exhaustive, the motivations aggregated from several sources in Table 2.1 cover most of the factors we encountered in our literature study. We explicitly left the formulations close to the original to prevent the introduction of ambiguity.

Table 2.1 Motivations for network formation

Author(s) and year	Identified motivation(s)
Osterwalder and Pigneur, 2003	• creating and co-producing value; offer bundles of products and services
Kothandaraman and Wilson, 2001	• the world is too complex to do all things, firms need partners
Gulati et al, 2000; Gulati, 1998	• access to key resources in the environment
Riemer et al, 2002: 12; Riemer et al, 2001: 825	• economies of scale and/or scope • technology and human resource exchanges • co-opting or blocking competition • overcoming government mandated trade or investment barriers • facilitating international expansion and opening new (global) markets • linking complementary contributions of the partners in a value system • achieving synergies • collaborative research and development (share costs/ risks) • order pooling, collaborative procurement • operations: reduction of vertical integration for flexibility concerns, increase scale of operations • marketing and distribution: customer service, co-branding, enlargement of regional range.
Garcia-Pont and Nohria, 1999	• "local mimetism": maintain parity with the firm's closest competitors • previous experiences
Porter, 1990 u.q. Peltoniemi, 2004	• physical proximity of world-class rivals of the same industry
Das and Teng, 1998	• combine the resources of the partners
Pateli and Giaglis, 2006	• deal with the complexity of product/ service offerings and the risks typically associated with digital markets
Shapiro and Varian, 1999	• complementing the firm's resources • ensuring compatibility or incompatibility of systems • achieving critical mass
Stabell and Fjeldstad, 1998	• capacity utilization • scale • reputation

Although many of the motivations in the table are overlapping and can be explained through similar concepts such as resource dependency theory (RDT, see section 2.2.4.4), this table further emphasizes the different theoretical fields towards network formation. A large part of the motivations that are shown here focus on resources, others focus on dealing with the complexity of the environment or economies of scale.

2.2.2 Inter-organizational networks defined

Based on a review of the concept Riemer et al (2002: 6) provide a high level definition of inter-firm networks; "an inter-firm network is defined by the relations between a defined set of independent organizations (the network structure) and their interactions in the structure (the network process)." This generic definition applies well to the research goals of this thesis as it distinguishes between the two core levels of analysis here; it defines the network structure and the network process. However, it only reveals two general aspects of inter organizational networks; it consists of a defined set of independent organizations that interact. A further definition of the concept requires to look at more specific types of inter organizational networks.

Throughout literature many are discussed (see e.g. Riemer et al, 2001, 2002; Gulati, 1998) each corresponding to specific types of analysis and industries. As shown by Riemer et al, (2002) it makes little sense to try to provide an exhaustive picture. Furthermore, due to the diversity in names and terms

used to denote network types it would introduce unwanted ambiguity. To this end Riemer et al (2001) have focussed on differentiating characteristics of inter-organizational networks, shown in Table 2.2.

Table 2.2 Inter-organizational network classification criteria (Riemer et al, 2001)

Classification criteria	Extensions	
Duration of collaboration	Strategic (long-term collaboration)	Onetime (Short-term, one project)
Value chain focus	Vertical (cooperation along the value chain)	Horizontal (cooperation on one stage of the value chain)
Rules for network entry	Open (entries welcome)	Closed (stable barriers)
Functional focus	Resource (internal) view (procurement, R&D, personnel)	Market (external) view (Distribution, customer-oriented)
Differentiation of partner roles	Focal (dominated by one partner)	Polycentric (partners have similar influence)
Stability of network group involved in value creation	Dynamic (partners involved depend on specific project)	Stable (always the same partners involved)
Industrial sector focus	Production	Services
Regional sector focus	Global	Local
Settlement nature	Contract based	Trust based

As the domain under study here concerns services in the mobile Internet industry we focus on the network types relevant here. As explained by (Kijl et al, 2005), the value configuration that best suits the analysis of industries such as telecommunications, banking, insurance and Internet based services is the value network. Therefore we further focus on this type of network in the following paragraph.

2.2.3 Value networks

Value networks are also frequently named value webs, as there appears to be little distinction between these terms. Whereas some authors specifically use either of the terms, they are frequently used to denote the same concepts and are used interchangeably (e.g. Bouwman and MacInnes, 2006; Li and Whalley, 2002; Riemer et al, 2002). Therefore we use both terms to denote the same concept which we further discuss in this paragraph. However, it is difficult to asses what exactly a value network is, due to the fact that its meaning can differ throughout disciplines (Haglind and Helander, 1998) and, as stated earlier, can range over several levels of aggregation.

Stabell and Fjeldstad (1998: 427) define value networks as “firms that can be modelled as value networks rely on a mediating technology to link clients or customers who are or wish to be interdependent”. Although this view can be abstracted to use the mediating technology of the value network as interconnecting element, we require more focus on roles. This is visible in the discussion of Kijl et al (2005) who more strongly emphasize the aspects of value creation and network roles. They emphasize the fact that value networks concern value creation by a group of companies, which can be various economic players, without considering all individual choices in terms of make or buy decisions. Each actor in a value network can have one or more roles in the creation of value (Kijl et al, 2005). However, solely regarding value networks as a cooperation of organisations pursuing a common goal is rather broad and can include many related concepts. This is in line with Allee (2000) who state that virtually any organization can be regarded a value network. Peppard and Rylander (2006: 7) include a context in which value networks operate in their definition, they define value networks as “a set of relatively autonomous units that can be managed independently, but operate together in a framework of common principles and service level agreements (SLAs).” Below we further try to differentiate a value network from related concepts.

In contrast to the traditional value chain many more issues should be considered in a value network as it encompasses much more than the flow of products, services, and revenue. In a value network knowledge, information, and other intangibles can be considered value in their own right (Allee, 2000a). Expanding this perspective on intangibles further, Allee (2000b) notes that value (domains) should include business relationships, human competence, internal structures, social citizenship, environmental health and corporate identity. An interesting aspect of value is the fact that over time it can increase or decrease. Think of the value of news for example that decreases over time. Positive network externalities also contribute to value perception. Network externalities are defined by Katz and Shapiro (1985: 424) as “the utility that a given user derives from the good depends upon the number of other users who are in the same "network" as is he or she”. Therefore consumers will base their purchase decisions on the expected size of the network (Katz and Shapiro, 1985). Hence, in a value network with positive network externalities the first customer has relatively low value when compared

to a customer that joins later. This also holds for actors that join the network; once a larger user base is established by other partners, it is more interesting to join the network.

Another distinctive element of value networks is the fact that although the actors involved in the value network can also have their own goals and motivations, the network partners also pursue a common goal. This differentiates the value network from a business ecosystem (Peltoniemi, 2004) where the actors involved in a cooperative network share value without pursuing a common goal. This differentiating characteristic of a value network also entails the fact that a value network can be regarded service or product specific (Montalvo et al, 2004). A value chain can also be considered product specific as in a chain value is sequentially added to inputs by all partners until the final product stage is reached (Kijl et al, 2005). This aspect of sequential mostly pre-set contributions to the final product is what differentiates a value chain from a value network where the interactions are parallel and reciprocal. This reciprocal interdependency is interpreted differently throughout literature.

Whereas some authors denote one central actor in the network, others do not explicitly use this relation. For example Peltoniemi notes that "in a value network it is common that one actor is quite a lot larger than the other [and] small suppliers […] can be completely dependent on the dominant actor and must submit to its terms." (Peltoniemi, 2004: 6). Riemer et al, (2001) denote a central actor in the value web named "value broker" that both initiates and dominates the value web and enjoys more rights than other actors involved. This role is defined "context provider" by Tapscott et al. (2000). This dominant or central actor does not necessarily have to be the largest actor and it can take many forms. Haglind and Helander (1998) place the customer in charge of the value network around whom the companies organize their activities. Weiner et al (1997 u.q. Haglind and Helander, 1998) speak of "the leader in the value network" as a "virtual organization". Stabell and Fjeldstad, (1998) regard the actor that provides the mediation technology that is used to connect consumers as the central actor that admits members to the network that complement each other and in some cases excludes those that don't.

2.2.4 Value network analysis

The analysis of value is rooted in the work of Porter (e.g. Porter, 1985, 1990) on value chains. This concept can be seen as the basis of the value network concept (Kijl et al, 2005). Due to its importance in the evolvement of others concepts like the value network we elaborate on it shortly.

2.2.4.1 Porter's value chain

Porter has termed the value chain as the set of linked activities performed by an organization that impacts its competitiveness. It consists of five primary activities and four support activities. These are shown in Figure 2.2. Whereas the primary activities directly relate to the creation or delivery of a product or service, the support activities span the entire organization and facilitate the primary activities (Porter, 1985, 1990).

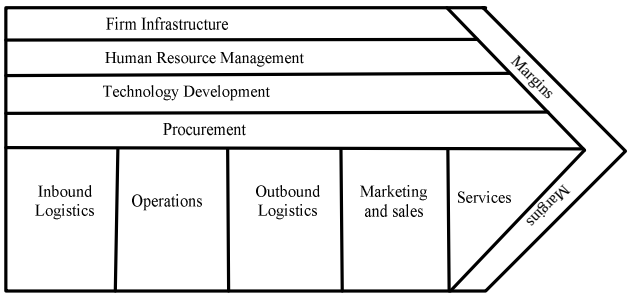


Figure 2.2 Porter's value chain (Porter, 1990: 41)

This distinction in activities enables the structured analysis of a firm. However, when considering multiple firms cooperating to produce a product or service the applicability of the concept is rather narrow. The value chain concept assumes a sequential flow of goods to which each actor adds value until a final product stage is reached. This process is depicted in Figure 2.3.

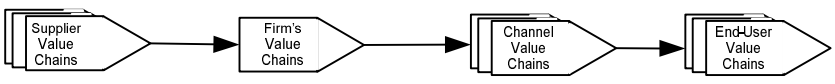


Figure 2.3 Porter's value system (Porter 1990: 43)

The value chain assumes a sequential flow of goods that is not present in value networks (Stabell and Fjeldstad, 1998). When using the value chain concept in the service industries it should be limited to discussing the internal analysis of firms through its structuring capabilities. An example of such an analysis can be found in Coursaris et al (2006). However, this approach should also be adopted with care as the activities defined in Porter's value chain are directly related with the sequential interconnection with other firms and their logistics. When considering assets of less tangible nature such as telecommunication services, the value chain is unsuited. More firmly stated by Kijl et al; "we can say that the primary activity typology of the value chain appears well suited to describing and understanding a traditional manufacturing company. At the other hand we see that the typology and underlying value creation logic is less suitable to the analysis of activities in service industries like telecommunications and IT." (Kijl et al, 2005: 18).

2.2.4.2 A resource perspective

The creation of value in firms but increasingly also in networks is frequently studied by focussing on resources (Montalvo et al, 2004). Viewing a firm as a bundle of resources started in 1959 in the theory of the growth of the firm by Penrose who noted; "[A] firm is more than an administrative unit; it is also a collection of productive resources the disposal of which between different uses and over time is determined by administrative decision" (Penrose 1959: 24, u.q. Hoskisson et al 1999: 438).

The relevancy of a resource perspective on value network analysis is evident from the fact that value networks inherently rely on the complementing of resources of the firms involved in it (see also Table 2.1). Stated otherwise by Montalvo et al; "The common premise is that it is precisely the complementarity of resources that necessitates the formation and evolution of both, strategic alliances and value networks, and that none of the actors can make all the necessary components available for product development or service provision" (Montalvo et al, 2004: 628). Resources are a common concept under study in a large variety of literature such as Human Resource Management, economics and finance, entrepreneurship, marketing, international business, and corporate governance (Barney et al, 2001). The two major theories using resources as asset of analysis are the Resource Based View (RBV) of the firm and Resource Dependence Theory (RDT). We discuss both after defining what can be understood by a resource.

A resource can be defined very broadly to include almost anything in an organisational or inter-organisational setting (Montalvo et al, 2004). This is clearly visible in some of the most widely used definitions of a resource. For example Daft states "Firm resources include all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. controlled by a firm that enable the firm to conceive of and implement strategies that improve its efficiency and effectiveness" (Daft, 1983 u.q. Barney, 1991: 101). Wernerfelt is only moderately more specific when stating "By a resource is meant anything which could be thought of as a strength or weakness of a given firm… […] …a firm's resources at a given time could be defined as those (tangible and intangible) assets which are tied semi-permanently to the firm" (Wernerfelt, 1984: 172). Especially interesting in this latter definition is the distinction between tangible and intangible resources which becomes more relevant, with the increasing focus on knowledge and other assets of intangible nature as sources of value (Allee, 2000a, 2000b). This distinction is equal to what Das and Teng (2000) based on earlier work by Miller and Shamsie (1996), define as property-based and knowledge-based resources (Montalvo et al, 2004). In line with the classification of value between of tangible and intangible nature in earlier sections in this chapter we use these terms instead of property and knowledge based. Especially since intangible assets encompass more than just knowledge Allee (2000a, 200b). Additional to the resources identified by Das and Teng (2000), Montalvo et al (2004) add skills as a firm's resources. This results in the classification of resources shown in Table 2.3.

Table 2.3 Resource types based on Das and Teng (2000) and Montalvo et al (2004)

Tangible resources	Intangible resources
Human resources	Organizational resources (e.g. culture)
Patents, contracts, copyrights, trademarks, and registered designs	Technological and managerial resources
Physical resources	Skills

There are several levels of aggregation on which a resource can be described; it can be regarded as any high level asset of a firm or a more concrete aspect of its knowledge or skills. Andreu and Ciborra (1996) complicate this matter further by defining (core) capabilities also called distinctive capabilities. These can be regarded as a combination or specific use of resources aided by organizational routines (Amit and Schoemaker, 1993). More specifically; the routines are defined as "a particular way of doing what an organization has developed and learned, and in the utilization of which that organization is very efficient and effective, to the point of becoming almost automatic, a 'natural' reflecting of its 'way of being'." (Andreu and Ciborra, 1996: 112).

2.2.4.3 The Resource Based View of the firm

On a high level the Resource Based View (RBV) deals with the central questions of why firms are heterogeneous and how they achieve and sustain competitive advantage (Hoskisson et al, 1999). These two questions return in the two major assumptions made in the resource based view theory. The first is that heterogeneity between the firms in an industry can exist concerning the resources they control. The second is that the RBV assumes that these resources are not mobile, imitable or substitutable (Barney, 1991). The latter already provides the answer to the first question as the immobility, inimitability and non-substitutability contribute to the continuation of the heterogeneity between firms (Barney, 1991). Immobility refers to "the difficulty, as well as the nontrivial costs, of moving certain resources from one firm to another" (Das and Teng, 2000: 40). Inimitability and non-substitutability denote the barriers that withhold an actor to obtain similar resources elsewhere (Das and Teng, 2000).

Concerning the competitive advantage through resources the major premise of the Resource Based View of the firm is that competitive advantage of a firm is derived from the resources and capabilities the firm controls that are valuable, rare, imperfectly imitable, and not substitutable (Barney, 1991; Barney et al, 2001). These relations are summarized in Figure 2.4 that provides Barney's framework for the analysis of a firm's resources as sources of sustained competitive advantage.

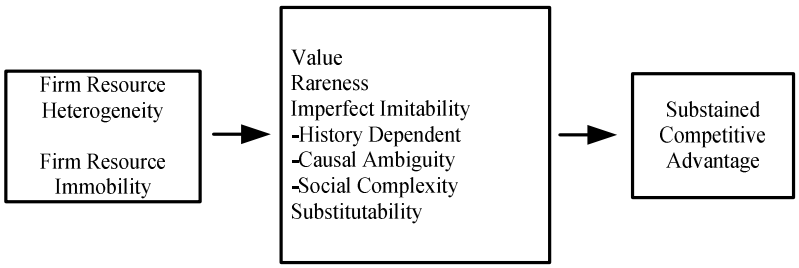


Figure 2.4 Resources as sources of sustained competitive advantage (Barney, 1991: 112)

Stated differently; competitive advantage comes from resources that are unique and provide value in the market (Medcof, 2001). The importance of a resource and hence a partner in the value network directly relates to the interdependencies and power relations in the network. This is the major subject of the Resource Dependency Theory.

2.2.4.4 Resource Dependency Theory

Resource Dependency Theory (RDT) yields that the power an organization has in the value network depends upon the resource dependency relationship is has with other organizations (Inkpen and Beamish, 1997; Harpaz and Meshoulam, 1997; Cool and Henderson, 1998). Clearly this relation works in two ways; if firms can easily obtain the resource elsewhere, the dependence and thus power will be low. If a focal organization depends on an important resource of another organization there is a dependency relation and the other organization will have power over the focal organization (Medcof, 2001). This is due to the fact that in a cooperative relationship, to a certain degree, each firm can withhold or increase the resources in question that are important to the partner firms (Inkpen and Beamish, 1997).

Based on this notion of fit between resources of organizations networks are formed. A firm will try to form alliances with other firms to ensure a consistent supply of critical resources and in doing so create interdependence between the partners and gain access to the other firm's network. This process allows the creation of a value network that is critical to its survival as it allows to deal with the uncertainty of the competitive environment, provide flexibility and reduce the need for (risk full) investments (Sakaguchi et al, 2004).

RDT has three major theoretical assumptions (Sakauchi et al, 2004: 3):
1) Companies consist of either internal and external networks or coalitions.
2) The environment plays a critical role, as it contains vital resources that are necessary for the survival of the company.
3) All companies attempt to attain two objectives:
   - To minimize the demand of essential resources by acquiring control of these resources, thus limiting external dependency and minimizing control of outsiders.
   - To maximize the resource dependency of other organizations to the company.

Resource Dependency theory can be generalized as follows: "resource dependence theorists characterize the links among organizations as a set of power relations based on exchanges of resources. Organizations attempt to alter their dependence relationships by minimizing their own dependence or by increasing the dependence of other organizations on themselves." (Ulrich and Barney, 1984: 472). The theory not only applies to the formation and termination of relationships, it also has a more dynamic character as over time the dependencies can change. This change is evident in value networks (Kijl et al, 2005). The networks formed through resource dependencies have no fixed boundaries but contract and expand over time (Sakaguchi et al, 2004). This constant state of flux influences the bargaining power of specific partners in the network (Inkpen and Beamish, 1997).

RDT has a clear relation with the RBV of the firm. They can be theoretically connected due to the resemblance of some of the fundamental concepts (Medcof, 2001). The concept of a unique and valuable resource that provides strategic advantage in the RBV resembles the meaning of this resource in RDT where the value and uniqueness of the resource is inherently linked to the firm's dependence on it (Medcof, 2001). RDT theory provides insight into the market power that specific organizations have over others and can aid in the understanding of the formation of relations, as was already identified in Table 2.1. This is especially relevant in our study as we do not look at resources from the perspective of a single firm but rather at the relations between firms, based on resources. RDT provides our rationale for looking at resources in a more dynamic way. Dependencies among actors on the basis of resources can change over time as resources become less important or alternatives become available.

2.2.5 Modelling a value network

An important aspect of understanding a value network is its conceptualisation and modelling. Not only in terms of the definition of the concept but especially the focus on the relevant aspects and their relations. As Mylopoulos states; "Conceptual modelling defines aspects of the physical and social world in order to make them more understandable and to improve communication about them" (Mylopoulos, 1992 u.q. Gordijn and Tan, 2001: 31). However conceptually modelling a value network is a challenging task as the complexity within it is hard to confine in a single model. This is emphasized by Allee who states; "When we model a Value Network we produce a view of the world that looks much more like spaghetti and meatballs than an engineering schematic, value chain or flowchart" (Allee, 1999: 130).

Therefore, when modelling a value network it is important to remain on a high level of aggregation. Working from this level on to a visualization of the relations between the firms and their resources provides a clear overview of the value network level. Without explicitly applying a formal method, connecting the relevant actors in a visual map, possibly using UML building blocks, provides a great deal of transparency of a value network. This approach is frequently applied throughout literature to denote value networks in the communication industries (e.g. Kuo and Yu, 2006; Peppard and Rylander, 2006; Bauer et al, 2004). As the amount of actors involved in the value network can be very high, segmenting actors according to role is frequently applied (e.g. Tilson and Lyytinen, 2006; Grover and Saeed, 2003). Additionally, the actors involved can be grouped according to the layer or segment of the industry in which they predominantly play a role. Especially in the services industries and more specifically the mobile Internet domain under study here this can provide more transparency (see for example Fransman, 2001, 2002; Sicker, 2002; Soininen, 2005).

A more formal approach in the analysis of value networks is the e^3-value approach (Gordijn, 2002; Gordijn and Tan, 2001). One of the major advantages of this approach over UML techniques in the modelling of value networks is the ability to model dependencies in addition to sequences and economic value and value interfaces. This approach has primarily two goals. First it targets modelling

the creation, distribution, and consumption of goods or services in a value network to create a shared understanding. Second, it provides a quantitative means of evaluating the value propositions of the value network partners (Gordijn and Tan, 2001). A value proposition is defined as "something offered by an actor for consideration or acceptance by another party" (Gordijn and Akkermans, 2003: 114).

However, although e^3-value provides insights into value exchanges and contributions, it does not deal with how the value is exchanged between these firms. This is delineated from e^3-value to focus on the viability of the cooperation between the network partners which is the primary goal of the method. The basic goal of the e^3-value approach is therefore only to a certain extent aligned with our research goal as only focuses on value contributions and not the actual exchange of information on an infrastructure. Therefore we will only use the first part; the view on actors, roles and contributions of value. Our research, additional to value contributions also targets the manner in which this value is produced and the relation between the value network level and the operational level to relate the billing processes to the mobile Internet value network roles. Hence it requires looking at the operational processes between the actors involved and the exchanges of information and use of technology in the value network. As Davenport (1993: 7) states: "processes are the structure by which an organization does what is necessary to produce value for its customers". In the following section we discuss business processes.

2.3 Business processes

Business processes entail the question of "how" value is created in the network. More formally Davenport refers to a business process as "a structured set of activities designed to produce a specific output for a particular customer or market" (Davenport, 1993: 5). Tsalgatidou and Junginger (1995: 17) define a business process as "a set of logically interrelated activities within an organization the execution of which contributes in the achievement of the business objectives". The ITU (2004: 4) defines a process as: "A process describes a systematic, sequenced set of functional activities that deliver a specified result". Bititci and Muir identify the commonalities throughout several definitions and define a business process as "a collection of various tasks which produce an output" (Bititci and Muir, 1997: 366).

There are primarily four aspects visible here; (1) a business process consists of several structured activities, (2) the activities provide output for a specific market or customer, (3) the activities are sequential, and (4) the activities relate to the achievement of a specific goal of the firm participating in the process. This is aligned with the characteristics of a business process that Kavakli and Loucopoulos (1998) identify. They state that a process has well defined products and customers, has clear goals and involves several activities. Furthermore they state that a business process crosses functional and organizational boundaries. The latter is important here as we specifically focus on the way that business processes connect the actors in the value network. Especially since business processes are increasingly inter-organizational (Bouwman et al, 2005: Ch. 6), the analysis of a business process as being part of a specific organization is insufficient. An often used distinction in business processes relevant in that respect is between front-office processes and back-office processes. Processes that require customer contact and are visible to customers are termed front-office. Processes that are carried out remotely from customers, and hence are not visible to these customers, are termed back-office processes (Zomerdijk and de Vries, 2007).

Business Processes can both be defined bottom-up and top-down. In a bottom-up approach the processes are studied on a great level of detail and subsequently aggregated towards more generic concepts whereas a top-down approach starts from generic processes and analyzes processes within scope based on these. Although bottom-up approaches are used, the majority of authors prefer a top-down approach (Bititci and Muir, 1997). This leads to the discussion whether generic business processes can be defined. For example Porter's value chain is frequently used as a set of generic business processes (Partridge and Perren, 1993 u.q. Bititci and Muir, 1997). Generic business processes are also evident in specific industries such as telecommunications where the Telemanagement forum has created a blueprint called enhanced Telecom Operations Map (eTOM) for the relevant processes at a service provider (Kelly, 2003). However, this map only works until a certain level of aggregation. The general consent to the question whether business processes can be defined is that it is possible, but only until a certain level of aggregation, at more elaborate levels of granularity; business processes become too specific to model generically (Bititci and Muir, 1997).

2.3.1 Business process theories

Business processes are studied through a large variety of theoretical perspectives and the terms in use for this purpose are broad and overlapping. Many approaches use similar techniques under several names. Some of the main terms in use are Business Process Reengineering or Redesign (BPR), Business Process Analysis (BPA), Business Process Management, and Business Process Modelling (BPM). We further show the relation of the several theoretical concepts on business processes in Appendix 2.

2.3.1.1 Business Process Reengineering

The field most widely developed in analyzing, changing and improving processes is Business Process Reengineering. The term Business Process Reengineering was first mentioned by Hammer in 1990 in his seminal paper "Re-engineering work: don't automate, obliterate" (Hammer, 1990) and has since gained great momentum. The main goal of BPR is to improve the efficiency of the processes and the resulting quality of the service or product. BPR targets this optimization through the incorporation of possibilities of information technology in business process analysis (Castano et al, 1999). Many terms are in use in BPR literature to denote similar concepts and meanings. For example business process redesign, (business) process innovation and business process change (Sarkar et al, 2006). Basically all refer to the application of BPA in combination with IT to identify improvements in the processes. The broad interpretation of the concept reengineering is however not supported by all authors. For example (Attaran, 2004) states that not every process change can be considered reengineering as it should include a design of new processes and be linked to a clear strategy on why these processes should be redesigned. In any company, the management should have a clear view of the targeted processes as the starting point for intervention, a so-called "process model" (Paper and Chang, 2005). Analysis of processes and identifying improvements is thus, according to this strict view not reengineering.

2.3.1.2 Business Process Analysis

From the above it becomes clear that business process analysis and related concepts are part of BPR techniques. Nevertheless, it can also be approached from a more general perspective that not necessarily incorporates the application of IT. Basically BPA investigates business processes and their properties to discover potential guidelines for improvements. The term and tools are rather broadly applied and can contain for example animation, simulation and diagnosis, verification and performance analysis and planning (Weske et al, 2004; Castano et al, 1999). A central question here is what the properties of business processes are. In the analysis of business processes, only looking at the process is too narrow since other aspects are also relevant in their analysis. As Grant (2004) explains, the BPR view by Hammer misdirects developers to look only at processes, while factors such as the organizational structure, people, communication and technology are equally important.

As we intend to connect the process level in a later stage to the value network level, such a more holistic approach towards business processes is better suited. One of the major more holistic approaches is provided by Alter (1999) in his Work Centred Analysis (WCA), which is based on several theoretical fields such as total quality management, business process reengineering and general systems theory. In this framework, shown in Figure 2.5, the structure of the process and the other relevant aspects, namely the participants, the information and the technology, are dealt with separately in their relation to the process.

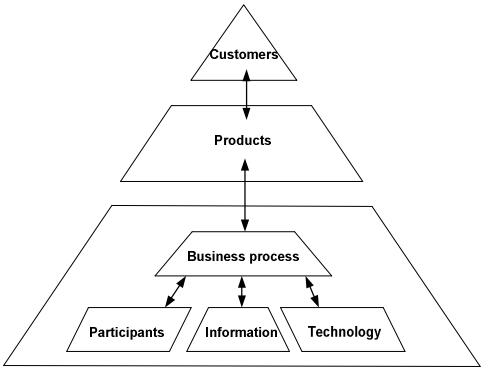


Figure 2.5 the WCA framework of Alter (Alter, 1999)

The strength of this framework is the overview it provides as a structured means to look at business processes as part of an enterprise. Not only the actual process activities are relevant in the provision of the result to the customer but also the technology, information and participants that create this value. For a more elaborate discussion of this framework and our interpretation of the aspects in this framework we refer to Appendix 1.

2.3.2 Enterprise architectures

Business processes as part of the overall enterprise is also the domain of enterprise architectures. Although not specifically part of business process theory we discuss it here to further place business process into a broader context. Enterprise architectures basically comprise of a wider perspective on business processes to support an enterprise's overall goals. The information and technology aspects are visible in the definition of Ross who defines the IT architecture at the enterprise level as "the organizing logic for applications, data and infrastructure technologies, as captured in a set of policies and technical choices, intended to enable the firm's business strategy." (Ross, 2003: 2). The stakeholders or actors are not mentioned here. However, as (Jonkers et al, 2004: 257) note, "A coherent description of enterprise architecture provides insight, enables communication among stakeholders and guides complicated change processes".

The different aspects of enterprise architectures can be analyzed in layers as this enables the differentiation among relevant concepts and reduce complexity. Furthermore, it enables to focus on one or more specific layers that can be merged or split while using different (possibly stakeholder) views and objectives (Jansen, 2006). This flexibility also has its disadvantages as the separate analysis at each layer can compromise consistency and integrated enterprise modelling. As (Jonkers et al, 2004: 257) state "Unfortunately so far no enterprise architecture description language exists that fully enables integrated enterprise modelling, because for each architectural domain, architects use their own modelling techniques and concepts, tool support, visualization techniques etc.". The several layers of enterprise architectures are shown in Figure 2.6. Depending on the scope of analysis or design, these layers can be structured differently and as already mentioned, merged or separated. We shortly discuss the layers separately.

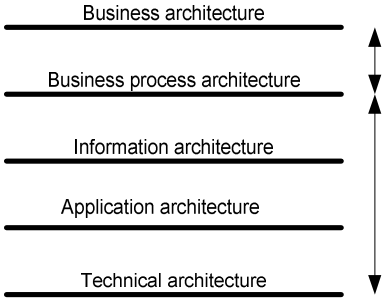


Figure 2.6 Enterprise architecture layers (based on Jansen, 2006)

Business architecture: The business architecture can broadly be regarded as the way in which the responsibilities regarding the most important functions and business processes are organized in the enterprise (Versteeg and Bouwman, 2004). Essentially the business architecture describes the structure of the underlying layers in Figure 2.6 and shows the responsibilities in the several domains using these layers. A business architecture is not normative but descriptive. As Versteeg and Bouwman (2004: 4) state: "In our view a business architecture is not a normative framework but a tool that can be used to acquire insight into the underlying complexity and relationships between the various business domains". Furthermore, a business architecture is not explicitly limited to one organization as it can also incorporate for example a value chain (Versteeg and Bouwman, 2004). Versteeg and Bouwman take this even a step further by stating that the business architecture concept could even be applied in virtual enterprises and inter-organizational networks. These aspects make the business architecture applicable in our research. However, a business architecture incorporates the entire operationalization of a firm's strategy and maps the relations among the different functional departments.

Business process architecture: The business process architecture describes the business processes that reside in the enterprise. These were already sufficiently discussed throughout this chapter. In the next section we will further discuss modelling methods targeted at this level.

Information architecture: The information architecture deals with the organization of information exchanges between actors. Formally it is defined as "a high-level map of the information requirements of an organization" (Brancheau and Wetherbe, 1986 u.q. Wang, 1997: 303).
Application architecture: The application architecture concerns the software applications, components and objects and their relations (Jansen, 2006).
Technical architecture: The technical architecture is essentially the infrastructure, the hardware on which applications and operating systems run, and information is communicated.

Considering our research goal and questions not all these layers are equally relevant. As we further discuss in later sections we primarily focus on the process architecture, supported by the information and technological architectures. Each layer has its own specific perspectives, analysis, and visualisation and modelling methods. To further drill down the analysis of business processes we specifically target the modelling at this layer in the next section.

2.3.2.1 Business Process Modelling

The analysis of business processes and thus also the reengineering requires a structured overview. Therefore, any project or business process analysis and reengineering, starts by creating a representation of the process itself (Castano et al, 1999). This need has given rise to broad field of techniques and methodologies captured in the term business process modelling. BPM can be considered the technique of representing the business process (system) and its behaviour in a model using a process language (Weske et al, 2004; Kavakli and Loucopoulos, 1998). The goal of modelling the process is to capture it in a clear and formal way, at differentiating levels of abstraction (Castano et al, 1999) which is core to further analysis. According to Kavakli and Loucopoulos (1998) these techniques fall into three categories; (1) product oriented focus on the evolution of the products in the processes (2) agent or role oriented denote and analyse the role of agents that contribute to the process, and (3) activity oriented denote the process as a set of ordered activities.

BPM should not be confused with frameworks used in BPR and BPA. As Reijers and Mansar (2005: 284) state; "*A framework is not a model of a business process. It is rather an explicit set of ideas that helps in thinking about the business process in the context of reengineering*". BPM is thus a means of understanding concrete process steps that is an important input to BPA and BPR that regard the broader perspective and build on the analysis in BPM.

In an extensive literature study Aguilar-Savén (2004) identifies, compares, analyzes and illustrates the available techniques for BPM. She identifies primarily 18 techniques, and among others their attributes, characteristics and strengths and weaknesses and the modeller's perspective. Although the different techniques in her analysis could also be structured according to the categories identified by Kavakli and Loucopoulos (1998) mentioned above she uses another distinction. To aid in the selection of techniques she distinguishes two dimensions; the purpose of the business process model and the so-called change model permissiveness. Based on these two dimensions Aguilar-Savén comes up with the classification framework shown in Figure 2.7. The modelling methods in this framework apply to a certain extent also to other layers than the business process level in the discussion of the enterprise architectures in the former section. Depending on their focus, the business process layer is connected to other layers such as the application, information and technology architectures.

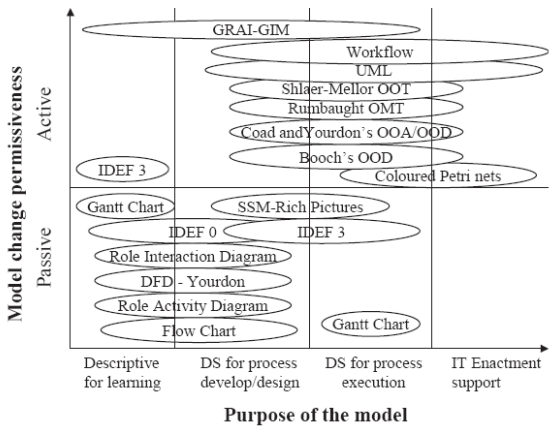


Figure 2.7 BPM techniques classification framework (Aguilar-Savén, 2004: 146)

The purposes of the models in this figure can be one of the following four: (1) descriptive models for learning, (2) descriptive and analytical models for decision support to process development and design, (3) enactable or analytical models for decision support during process execution, and control, and (4) enactment support models to IT (Aguilar-Savén, 2004: 146). Permissiveness refers to the distinction between passive (the user can not change the process without remodelling) and active (the user can actively change processes) models. Essentially this refers to the ability of the user of the model to change parameters or parts of the model to influence the results. Hence the more active models will have a more simulative, optimizing character than the passive models that deal with scenarios and can be more normative in character.

This framework provides a good means to determine the modelling methods suited in our analysis. The methods in this framework differ in their application only few of them deal with inter-organizational processes on a descriptive and analytical level which we require in this research, given the research goal. Based on the analysis of Aguilar-Savén (2004) a method can be selected that suits our research goal. The model will be primarily used for understanding the process and creating a basis for potential design and decision support and does not require an active component. The latter is due to the fact that the user (analyst) does not require the ability to change the model or simulate specific scenarios. These two aspects create a quadrant in the framework of Aguilar-Savén that holds five modelling methodologies: IDEF0, Role Interaction Diagram, DFD – Yourdan, Role Activity Diagram, and Flow Chart. Furthermore, as the application of the modelling technique in this chapter requires a high level of analysis to meet aspects relevant in the value network and must enable the modelling of multiple actors and their contribution to the processes the selection is further decreased as three methods do not apply.

The Data Flow Diagram method does not apply to our research goal as it focuses on what a process will do and not how it will be done (Aguilar-Savén, 2004). The Role Activity Diagram does not allow for the modelling of business process objects such as machines or products (Aguilar-Savén, 2004) and hence does not support an analysis or identification of the use of information and technology resources in business processes. Furthermore, a high level use of the method is not possible as it does not allow for decomposition. These aspects make the method not applicable in the study here. Equally the Flow Chart method does not support a high-level overview. Its main strength is the modelling of processes requiring a high level of detail (Aguilar-Savén, 2004). Therefore it does not apply to our research goal.

This leaves the IDEF0-diagram and the Role interaction diagram as most applicable modelling methods. Examples of both methods are shown in Figure 2.8. The IDEF0 (Integration DEFinition language 0) method is particularly suited for both a high level overview and showing detail as it allows decomposition. The decomposition of processes is essentially the creation of what Pijpers and Gordijn (2007) define as low-level process modelling. Hence a modelling methodology that allows decomposition allows switching among high-level and low-level process models which provides flexibility. This flexibility is required here as the level at which the analysis of business processes must be performed is difficult to specify ex-ante. In the light of analyzing business processes in a value network, the level until which the decomposition of these processes should continue is related to the extent to which underlying information and technology is shared among actors (Versteeg and Bouwman, 2004).

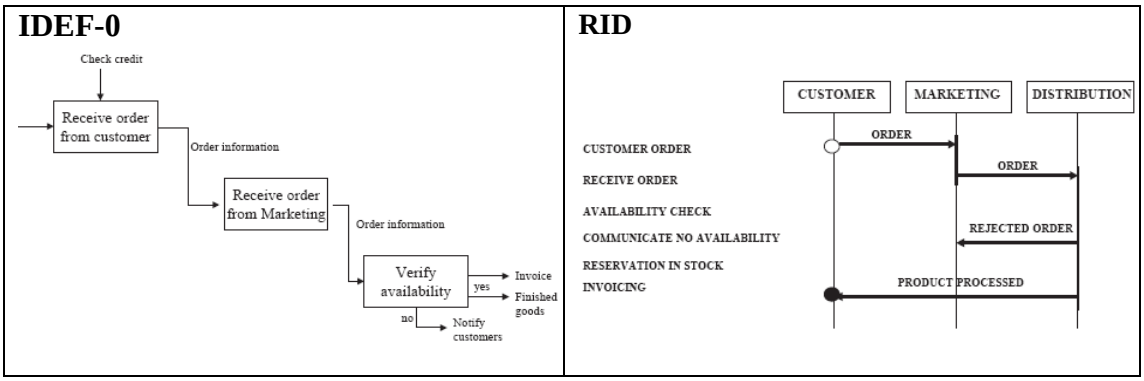


Figure 2.8 Examples of IDEF-0 and RID

Additional to the input, control and output related to activities IDEF-0 incorporates the modelling of mechanisms which can best be regarded as resources such as technology and information. Hence IDEF-0 supports modelling information (control), activities (process), and mechanisms (information and technology resources). For an extensive discussion of the IDEF-0 method we refer to National Institute of Standards and Technology (1993). The main strength of the Role Interaction Diagram (RID) is the focus on coordination of interrelated activities among multiple roles. Although it does not explicitly allow the modelling of resources, its ability to model the activities easily among multiple actors provides its use for the purpose at hand here. The RID is purely aimed at relating process activities to actors.

With the identification of two modelling methods that are aligned with the broader view and descriptive analysis on business processes from the WCA framework and enterprise architecture theory we will further focus on the inter-organizational perspective. Whereas both the WCA framework and enterprise architectures structure the thinking about business processes and their related architectures, they are predominantly oriented on a single enterprise. In the following section we discuss the relations between the value network level and the business process level.

2.3.3 Business process evaluation criteria

In the introduction we discussed that one of the deliverables of this research is an elaboration on and illustration of the expected billing processes in the mobile Internet value network. On a value network role level we identified the control of information and technology resources as the most important aspects. To evaluate the business process designs we require criteria, the identification of which from business process literature is the subject of this paragraph. From the analysis in earlier paragraphs we identified three aspects that should be the focus of our criteria, namely (1) the actual business process activities, (2) the use of technology in these activities, and (3) the use of information in these activities. The criteria are related to these three aspects.

2.3.3.1 Business process criteria

The different business process activities each represent a part of the overall process. From literature it can be identified that critical success factors in this respect point to ease of use and simplicity. Activities should be integrated and re-sequenced where possible, and redundant steps should be removed (Reijers and Mansar, 2005). This relates to what is defined as the service criterion by Tan et al (2007); processes should be designed customer centered. The amount of activities required at the user and the complexity of these activities should be minimal. Hence in this respect the primary criterion we use to assess the sequences of business process activities is *usability*.

2.3.3.2 Technology criteria

Concerning technology basically two criteria can be identified with respect to the support of business processes across firms. The first criterion that can be identified is *interoperability* which is defined by the IEEE as “the ability of two or more systems or components to exchange information and to use the information that has been exchanged” (Rukanova et al, 2006:13). For inter-firm business processes to function the technology that is used should be interoperable. In this respect literature points to two crucial related aspects: (1) the use of standards (Lam ,2005; Reijers and Mansar, 2005), and (2) the use of reusable (modular) components (Ross, 2003; Yang and Papazoglou, 2000).

The second technology criterion on technology in business processes emphasized in literature is the proper *usage of legacy* (Lam ,2005; Yang and Papazoglou, 2000; Paper and Chang, 2005). Organizations frequently incurred large costs in the deployment of their current legacy which can still be valuable resources. Furthermore, the replacement of legacy systems when deploying changes in business processes is not always desirable. The legacy may be entrenched in the organization’s operations (Lam, 2005; Robertson, 1997). However, when legacy provides too much physical constraints, this could be elevated by applying new technology (Reijers and Mansar, 2005).

2.3.3.3 Information criteria

Literature on information criteria in business processes predominantly points to the *quality of information*. This is a rather ambiguous terms and is therefore frequently broken down into multiple types. Lee et al (2002) define four types of information quality: (1) intrinsic, (2) contextual, (3) representational, and (4) accessibility. They aggregate seven views from literature on the quality of

information under these headings. From this aggregation the primary aspects of information quality become visible. Intrinsic quality refers primarily to the accuracy, consistency, and believability. Believability also returns in the discussion of critical success factors of Reijers and Mansar (2005) that emphasize the use of information from trusted sources (actors). Contextual quality refers to the relevance, completeness, quantity and timeliness. Representational quality refers to the interpretability of the presentation. Accessibility refers to the availability, locatability and convenience of access (Lee et al, 2002).

Chae et al (2002) specifically focus on the quality of information in the mobile Internet. They define four aspects that are relevant here. Connection quality refers to the stability and responsiveness of the connection. Content quality refers to the objectivity, believability and amount of information. Interaction quality refers to the easy and efficiency of the interaction. The use of the term contextual quality is similar to the use of Lee et al (2002) of this term. Connection quality closely relates to the interoperability at the technology level. Content quality is rather similar to what Lee et al (2002) define as intrinsic quality. Interaction quality closely relates to what is termed accessibility by Lee et al (2002) but also strongly emphasizes the usability criterion at the business process activity level.

2.3.3.4 Integration

The criteria discussed above are condensed, and overlap and redundancy are removed to provide a usable overview to assess inter-organizational business processes. In the three domains this provides in total four criteria. Each criterion is further specified to provide focus. The criteria are directly translated form the literature discussed above. The specifications are also adopted from literature but more are condensed. Especially in the domain of information several specifications of the different authors are aggregated to provide a balanced set of criteria. This set is shown in Table 2.4.

Table 2.4 Criteria to evaluate inter-organizational business processes

Domain	Criterion	Specification
Business process activities	Usability	Amount of activities Complexity of activities
Technology	Interoperability	Standardisation Modularisation Complexity of interconnections
	Leverage of legacy	Use of legacy Required replacements or adoption of new technology
Information	Quality	Intrinsic or content quality (i.e. believability, accuracy, consistency) Contextual quality (i.e. completeness, quantity, timeliness) Representational, accessibility or interaction quality (i.e. locatability, interpretibility, convenience)

2.4 The gap between business processes and the value network

In this chapter we provided insights in the two primary levels of analysis; the value network level and the business process level. Around the business process level we also shortly discussed several architectural views that aid the relation of business processes to other components in the enterprise. In this paragraph we further elaborate on the relation between the value network and business processes. Although several authors have identified similar gaps, such as the lack between the value chain and a firm's strategy (Holmberg, 2000), or the lack of alignment between business goals and processes (Kavakli and Loucopoulos, 1998; Soffer, 2005), only few approaches exist that deal with this type of relation.

2.4.1 Value as the binding concept

Following the reasoning of Gordijn and Tan (2001) the relation between the concepts is best analyzed through focussing on value. On the value network level a model shows the transfers of value between actors but not their behaviour, nor the sequential order of the value transfers. Business process models show the order of the value activities and the flow of value objects, but does not show which processes create which value for which value transfers (Pijpers and Gordijn, 2007).

Business processes essentially entail the "how" of creating value whereas the value network concerns the "who". When dividing a service into specific contributions of value, both tangible and intangible, these different pieces can be attributed to either a specific actor or cooperation among actors. Depending on the level of aggregation on which the creation of value is analyzed, it can become a more

actor specific contribution. The creation of value can best be regarded as the provision of a service to the business process by different actors (Jonkers et al, 2004). The business processes that run both within and between these actors connect the value contributions to create the value system and hence the final service or product. Thus basically value can be considered a connecting term between the business process level and the network level.

Within the scope of our study the processes that run *between* the different actors in the value network are mostly relevant as the view on billing primarily concerns the exchange of information that eventually will be processed *internally* to create a final presentation to the end user. Therefore, although these processes can not be entirely separated, the focus lies on *inter-firm processes, front-office processes* in contrast to firm internal back-office processes.

2.4.2 Current approaches

There can be several directions in relating the two levels of analysis. From a literature study we identified four types of approaches. We discuss these, their goals and their relation to our research goal in Appendix 3. Although none of these approaches appear to be directly applicable here, as the goals of the approaches are not similar in nature to our research goal, they do provide valuable insights. First, it is not feasible to directly relate aspects from both views but linking similar concepts and terms suits the descriptive, explorative character of our research. Furthermore the second and third approaches stress the need for aggregating both levels into usable concepts and the fourth approach stresses the need for identifying common concepts in both views.

Based on these findings we do not directly relate aspects of the two levels but in line with the generalisations of Pijpers and Gordijn (2007) we identify more generic aspects in both levels of analysis. On these levels we focus on concepts common on both levels, as done by for example Dijkman et al (2003). The advantage of aggregating both levels is that they do not require exhaustive description but only analysis to the extent that similar concepts on both levels can be distilled. Furthermore, the aggregated level is sufficiently flexible to suit the exploratory character of our research and enables the incorporation of legacy systems and related path dependencies. These can be regarded important denominators in process changes (Versteeg and Bouwman, 2004).

Given the approach discussed here, two aspects must be dealt with, namely; (1) finding a suitable level of granularity for both levels of analysis, i.e. working down from the value network level and upwards from the process level, and (2) relating common denominators that can explain or differentiate each level. We discuss these aspects in the following paragraphs.

2.4.3 From value network towards operational processes

To work downwards form the value network level towards more operational processes, the actors' contributions to this operational level must be captured. Given the fact that a complete decomposition of each enterprise in the value network complicates rather than clarifies the overall picture (Gordijn and Tan, 2001), a focus within firms must be chosen that does not incorporate the entire structure of the enterprises in the value network and these enterprises must be differentiated.

As discussed earlier in this chapter a good differentiation of actors in the value network is a differentiation in roles. The focus on roles applies when considering the intended relation to business processes. A role brings specific responsibilities to specific firms. In the discussion of enterprise architecture it was evident that this is the domain of the business architecture. Hence ideally the value network could be decomposed into roles which subsequently relate to specific responsibilities laid down in a business architecture which in its turn provides the basic overview of the enterprise architecture. Thus, each enterprise could be mapped in an enterprise architecture which subsequently could be connected on each different layer on the basis of the business architecture. Although we believe such an approach would be possible, it would introduce tremendous complexity and goes far beyond the scope of our research. Especially since we also target the exploration of future scenarios and not only regard the description of the current situation.

Therefore we consider another more doable approach within the scope of our research. To further explain the heterogeneity of roles in a value network the Resource Based View of the firm yields that viewing a firm as a collection of resources enables differentiation. Furthermore, to deal with relations among firms performing roles in the value network Resource Dependency Theory applies. This theory

shows the constant striving of firms to acquire or outsource specific resources either internally or in the market. This enables the identification of changes in the acquisition and application of resources in the value network. Therefore focussing on resources provides sufficient flexibility to suit the exploratory character of this research. As discussed throughout section 2.2 resources entail both tangible assets such as infrastructure but also assets of more intangible nature such as information, knowledge and power. Although these can be identified in the mobile Internet value network, within the scope of our research we require more focus. Therefore we will predominantly focus on two types of resources; technology and information.

These are the aspects that are of primary input to business processes in the WCA framework of Alter (1999) in the analysis of business processes. Furthermore, as shown in the discussion of enterprise architectures they are considered important layers underlying business processes. We will deal with this more concrete specification of the processes in the next paragraph.

2.4.4 From process to value network

Working upwards from the process level proves a fundamental challenge as the current fields of study of processes appear to be primarily internally oriented. To meet the analysis of value networks, a high level and broad approach is required in the analysis of business processes. The WCA framework of Alter appears suited for this task since it distinguishes the high level components involved in a business system that contributes to its processes. However, despite of being high-level, the framework is rather firm specific and thus lacks a direct link to other firms' processes. This makes the framework in its current form hard to apply on a value network level.

The adaptation of the WCA framework of Alter (1999) by Reijers and Mansar (2005) contributed to a more prominent role of the external environment and provided some useful distinctions in the process level. Although Reijers and Mansar (2005) do not explicitly mention why the border between the firm and the environment is shown with a dashed line, we believe this to be an important aspect here. As business processes are increasingly inter-organizational, these borders are blurred. The participants in the business process are increasingly part of several organizations and technology and information are commonly contributed by different actors. This is due to the fact that business processes are increasingly inter-organizational.

2.5 Conclusions

In this chapter the following question was answered: *What are value networks and business processes and how can both be described and related?* This comprises of the following three questions to which we provide the answers in this conclusion:

- What are value networks and how can they be analyzed?
- What are business processes and how can they be analyzed?
- How can both be related?

2.5.1 Concepts

A value network turns out to be a multi-dimensional concept working on several levels of aggregation. Though basically it can be considered as a structure in which different actors exchange value, its analysis turns out difficult as throughout literature there is little consensus on what should be the focus. A value network can be approached as being service specific in which a service requires certain value network constellations or more general in which actors cooperate to deliver a broad range of services. In our analysis we use a value network to denote the networked cooperation among actors to provide customers with a broad range of services. Hence, we do not use the term value network service specific but as an aggregation of multiple service types. Evidently this interpretation is rather close to a business ecosystem. Furthermore a value network can be regarded as dominated by one specific actor or be the result of cooperation on a more equal basis. Given the domain under study in our research we can immediately point to the mobile network operator as dominant actor. However, the value network may be migrating towards a more open cooperation which means that we do not consider the latter dominance to be unequivocal.

Several authors focus purely on the exchange of value and the interdependencies between actors when analyzing value networks. For example Gordijn and Tan (2001) and Gordijn and Akkermans (2003) in their e3-value approach focus exclusively on value exchanges, explicitly not regarding other exchanges

such as information and the use of technology. Many scholars focus on roles in their approaches to analyze a value network. An important question in defining roles is what differentiates roles. This can be regarded as the responsibilities of these roles but can also be approached from a resource perspective. The resource based view of the firm (Barney, 1991) yields that heterogeneity in firms (and hence firms performing specific roles) can be explained through their resource portfolio. The latter perspective can also include technology and information which better aligns to our research goal and is therefore the focus of this research.

A business process can best be defined through the following four properties; (1) a business process consists of several structured activities, (2) the activities provide output for a specific market or customer, (3) the activities are sequences, and (4) the activities relate to the achievement of a specific goal of the firm. A business process can not be seen separately from the organization(s) in which it resides. Therefore a broad approach to analysis is required, of which the approach by Alter (1999), the so-called WCA framework is recognized as a widely applicable framework as it incorporates not only processes but also the customer, products, participants, technology and information. In line with these aspects enterprise architecture theory uses several interacting layers of which for example the business process layer interacts with the other layers such as the information, application and technology layer. In our research we focus on two layers: technology and information as primary inputs to business processes. We consider both to be crucial inputs to the business processes under study as well as resources, the control of which may differentiate actors strategically. To evaluate inter-organizational business processes we found customer usability, interoperability, leverage of legacy and information quality to be important criteria. We use the specifications of these criteria in a later stage to evaluate our business process designs.

2.5.2 Relations between concepts

From literature we identified several approaches to relate different views and levels of analysis. However, only few of these specifically target the relation between value network relations and the business processes that reside in them.

The approach, proposed by Pijpers and Gordijn (2007) follows earlier work of Gordijn (e.g. Gordijn, 2002; Gordijn and Tan, 2001; Gordijn and Akkermans, 2002, 2004) in which value is considered the binding concept. On a value network level it concerns propositions of value that are exchanged whereas business processes enable the actual flows of value. In Appendix 3 we discuss this approach further. It focuses on (primarily monetary) reciprocal value exchanges among actors that are translated into ownership of assets and subsequently transactions across the boundaries of firms. These transactions are basically the business processes.

Another approach is the differentiation among roles in the network through information and technology resources. Hence only a moderate part of the resource portfolio of an enterprise fulfilling a role is incorporated. However, these aspects suffice in the discussion of business processes as information and technology were identified as the primary inputs in business processes from literature. Furthermore, as explained by Ray et al (2004) resource-based logic is entirely supported at the business process level of a firm. In the light of enterprise architectures literature the focus on information and technology resources provides several delineations as the application architecture is not developed and the definition of roles implicitly already defines several responsibilities of the business architecture.

The goal of our research is to explore the future billing processes. Both types of approaches apply here and are highly complementary; complementing economical viability with technological feasibility. The first approach stresses the need for reciprocity, a clear definition of boundaries and economical viability, the latter emphasizes the fact that information and technology are also important determinants of business process feasibility. However, given the time scope of our research we can use only one approach, forcing a selection.

We select the resource perspective based on two premises. The first is directly related to the basic difference between the approaches. The value perspective starts with the goal of assessing viability whereas our research goal is to establish feasibility. Although both are required, the focus on feasibility points to a resource perspective. Second, we identified legacy systems, related path dependency and technological developments as important determinants in the evolving industry. The focus on legacy technology and visible developments as a starting point for further analysis better fits a resource perspective as it does not start on the value level, laying down technology. We shortly discuss the

resource perspective further before illustrating this theoretical perspective in a framework in the next paragraph.

Resources can be connected to roles in the current role divisions and, when defined on a sufficiently high level, be connected to future role divisions. This enables the identification of information and technology resources that should be developed by actors targeting (a) specific role(s) in the value network. On the other hand, from a process perspective the (technological) developments taking place here require the control of specific technological and information resources to fulfil specific roles. Hence on both levels of analysis the focus on information and technological resources is sufficiently flexible and high-level to enable both current analysis and future exploration. The resource based view provides this focus on resources in the value network level as this theoretical field can be used to explain the heterogeneity of firms. As evident from Resource Dependency Theory the control over specific resources can also shift over time enabling more explorative conceptions of the value network. On the operational level business processes must be analyzed on a rather high level to identify information and technology resources that support the processes.

The WCA framework of Alter (1999) provides a structured means to approach and think about business processes but does not provide concrete processes modelling approaches. Alter (1999) only notes two methods for the concrete illustration of business processes and therefore we prefer the more elaborate discussion of Aguilar-Savén (2004). This discussion on modelling methods provided two methods to obtain a usable focus on processes in a value network. These are the IDEF-0 method and the Role Interaction Diagram. The IDEF-0 method is applicable at multiple levels of aggregation and allows a focus on technology and information additional to the process activities. Hence it provides relations among these three architectural layers. The Role Interaction Diagram (RID) provides more focus on the activities of different actors within the process. Placing these methods into enterprise architectures, the IDEF-0 method defines the activity sequences of the business process architecture and the technology and information requirements from the information and technology architectures. The RID method also targets the activities at the business process layers but with its focus on actors it also enables placing the business process as part of the responsibility of different actors.

2.5.3 Conceptual framework as theoretical perspective

From our study into literature on value network and business processes we have created a conceptual framework to demarcate our focus and structure our approach towards the theoretical gap between the two levels of analysis. It should not be regarded as a model or a template but as a theoretical lens that emphasizes those aspects on the value network and business process level that we focus on in our analysis of inter-organizational business processes. This framework is shown in Figure 2.9.

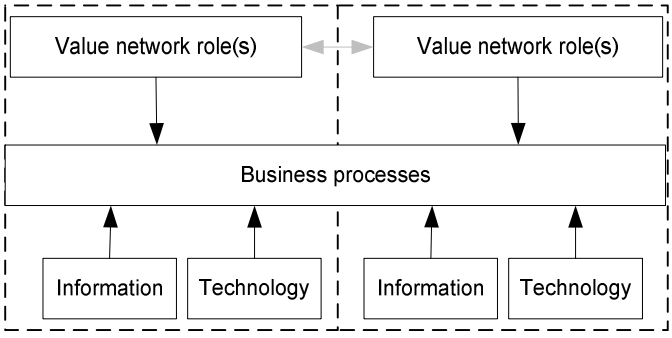


Figure 2.9 Conceptual framework

The dotted lines represent the boundaries of an actor, we only show the relations between two actors whereas evidently a value network will consist of many more, but this would rather obscure than clarify the framework. The framework shows that an actor has one or more roles in value network. Each role corresponds to specific activities in the value network's business processes, i.e. a specific role lays down specific responsibilities in terms of business process activities. To be performed, these activities require information and technology. The control of this technology and information can be attributed to actors fulfilling specific roles and fall within the actor's boundary. However, given the increasing extent to which business processes are inter-organizational, technology and information are shared among actors participating on the business process level. Hence the interconnection of systems and the sharing of information enable business process activities to cross the boundaries of actors.

The use of roles has at least two major advantages over directly speaking of the actors that fulfil the roles. Roles are more stable than the actors fulfilling them and the complicating aspect that one actor can have multiple roles or one role can be performed by multiple actors, is mitigated (Jonkers et al, 2004). We differentiate roles not only on their responsibilities in the value network in terms of service provisioning to the value network, but more specifically in the contribution of Informational and Technological resources to the business processes that run through the roles in the network. The control of resources provides a good means to differentiate roles and the focus on information and technological resources enables a usable link to the business processes as they are the primary enabling aspects.

Actors fulfilling roles can be related several ways. The grey marked arrow points to the interactions on a value level, i.e. the actual contributions of value by actors which concern (primarily monetary) exchanges (see e.g. the e^3-methodology discussed earlier). This value perspective could be further developed by analyzing the transactions between actors on a business process level, but as stated earlier we take another perspective. In our perspective the link between the value network (roles) and business processes is established through focussing on informational and technological resources. Therefore in the perception of business processes, the activities must also be perceived in relation to the information architecture layer and technology layer. This type of broad analysis is accomplished by the IDEF-0 method. However, this method lacks a good view of the attribution of activities to specific roles or companies. To this end, in case multiple roles interact the Role Interaction Diagram model is used.

3. Billing in the mobile Internet industry

3.1 Introduction

This chapter deals with the second research question which concerns the analysis of the mobile value network and the billing of content services. We illustrate and discuss the current roles in the value network and how the billing processes are organized throughout these roles.

This chapter is structured as follows. In section 3.2, we provide some context information on the wireless industry in terms of its size and revenues. Then we identify the roles in the mobile industry's value network relevant in service provisioning in section 3.3. Subsequently, we assume a billing perspective in this value network, explain the concept of billing and related terms and characteristics and focus on the roles relevant in billing in section 3.4. In section 3.5 we discuss billing in the current mobile value network in terms of the relevant characteristics, the control of technology and the information requirements. Finally in section 3.6 this chapter is concluded with an integrative overview of the analyses in this chapter providing a good starting point for the exploration of developments in chapter 4.

3.2 The mobile industry expressed in figures

Mobile networks are greatly proliferating, currently adding over 150 million subscribers per annual quarter, adding up to 2.69 billion subscribers worldwide (www 1: 3gamericas, 2006). However, the mobile voice market in the developed countries is nearly saturated and ARPU is decreasing every year due to competition (Kuo and Yu, 2006; Tilson and Lyytinen, 2006). This trend is visible in Figure 3.1 that shows the data revenues in several countries on a monthly basis.

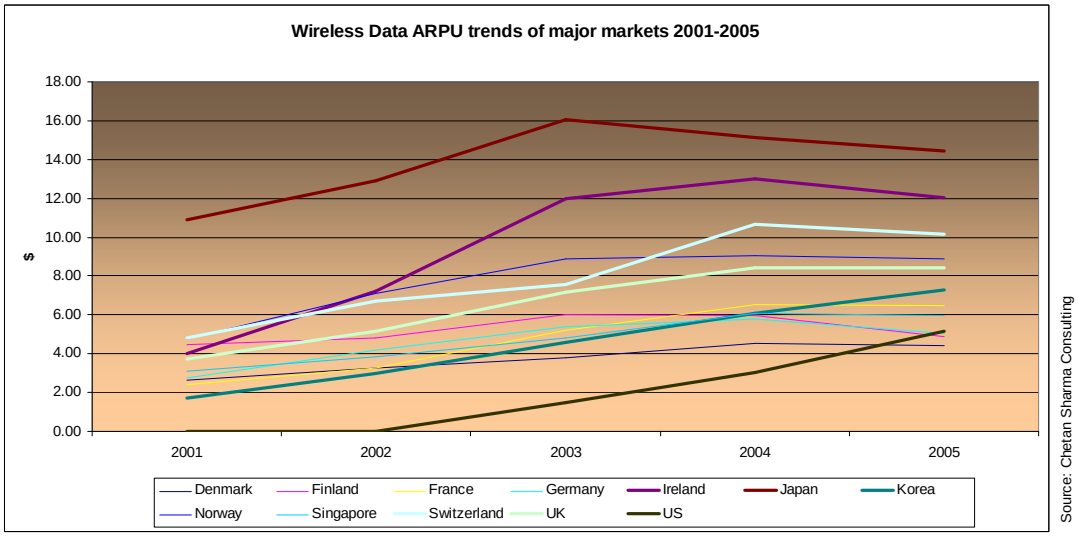


Figure 3.1 ARPU developments (source: Sharma, 2006)

With the currently saturated markets in the developed countries operators are seeking new ways to obtain more revenue. One way is the exploitation of new growth markets such as India, China, Western Europe and Latin America. From an operator perspective there is great potential for wireless services here (www 2: UMTS forum, 2007). For example Vodafone has recently acquired a large telecom operator in India to broaden its scope and increase its customer base (Mohamedjoesoef, 2007). However, increasing the number of subscribers is difficult and the focus of operators is predominantly on data as a means to increase ARPU (Bauer et al, 2004). One of the main drivers is the successes in Japan where ARPU is significantly higher than in Europe, due to more advanced services (Farley and Capp, 2005).

Thus although voice is still king, operators are looking at data services as means of maintaining revenue growth (Tilson and Lyytinen, 2006). Crucial here is the uptake of the mobile Internet, but these figures remain rather low in Europe where currently only 21 percent of mobile subscribers use the mobile Internet (Forrester, 2006). The success of for example I-mode in Japan has not been matched in

Europe. This can very well be the result of the low fixed (broadband) Internet penetration in Japan that stimulates access on mobile devices. Mobile data services in Europe have not been able to significantly raise ARPU and doubts on the market potential of data services (e.g. Ballon, 2004) still appear to hold in Europe. The revenue on data services is still behind on voice services, see Figure 3.2. Especially since SMS remains the largest contributor to the non-voice services with in 2006 contributing between 70% and 80% of Total Non-Voice Mobile Service Revenues Worldwide" (www 3: Research and markets, 2007). This is likely to be the case in Indonesia and the Philippines where although total ARPU is rather low, the contribution of data revenue to this ARPU is considerable.

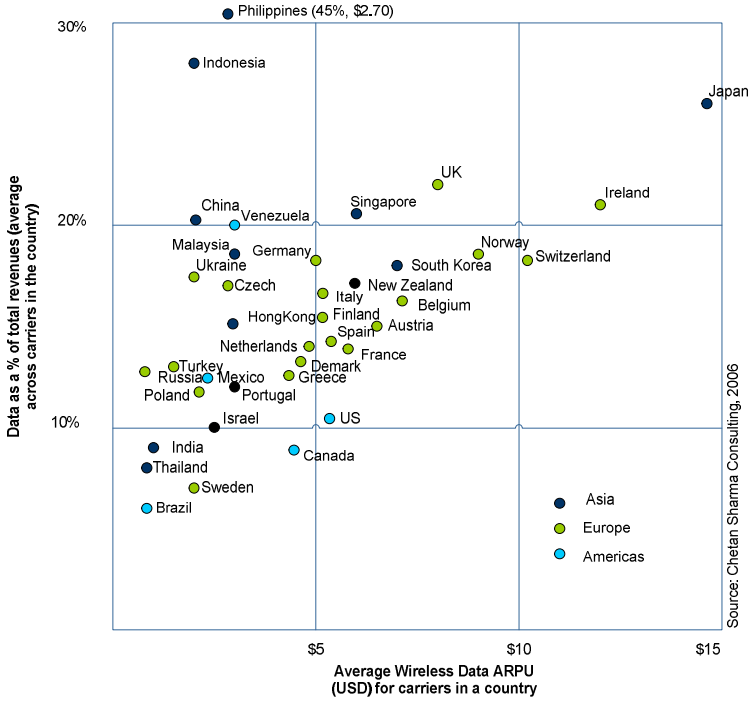


Figure 3.2 Wireless Data ARPU per country (source: Sharma, 2006)

Nevertheless, despite of the gap between voice and data revenues, wireless data networks are expanding; at present UMTS and W-CDMA networks are jointly serving over 100 million subscribers and are adding over 15 million subscribers per annual quarter worldwide (www 4: 3gamericas, 2006). This figure does not include the usage of other wireless technology such as Wifi and Wimax.

3.2.1 The Dutch mobile industry

According to the CBS, the Netherlands at present (as of May, 17, 2007) have 16.366.136 inhabitants (www 5: CBS, 2007), while there are 16.141.500 mobile phone users, of which 1.243.500 are subscribed to third generation UMTS networks (Netsize, 2007a). Evidently, the Dutch market is saturated on the penetration of mobile phones whereas the third generation UMTS has yet to gain share. This is evident from the data of Forrester research that show that currently the WAP (Wireless Application Protocol) and mobile Internet penetration in the Netherlands jointly ranges between 20 and 25 percent and lacks behind on other mobile technology developments (see figure Figure 3.3).

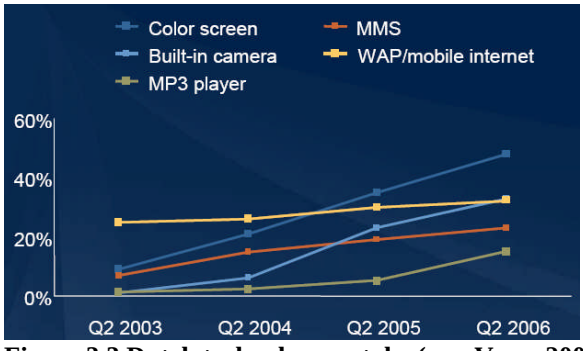


Figure 3.3 Dutch technology uptake (van Veen, 2007)

According to Forrester this is due to primarily the price (52% of respondents) and lack of value perception of the customer (39% of respondents) (van Veen, 2007). The current lack of uptake of the mobile Internet is also visible in the moderate penetration of websites tailored to the mobile device. For example in a study of 53 banks, insurers, web shops and publishers in the Netherlands only 13 percent offered a mobile website (www 6: Besselink, 2007).

With the take-over of Telfort by the former incumbent operator KPN Mobile in June 2005 (www 7: Emerce, 2005), there are now four operators left owning network facilities. These are KPN, Orange, T-Mobile and Vodafone, each currently offering UMTS and GPRS. However, the acquisition of Orange by T-mobile is nearly a fact after which only three operators are left (www 8: Groen, 2007). The distribution of subscribers, both post-paid en pre-paid and the monthly ARPU obtained per operator of the third quarters of 2005 and 2006 are shown in Figure 3.4.

	KPN	Orange	T-Mobile	Vodafone
Total Subs				
3Q05	5,415,950	1,849,000	2,295,000	3,758,120
3Q06	7,719,530	2,012,000	2,466,000	3,698,130
Prepaid Subs (as % of total)				
3Q05	2,917,190 (53.9%)	1,137,600 (61.5%)	1,125,000 (49.0%)	2,026,170 (53.9%)
3Q06	4,010,160 (51.9%)	1,237,900 (61.5%)	1,121,000 (45.5%)	1,762,810 (47.7%)
Postpaid Subs (as % of total)				
3Q05	2,498,760 (46.1%)	711,400 (38.5%)	1,170,000 (51.0%)	1,731,950 (46.1%)
3Q06	3,709,370 (48.1%)	774,100 (38.5%)	1,345,000 (54.5%)	1,935,320 (52.3%)
ARPU				
3Q05	39.06	30.72	45.16	44.67
3Q06	38.25	27.31	48.45	47.05

Figure 3.4 Dutch operators in figures (Netsize 2007a: 129)

From this figure it is clear that KPN has the most subscribers but in terms of ARPU comes third. The latter could be explained through the number of MVNOs (discussed later in this chapter), that generally generate less ARPU. T-mobile is an exception here as this operator only started providing network services to MVNOs[5]. As of March 2006 there were nearly 40 Virtual Operators active on the Dutch market, representing a customer base of 15,2 percent which equals 2.5 million subscribers. Given the fact that a year earlier the Virtual Operators served 2.17 million subscribers their growth in market share is evident (Bout et al, 2006).

The large differences in ARPU can also be explained through the fact that Vodafone and T-mobile have a larger established business user base that generally generates more usage. Also data may be relevant in the explanation of the differences in ARPU. However, the percentage of data as part of the overall revenue is rather similar throughout the three operators for which number are present (see Figure 3.5). Therefore, the data usage does not appear to be a significant factor in the explanation of the differences in ARPU between operators.

	KPN	Orange	T-Mobile	Vodafone
Revenues (in million USD)				
3Q05	737.18	200.16	323.43	539.37
3Q06	992.04	207.84	364.68	562.46
Data as % of Revenues				
3Q05	15.0	16.8	15.0	n/a
3Q06	17.0	19.4	19.0	n/a

Figure 3.5 Revenues and data share of Dutch operators (Netsize, 2007a: 130)

3.3 The mobile Internet value network

The mobile Internet is a broad concept and defining it is a challenging task as depending on the perspective, it can be different things. Saarikoski (2006) has recognized this difficulty and has worked

[5] As of June 2007 T-mobile provides network service to its first MVNO (Lycatel mobile) in the Netherlands. See https://www.t-point.nl/corporate/htdocs/page/pers/persberichten.aspx?item=2006/juni_15_06.xml

from the general definition of the mobile Internet as "a direct connection from a mobile phone (handset) or a portable device to the Internet" (Saarikoski, 2006: 12), to more actor-specific perceptions of the concept. We identified the following characteristics that can apply to the mobile Internet from different perspectives:

- The mobile Internet is based on packet-switched radio technology and is "always on".
- It has extensive geographical coverage.
- Experiences on the mobile Internet are at least similar to the regular Internet
- It provides easy access to value added services with a small and lightweight device that has a long battery life.
- Users can participate in content creation.
- The mobile Internet provides the possibility to charge for content.

Although these characteristics clearly do not provide an exhaustive overview of the concept they are a starting point for the discussion of the mobile Internet value network and billing within this network in this chapter. Two other terms I discuss to denote our interpretation are content and services as it turns out that the terminology used in practice in the online content market are rather confusing (KPMG, 2006a).

Depending on the context, the term service can refer to two things. When provisioning of autonomous operating services between businesses, a service refers to "a *contractually defined behaviour* that can be implemented as a component for use by another component" (O'Reilly, 2000, u.q. by Levenshteyn and Fikouras, 2006: 80). When speaking of services provided to end-users on the mobile network, the UMTS forum defines a mobile service as "a service with a set of capabilities that allow some combination of terminal mobility and service profile management" (Bhushan et al, 2005: 721).

Content refers to the asset that is communicated and provides some form of added value to the end user. Some characteristics of content are that it can easily be modified, consumed repetitively by the same or different users, and is fast and cheap to reproduce. Typically content on the mobile Internet will include (Barnes, 2002: 99);

- Text, e.g. news, stock prices, film listings, advertisements, product descriptions and restaurant locations.
- Audio, e.g. voice, wireless Internet radio and music files (including MP3 format).
- Graphics, such as wireless bitmap or GIF formats.
- Video, e.g. animated graphics files, wireless TV and video files.

The concept value network and viewpoints for their analysis were discussed in chapter 2. In this section we focus on the value network in the telecommunications and Internet industries. Although we define the industries telecommunications and Internet here, it will soon be evident that with the transition of the telecom sector towards the Internet it is more accurate to speak of the "infocommunications" industry (Fransman, 2002). In a broad definition this industry includes "all suppliers that provide elements (products and services) to networks that carry voice, video, and data" (Grover and Saeed, 2003: 120). Evidently the focus here lies at wireless networks, and more specifically the use of Internet on wireless (mobile) networks. In the following paragraphs we focus on the roles in the industry relevant in service provisioning and billing. Subsequently we discuss the technological and informational resources that typically can be attributed to these roles.

3.3.1 Roles in the infocommunications industry

In a much generalized view, there are three areas of mobile business; devices, network and services (Soininen, 2005), shown in the simplified value chain below.

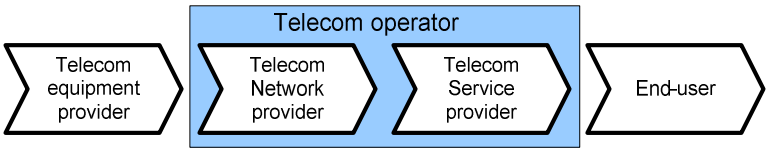


Figure 3.6 Telecom value chain, simplified (Based on Lemstra, 2006)

When analyzing these relations more deeply, the various roles that can be placed within these areas give rise to a complex network of interdependencies which can best be unravelled through structuring

in networked layers. This is a frequently applied method to analyze the infocommunications industry and is rooted in the OSI model for interconnection (Zimmerman, 1980) where physical connection of systems are separated from services. One of the first and foremost authors adopting such an approach is Fransman (2001) who translated the old telecommunication industry's three roles mentioned above into the six layers of the infocommunications industry.

The focus on layers in the industry also has its disadvantages. This is also understood by Fransman who in later work, additional to its strengths also discussed the shortcomings of the layer model (Fransman, 2002). In this 2002 paper he explains that a layered approach provides focus for analysis, emphasizes the modular structure and provides insights into the horizontal and vertical integration. Concerning the disadvantages he mentions the neglecting of heterogeneity within a layer and the lack of options for the analysis of industry dynamics and changing institutions (Fransman, 2002). Considering this we use a layer model according to its strength which is structuring obtain focus in the industry. We use a version of the layer model proposed by Soininen (2005). Although this model is also based on the layer model of Fransman (2001), it is more specific in terms of roles that are performed in specific layers. However, it still lacks several dynamics as it for example fails to capture the fact that users can also generate content, which in this model should strictly speaking not be possible. The layer model of Soininen (2005) is shown in Figure 3.7.

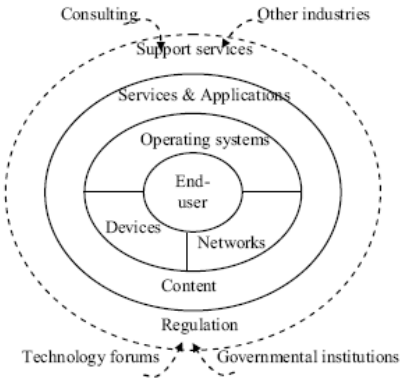


Figure 3.7 The mobile Internet industry and its segments (Soininen, 2005: 3)

The first layer, the end-user can be both private and a company and has three connections to the whole industry; (1) he uses a mobile device, which (2) has an operating system and (3) is connected to a mobile network (this is represented as the second layer). The third layer concerns the content, service and application provision which provide meaning to the mobile device. The outermost layer connects the industry to other industries. It involves industries such as consulting, and technology forums and governmental institutions. Within the scope of our study the second layer is of primary relevance as our research aims at the billing of content services on the mobile Internet. Furthermore, we limit the discussion of roles to mobile channels as other (wired) Internet channels are outside the scope of the study.

3.3.2 The content service provisioning layer

Soininen (2005) illustrates that at each layer a separate value network can be drawn that jointly performs the functions in this layer. The value network at the context provision layer identified by Soininen (2005) is shown in Figure 3.8.

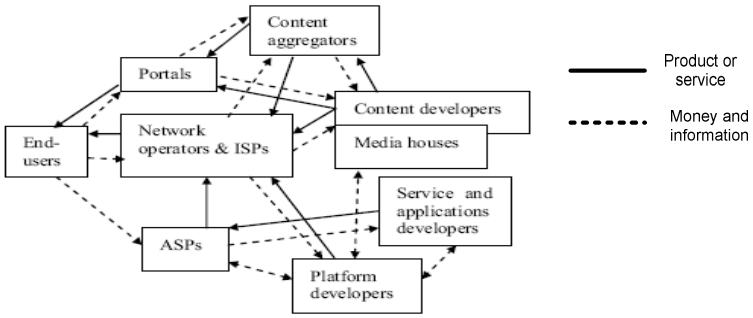


Figure 3.8 Content services and applications value network (Soininen, 2005)

This figure shows the roles involved on this layer and the flows of products or services, and money and information. We discuss these roles identified here in relation to the terms in use in other literature.

3.3.2.1 End-user

The end-users, in many cases called customer or consumer eventually consumes content services. They can be mainly divided into general consumers or enterprise users (Kuo and Yu, 2006), of which the first is our primary focus. The end-user is of increasing importance in the industry as his perception of the value of wireless content services determines the success of the offerings that are increasingly differentiated (Sabat, 2002; Peppard and Rylander, 2006). This customer driven approach is turning current actors such as operators from inward-focused to outward-looking, "customer-driven powerhouses" (Scales, 2004).

3.3.2.2 Portal provider

Literally, "portal" means "doorway or gate". Portals are basically the line of contact and browsing of the end-user to the mobile Internet (Kuo and Yu, 2006). It can be defined as "a network site that aggregates, presents, navigates, and delivers a wide range of Internet communication, commerce, and content services to a large number of visitors." (Sabat, 2002: 522). Barnes (2002) places the portal under "market making" as the portal is targeted at marketing and selling content, including programme development, service delivery and customer care. Portals are increasingly customized and tailored to the end-user's needs.

On a mobile device the technology has a strong influence on the possibilities on a portal when compared to portals on the regular Internet. This is due to the fact that fewer links can be shown on the screen. When assuming the availability of 5 direct links on a phone, compared to 25 on a regular website, a simple calculation learns that within three clicks on a phone 125 pages can be accessed whereas on a regular website this adds up to 15.625 pages. Clearly compared to regular Internet portals, mobile Internet portals have a strong need for customization and personalization (Barnes, 2002; Barnett et al, 2000). Examples of portal providers are "Startpagina" and "Pocketinfo" that have been very successful on the regular Internet in the Netherlands. On the mobile Internet the most widely used portals are those at the operators. Examples in the Netherlands are Vodafone live!, I-mode (KPN), Orange world and T-zones (T-mobile).

3.3.2.3 Application and Service Provider (ASP)

Soininen (2005) identifies ASPs as sellers of services in a Business to Business (B2B) market. In this business to business market they provide hands-on solutions to for example mobile operators. Tapscott et al (2000) define this role as commerce provider who "enables the flow of business" (Tapscott et al, 2000: 19). Basically the term ASP can incorporate many services such as SMS service provision, platform provision and content enabling. Therefore, this role actually incorporates several roles.

3.3.2.4 Content aggregator

Content aggregators are also frequently defined as content packagers (Barnes, 2002). The role is often similar to that of the portal (UMTS Forum, 2002) and many authors even include the portal in the aggregator portfolio (e.g. Barnett et al, 2000). In literature on content aggregators there is, compared to portals in literature, more focus on the adaptation of content to suit the user. To be consumable, in many cases, digital content must be edited, customized or combined (Barnes, 2002). This is defined as content enabling which, when defining the role broadly, also includes services such as billing, middleware, data optimization and security services Sabat (2002).

This is aligned with what Li and Whalley (2002) define as passive and active aggregation. When an actor actively aggregates, the number of service combinations will be limited but more targeted to the end-user. If an actor passively aggregates, there is less segmentation and classification and the user is more responsible for finding the desired content. In the latter case the aggregator only needs access to a broad range of content providers and does little filtering. The passive aggregator is also called content integrator (Kallio, 2004).

Based on the above we define a content aggregator rather active as a role aggregating, transforming, and preparing content to suit the end-user's needs. This incorporates several of the ASP functions but is separated from the portal provider. Examples of actors fulfilling the content aggregator role in the mobile domain are "InfoSpace" and "Netsize". An example from the regular Internet is "OD2".

3.3.2.5 Content and service developers and owner

As the name implies these actors own and create content and services. Clearly the producing actor is not necessarily the owner of the content. For example a content producer or developer can be a (pop) artist whereas the owner in this case is the record label (KPMG, 2006a).

This group of actors is placed under heading of content creation by Barnes (2002). Kuo and Yu (2006) use the term content developers to denote actors that provide, design and produce various kinds of products or services for all kinds of end-users. Content owners have no direct relations to aggregators or operators but interact with content providers (UMTS Forum, 2002: 4). Services are usually sold on the basis of wholesale to operators or providers of content and applications. Examples of actors fulfilling this role are "IceMobile", specifically in the mobile domain "Endemol", originating from the television industry and "Sony" and "Universal", originating from the music industry.

3.3.2.6 Content provider

A content provider is an actor that distributes content such as news, entertainment and music. Essentially content providers "deliver the intrinsic forms of value – goods, services, or information – that satisfy customer needs" (Tapscott et al, 2000: 19). In a rather generic definition Grover and Saeed (2003) define content providers as companies that provide and distribute copyright material (through either the Internet or other channels). Although content providers can create their own content (Tilson and Lyytinen, 2006), they usually provide content obtained elsewhere. The UMTS forum (2002: 3) defines the role of the content provider as "to provide services ("content" or applications) that add value to access and transport services. Value-added services can be produced by the content provider itself or purchased from others.". Examples of content providers are "Jamba!", "2Way traffic", "Disney" and "de Telegraaf".

Advertiser

One specific type of content providers is the advertiser that offers advertisements or sponsored services. (UMTS Forum, 2002: 4). Advertisers can be any actor willing to pay for the distribution of his brand name and products and services. The larges advertisers in the Netherlands are "Unilever", "KPN", and "Proctor and Gamble". However, many of these advertisers still focus on other media than the Internet such as radio and television; a large share of the top 100 advertisers in the Netherlands, ranked on advertising expenses, are only moderately represented on the Internet (www 9: Managers Online, 2007). The largest online advertiser in the Netherlands in 2006 was "Philips" that in total spent 3,7 million Euro (www 10: Mediaonderzoek.nl, 2006).

3.3.2.7 Mobile Virtual Network Operator (MVNO)

Mobile Virtual Network Operators are closely aligned with service providers in the wired word and are often termed resellers. They perform the function of an agent between the network operator and end customers (UMTS Forum, 2002). This type of role is increasingly present in the mobile industry. Their proliferation is enabled by the communication directives issues by the EU in 2002 and 2003 as these oblige MNOs to lease out capacity to all service providers at a fair price (Kiiski, 2006). The number of operators and virtual operators in Europe is shown in Figure 3.9.

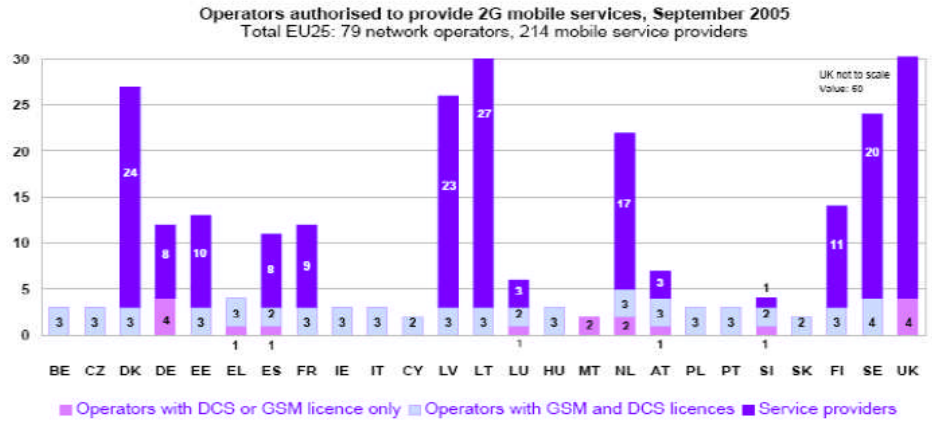


Figure 3.9 Mobile operators in EU countries (Kiiski, 2006: 3)

Kuo and Yu (2006) divide MVNOs into two categories, namely; other telecommunication operators and non-telecommunication operators. The first can have 3G licenses but be limited to providing services in a specific area or be new operators that want to expand their user base. The second type has no or little established user base and intends to create and expand this through acting as a MVNO. The non-telecommunication operators are usually actors operating in different industries in which they already have an established brand and retailing channel. Furthermore, MVNOs can be divided in types based on their service portfolio; Kiiski (2006) distinguishes between data-only, voice only and voice and data MVNOs. As MVNOs purchase capacity from the infrastructure company, they have limited physical assets and their resources could be deployed in a different way if their core business becomes unsustainable (Li and Whalley, 2002). This makes these actors rather flexible in their service portfolio and relations among other actors and able to focus on niche markets where possible.
Examples of MVNOs in the Netherlands are “Debitel”, “UPC”, and “Tele2/ Versatel”.

3.3.2.8 Platform developer

Platforms can be divided into technology platforms and application platforms. Technology platforms concern the technological infrastructure that facilitates the exchange between (end)-users and ASPs. Application platforms are pre-built components, for example wireless middleware and application middleware. These allow consumers to access the Internet services on mobile devices and enterprises to extend their commercial applications to the mobile network (Kuo and Yu, 2006).

Platform developers are placed under the heading of software intermediaries by Li and Whalley (2002) as they, among others, develop operating systems for mobile devices but can also build software for other parts of the value network. As currently only few platforms are developed in-house, these actors are primarily new industry participants from the computing industry such as operating system and middleware vendors (Tilson and Lyytinen, 2006).

In this respect it is relevant to consider the fact that billing for services is also based on platforms. In the current situation mobile network operators have large billing platforms in place to which other actors in the value network connect to incorporate billing for their content services. The platform developers can play a crucial role in the changing industry as the adaptation to other than the operator-centric models will require new, more flexible and more scalable billing platforms. These actors are more actively moving into the value network and are becoming more important in service delivery (Ballon, 2004). This is also evident from the fact that one of the largest billing platform providers, (Amdocs) has acquired a portal provider and content aggregator (Qpass) (see www.qpass.com).

Examples of platform developers are “Ericsson”, “Nokia” and “IBM”. A developer that specifically targets billing systems and platforms is “Amdocs”.

3.3.2.9 Mobile network operator and Internet Service Provider

In line with the distinction between mobile operators and Internet Service Providers (ISPs) by Soininen (2005), Grover and Saeed (2003) identify two types of network operators; landlines, and wireless and satellites. The landline operators are essentially the ISPs in the wired world. However, these can either own a physical network connection to the user, or rent capacity from a network owner. In the first role they are similar to the network operators in the wireless world; in the latter they equal to MVNOs.

The wireless and satellite network operators are most relevant in our study and are defined as “Companies that own and operate network based on virtual links such as wireless and satellite networks” (Grover and Saeed, 2003: 120). The UMTS Forum (2002) defines the key function of the network operator as the provision of access and transport services, typically as a 3G license holder.

Kuo and Yu (2006) therefore use the term “3G mobile network operators” as providers of mobile communication networks that are the vital channel for mobile services. Hence they define mobile operators as the most vital actor in the value network. However, this focus on the 3G license holder should be tempered. The developments in other mobile technologies such as Wifi and Wimax may provide similar access and transport functionality while not requiring 3G licenses to provide identical services. These technologies are considered disruptive by some, but complementary by others (Kurhonen, 2005). Examples of operators where already provided in section 3.2.1. Typical ISPs in the Netherlands are “UPC” and “XS4ALL” (part of KPN), and “Scarlet”.

3.4 Billing related roles

Figure 3.8 represents a specific viewpoint; the manner in which Soininen (2005) perceives the value network in the provision of services. There is for example a focus on development of services, applications, content and platforms but actors specialized in financial transactions such as clearinghouses and financial institutions are left out. As Fransman (2002) mentions, financial institutions should be regarded in any analysis of the infocommunications industry as they perform an increasingly important role. However, a specific viewpoint on a value network is inevitable as each actor fulfilling a specific role perceives the network differently (Peppard and Rylander, 2006; Li and Whalley, 2002). Within the goal of this research a billing perspective will be taken which means that the focus within the value network will not so much lay on content development but more on the distribution of content and service provisioning in relation to billing.

We have a broad perspective on the payment for content services as incorporating the connections between billable events at the end-user, the charge for it and the distribution of this charge among all the actors involved in the value network. This broad perspective is usually decomposed into several other terms to denote parts of this process. The most commonly used distinction is between charging, billing and accounting. Throughout literature there appears to be little consensus on the use of these terms. This ambiguity is further enhanced by the different views on in the telecommunications and Internet worlds. Koutsopoulou et al. (2004) have recognized this different interpretation of the processes and have made a first step towards the identification of these differences, shown in Table 3.1.

Table 3.1 Terminology used in the telecom and IP worlds (Koutsopoulou et al, 2004: 51)

Terms	Definition in the telecom world	Definition in the IP world
Charging	The functions whereby information related to a chargeable event is formatted and transferred in order to make it possible to determine usage for which the charged actor may be billed	A function that derives non-monetary cost for accounting data sets based on service and customer-specific tariff parameters
Billing	The functions whereby charging data are transformed into bills requiring payment.	A function that translates costs calculated by the charging into monetary units and generates a final bill for the customer.
Accounting	The process of apportioning charges between the home environment, serving network and user.	A function that describes the collection of data about resource consumption. This includes the control of data-gathering, transport, and storage of accounting data.

According to these definitions charging basically refers to generating and transferring information on chargeable events. In the IP world these events are interpreted more broadly including service costs and customer specific charging. Billing is quite similar in both worlds and refers to translating the information on customer usage into a final bill. Accounting, or payment settlement (Bhushan et al, 2005) is rather differently interpreted; whereas in the telecommunications world it primarily refers to apportioning revenue among the involved actors, in the IP world it refers to the collection about resource consumption which is more aligned with the charging definition in the telecommunications world. In this research we prefer the definitions used in the telecom world as these better separate charging and billing.

In the following paragraph we discuss some additional roles in the light of billing not discussed above and further delineate, relate and combine these roles with the roles identified earlier. We first discuss the role of financial service companies as required facilitators of monetary transactions. Then we discuss roles relevant in the three main billing related domains; charging, billing and accounting. Finally we highlight some additional related roles such as the AAC and clearing house.

3.4.1 Financial service provider

According to Fransman (2002) the actors in the value network providing financial services are critical for the functioning of the industry and Li and Whalley (2002) note that in the future these actors may become major competitors to mobile operators. However, in their classical role these actors have only enabled the payment of bills to operators. This role is aligned with what the UMTS forum calls the role of the financial institutions; they “handle financial transactions such as payments on behalf of other organizations. Organizations that carry out this role are usually described as banks, credit card or e-payment companies.” (UMTS Forum, 2002: 3). Financial institutions such as banks already have a

customer relation and have certain obligations through their banking licenses; they must for example identify their customers in a much stricter way than network operators (UMTS Forum, 2002).

3.4.2 SMS service and WAP billing provider

As we discuss more elaborately later, charging can be divided into two types; either charging for the usage of network resources, or charging for the value of content, i.e. "premium content". The charging for usage of network resources is based at the owner of the network resources which is the operator. The charging for premium content can be performed in several ways, depending on the selection of the actors in the market. As we discuss later this can be based on direct (online) charging, so-called WAP billing or based on SMS messages.

These billing types enable new roles. The first is termed "SMS service reseller" or "SMS service provider". This role entails the provision of premium rate SMS services to retailers (Garner et al, 2006). In this role actors usually operate on their own short code (e.g. 9876) to which they can add (a) word(s) to distinguish between messages. To enable the use of such a code the reseller must have a relation with multiple operators who each require a fee, making the code rather expensive. Therefore these actors function as SMS aggregator to create economies of scale through the potentially many related content providers. They have systems in place that act as a gateway between content provider and MNO. The WAP billing method also enables a new role, which usually is combined with an SMS service reseller. Examples of these companies are "Netsize" and "InfoSpace". Examples of companies strictly limiting their scope to SMS and related services are "Telefuture" and "Cellgate".

3.4.3 Billing and Collections Provider

The BCP is frequently termed a special type of ASP (Tsalgatidou and Pitoura, 2001) as it provides a hands-on solution between businesses and the customer. However, according to our definition the ASP is purely oriented Business to Business and the BCP is hence considered a separate role. According to the UMTS Forum the actor fulfilling the BCP's role "issues bills (or the equivalent) and arranges for collection of payments from customers." (UMTS Forum, 2002: 3). The accounting of the revenue is usually also performed by the actor handling collection as this actor obtains all the revenue and is hence responsible for distributing it among the actors involved in the value network. In the current situation it is mostly the operator that performs this role, but as already visible on the regular Internet, actors fulfilling this role are widely proliferating. We return to this subject in chapter 4.

The billing and collections role is of particular importance for fraud management. A large share of the fee that this actor takes from the revenue of the transaction is based on the risk that is incurred when facilitating the final transaction with the end user (Interview: Wennekers and Theunissen, 2007). When end-users do not pay, this actor has to ensure that either this payment does fall through, or bare the costs of missing the fee. However, when an end-user significantly exceeds its regular bill, fraud mechanisms must be in place to detect this and act accordingly (for example notify personnel to contact the customer). An aspect relevant here are the limitations that are imposed by law on financial transactions. An actor that wants to bill its customers for assets other than services on the mobile phone, especially in the case of pre-paid, needs a banking license (Interview: Haanstra, 2007). Examples of actors specifically fulfilling the BCP role (frequently defined as "payment providers" on the regular Internet are "Paypal" and "Wallie".

3.4.4 Authentication, Authorisation, Credit Reservation provider (AAC)

The AAC role is usually part of the BCP role. This is especially the case in prepaid scenarios where the AAC will be performed in real time (UMTS Forum, 2002). Authentication basically refers to the proof that the customer is the rightful customer and authorization is the verification that the customer is allowed to use the particular service (UMTS Forum, 2002). The AAC function is currently predominantly performed by the operator. The validation of the user identity is an important aspect in billing.

3.4.5 Clearinghouse

In a roaming scenario the end-user is connected to a network that is not proprietary to the operator he is subscribed to. Therefore the AAC and charging functions are performed by another operator. When users are connected to roaming networks, the operator can not directly bill the user but must communicate his charges with the operator the user is subscribed to. The settlement of these charges between the operators is performed by a so-called clearing house, defined by the UMTS forum as the

actor that “communicates the roaming records and/or settlements between visited and home domain “parties” (UMTS Forum, 2002: 4). Considering pre-paid users this situation becomes more complex as the monthly settlement between operators would provide too much risk as credits on pre-paid accounts may be depleted. Therefore other mechanisms are in place such as credit reservation and connection set-up based on pre-communicating credit information between operators. These mechanisms and roaming are outside the scope of our research. An example of a large clearinghouse is “BSG clearing”.

3.4.6 Relating roles in the value network

As discussed throughout section 3.3 many roles can be identified each denoted by several terms. Based on the analysis in these sections we have delineated several layers and roles to focus on the value network relevant in the billing for content services. In Table 3.2 we summarize the roles and their functions.

Table 3.2 Summary of roles

Role	Description of functions
End user	Consumer of services and content
Portal provider	The "gate" to the mobile Internet. Presents content and services and enables navigation
Application and Service provider	Enables "the flow of business" through providing several services in a B2B context on which other roles build
Content aggregator	Aggregates, transforms, and preparers content to suit the end-user’s needs
Content and service developer and owner	Can include a wide range of content and services. From artist to record labels to specific mobile Internet application developers.
Content provider	Delivers content and services that satisfy customer needs through an access channel.
Advertiser	Provides free content or paid content to reach the end-user.
MVNO	Reseller of capacity to end-users
Platform developer	Develops the technology that enable the functioning of services on the hardware in use.
Mobile Network Operator	Network owner and provider of access and transport services in the mobile domain.
Internet Service Provider	Provider of access and transport services in the fixed domain. Either owning a network or operating on a wholesale basis.
Financial service provider	Handles financial transactions such as payments on behalf of other organizations
SMS service and WAP billing provider	Provides a platform and interface (SMS short code) to parties wishing to bill their services through SMS or WAP billing on the user account at ther operator
Billing and collections provider	Compiles the end-user bill and arranges collections of this bill.
Authentication, Authorisation, Credit Reservation	Authenticaes and authorizes the user for specific content or services and ensures that sufficient credit is available to obtain the service or content.
Clearinghouse	Settles the roaming charging differeces between operators based on received TAP files

In Figure 3.10 these roles are shown in the current value network. In this figure we only show the provision of services, the flow of content and money. Evidently each financial transaction is facilitated by a financial service provider such as a bank. Furthermore, from the incorporation of the content aggregator separate from the mobile network operator it is evident that we show both the on-portal and off-portal provisioning of content services.

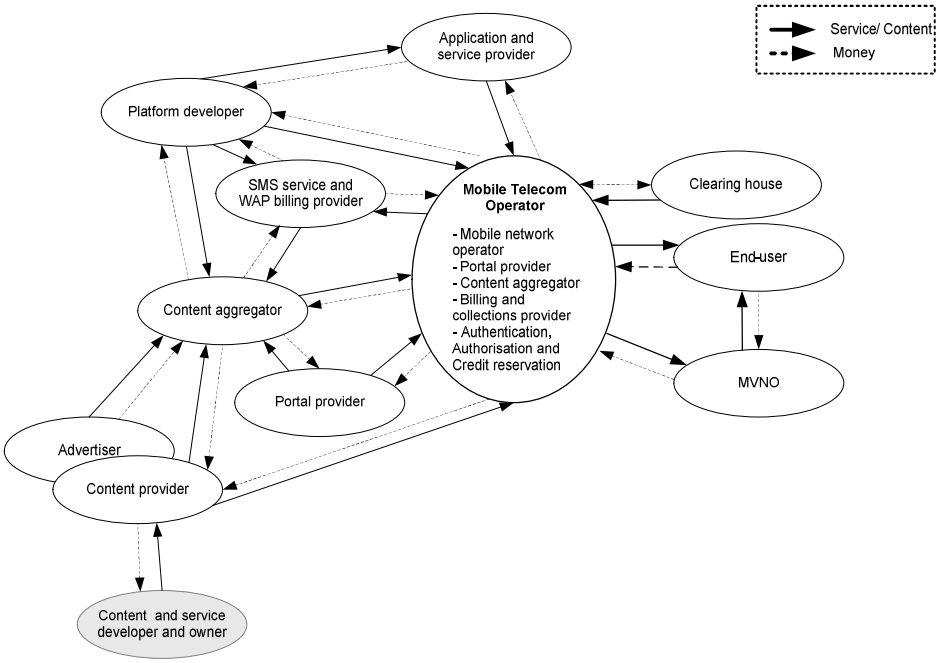


Figure 3.10 Current dominant role division in the mobile industry

Although this figure only provides a very small subset of the mobile industry and is limited to roles instead of actual actors (which would introduce many more complex relations) the network structure is clearly visible in this figure. There are many interrelations among actors and a sequential flow of services and finances can hardly be distinguished. Only on a very high level it is possible to distinguish the content creation as the start of a chain and the content consumption at the end user as the end. All in between can best be regarded a network. This aspect is best visible in the work of Li and Whalley (2002) who point to several channels and a myriad of network relations between the origin of the former chain, i.e. content creator, and the end user. When using the terms strictly this network should be defined as a business ecosystem as several separate value networks can be distinguished, of which the off-portal and on-portal provisioning of content services are most prominent. Multiple networked actors fulfilling several roles to provide a diversity in services can be distinguished while the a value network is frequently considered to be service specific (see chapter 2).

The platform developer role is increasingly important in the value network as this role enables many of the other roles. As already established, an actor fulfilling this role does not explicitly participate in the flow of content and payments, but rather provides other actors with technological support such as platforms and gateways to enable their business. The application and services providers are separated from the content providers as these actors are identified here as providing (primarily technological) business to business solutions to the telecommunications operator to offer to the end-user. The applications and service provider is thus not providing services to the end-user through for example a reselling role. This is the domain of the MVNO that has contact with the operator to resell services to the end-user. The operator is clearly in the central of the value network and currently fulfils many roles, namely: the transport of data on the network, the provision of a portal as first line of contact for the end-user, the provision of billing and collections functionality, and the authentication, authorization and credit reservation for end-users. These functionalities are shared with, or used by the MVNO. The telecommunications provider has contact with a clearing house that settles the roaming charges with other operators that for the sake of clarity are not shown here.

On the left-hand side the provisioning of content to the mobile operator channel is shown. The content and service developer and owner, for example an artist and label record company is shown in grey as this role is delineated from our research. The actors fulfilling this role usually have relationships with content providers that do all the distributing work for them and do not directly participate in the value network. Furthermore, a relevant aspect here is the fact that advertisers have flows of both money and content in identical directions. Both the content and the currency flows towards the aggregator. In return the advertiser gets the “advertising service” which essentially entails the incorporation of the advertising content into its content portfolio. Actors other than the operator can assume the portal provider role and provide portals outside the operator domain. This off-portal content provisioning differs in terms of billing from the on-portal (i.e. the use of services on the portal of the operator).

In the on-portal scenario the operator has direct contact with content providers as the operator does the aggregation itself. This is not a free market as the operator selects those actors that are placed on the portal (Interview: Bergkamp, 2007). In the off-portal scenario the operator does not have any direct contact with content providers but strictly deals with content aggregators that host content (Interview: Wennekers and Theunissen, 2007). These actors frequently also perform the SMS service provider role as they also aggregate providers to jointly use expensive short codes. The SMS service reseller can be a separate actor that owns one or multiple short-codes such as “Mollie BV”. Furthermore, as the name implies the SMS service function can also entirely be performed by the operator. As is for example the case at Orange who both offer SMS MT and MO services directly and through wholesale (Interview: Wennekers and Theunissen, 2007).

3.5 Billing processes in the mobile Internet value network

In this section we discuss how the roles identified in the former section interact throughout the billing processes. First we describe the difference between post- and pre-paid billing schemes and discuss the currently dominantly used charging models in section 3.5.1. Subsequently we discuss billing for network resource usage in section 3.5.2 and billing for the content services delivered on the network in section 3.5.3. Finally in section 3.6 we recapitalize the findings in this chapter as a starting point for the exploration of future scenarios in chapter 4.

3.5.1 Billing schemes, charging types and charging models

There are generally two types of billing schemes; post-paid, also called contract, and pre-paid billing. In post-paid billing the user signs a contract to pay at least a settled fee every month, irrespective of its usage and possibly an additional sum for calls and data usage. The user usually gets his device for free[6] but naturally this sum is returned to the operator via the contract (Bhushan et al, 2005). The post-paid schema allows for a wide variety of services but is inflexible in the switching between operators (Nicopolitidis et al, 2004). In pre-paid billing the user pays in advance for both the calls and data and the device (Nicopolitidis et al, 2004). Although the user is more flexible in his selection of an operator, the range of available services and roaming is less widely supported (Bhushan et al, 2005).

Related but not similar to the two billing schemes are two charging types; offline charging and online charging. These terms relate to the technical capabilities rather than the billing schemes (Nokia, 2006b). In offline mode the information on chargeable events is gathered and sent to the billing system after the event occurred. In post-paid billing schemes this does not pose a problem. However, in pre-paid or limited post-paid accounts this poses problems as the usage may pass the limits posed by the account. Therefore real-time, i.e. online charging has substantial advantages over offline charging (Ary et al, 2005).

Both post-paid en pre-paid, two aspects must be dealt with when charging the user: (1) the use of radio network resources and (2) the value of the content services delivered through these resources. To deal with the first type of charging, often defined as “bearer charging” (Ericsson, 2005) many models are in use in both telecommunications and the Internet, several of which we discuss in Appendix 5.

Basically they can be divided into fixed charging and packet charging. With fixed, or flat fee charging data may be collected on the actual amount of traffic generated, the pricing is based on a fixed (usually monthly) fee that is placed on the bill or deducted from the pre-paid credit. While packet charging, defined as metered charging in the non packet switched domain concerns paying based on the amount of generated traffic or time spent online. When comparing fixed charging with packet and metered charging, fixed charging has the advantage of transparency, as the user knows exactly what he will pay for the traffic part of service consumption, it lacks the possibility of congestion control through charging (Cushnie et al, 2000).

The second type of charging referred to as “premium content charging”, is only starting to be used. Currently users are frequently charged through subscription models that allow them to obtain a fixed number of content services on a monthly or weekly basis (e.g. at Sportsplaza (Interview: Staal, 2007), 2WayTraffic (Interview: van den Bulk, 2007) and Jamba (Euroforum, 2007). According to the UMTS Forum the terms value-based or content-based billing are frequently used for any type of billing where usage is involved (UMTS Forum, 2002). It raises the question of what is content or a service worth. An example of this difficulty is charging for an mp3 file download based on the value of the music title (UMTS Forum, 2002), or charging based on the location of the user, e.g. at home or at a remote location at which different technologies may be used. We discuss these issues further in chapter 4.

3.5.2 Charging and billing for network resource usage

Here we turn to the first component of the billing processes; the billing for the network resource usage. In this paragraph we frequently use terms to denote part of the physical infrastructure and information. To support this terminology we have provided a discussion and illustration of the infrastructure and information in billing for network resource usage in Appendix 4. As the billing for network resource usage nearly entirely is performed in the operator domain, it does not make sense to create a role interaction diagram. Therefore we only provide the IDEF-0 diagram to show how information and technology contribute to this part of the billing process. Furthermore, given the MNO centricity of the billing for network resource usage there are hardly any differences in the process between the on-portal and off-portal situation.

At present in the Netherlands the billing for network resource usage is predominantly based on packet metering (Orange, T-mobile, KPN mobile, Telfort, Rabobank, Tele2, Telfort) and time metering

[6] In some countries such as Belgium regulation forbids this type of customer binding and handsets are to be purchased separately by customers.

(Vodafone)[7]. Although flat fee is already applied at NTT DoCoMo in Japan[8], operators in Europe are only starting to offer this type of billing scheme. New subscriptions at three of the four major operators in the Netherlands are based on flat fee (possibly with some form of fair to use policy). However, opening up current subscriptions to introduce flat fee is not practiced by mobile operators as it would result in revenue losses as the voice part of the subscription and the sponsored handset should be renegotiated (Euroforum, 2007). Thus, wider use of flat fee is expected but currently not the case and therefore this is the subject of chapter 4.

3.5.2.1 IDEF-0 model of billing for network resource usage

The application of the IDEF-0 method leads to the basic view shown in Figure 3.11. This figure provides a high level view on the information that is required (top of figure), the inputs to the process (shown on the left), the outputs of the process (shown on the right), and the technological resources primarily used in the process (shown on the bottom of the figure). Especially in the latter category, termed "mechanisms" in IDEF-0, we have remained on a sufficiently high level of granularity, consistent with our discussion of the telecommunication infrastructure earlier, to remain understandable and generic.

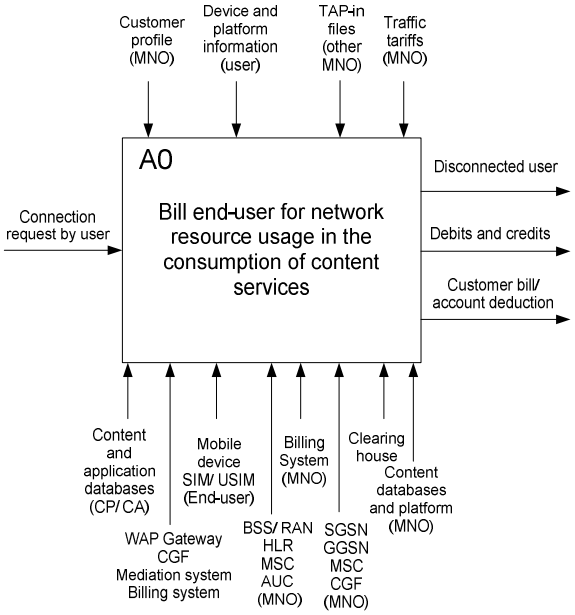


Figure 3.11 IDEF-0 model basic view of billing for resource usage

To further get into depth on the process activities and the specific information and technology required at these steps we created a first decomposition of this process in Figure 3.12. This means that we decomposed of the basic view (i.e. A0) into 6 steps (i.e. A1 – A6). This restriction to 6 steps is compelled in the methodology to remain understandable. When analysis on a deeper level of aggregation is required, each of the activities can be further decomposed. However, given the scope of our research, the current decomposition suffices.

As the input to the process we take the connection request by a user on his mobile device (note, this is a request for a data connection). At A1 this request is accepted based on the authentication on the SIM or USIM and the corresponding identity in the AUC and available credit through the billing system. The subscriber is added to the HLR and the connection is established through the MSC. The information relevant in these activities is the information on the device of the user (identified through the IMEI), the profile of the user (i.e. his account type and credit). If the user account allows it, the user is provided a unique session ID and credit for the session is reserved.

[7] Based on tariff schemes at http://kostenmobielInternet.nl/index.php?id=prive (last accessed at June 4, 2007).

[8] For the exact specification of this billing plan see http://www.nttdocomo.com/pr/2007/001339.html (last accessed at June 6, 2007).

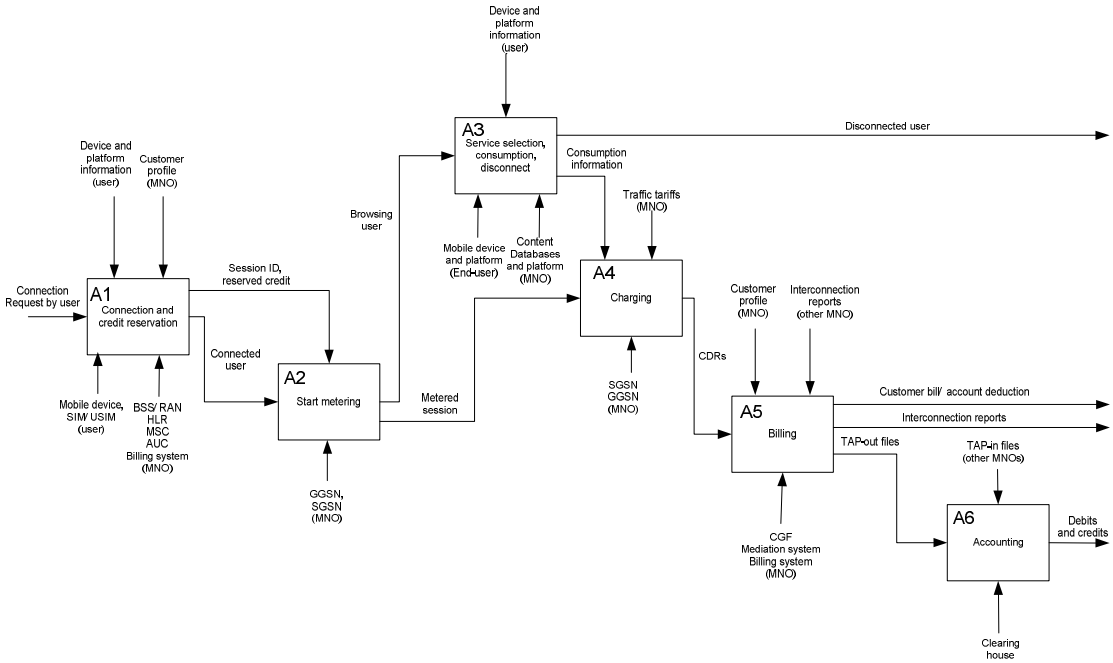


Figure 3.12 IDEF-0 first decomposition of network resource usage billing process

At this point the metering of the usage of the connected user can start at A2, based on the session ID and reserved credit. As discussed earlier the primary components relevant here are the GGSN and SGSN (the MSC only deals with voice traffic metering). Once the metering of the session has started the user can select and consume his required content after which the session ends at A3. Evidently the can contain multiple content services. To use a selected service the platform and device characteristics of the mobile device of the user must be known here. The content services that the user consumes can be on-portal as shown here (the MNO provides the databases and platform) or off-portal where payment and content aggregators provide the service. We more thoroughly discuss content service consumption later in this chapter when we specifically target billing for these processes.

After the user has ended his session the generation of CDRs start which, in case of purely technological resource orientation, is performed by the GGSN and SGSN. These CDRs are received by the billing mediation system and CGF where they are prepared and optimized for billing in the billing system. Although currently most operators have separate systems for pre-paid and post-paid subscribers, we denote one system for the sake of clarity as the basic functions are similar. Based on the customer profile in the billing system the usage of data is placed on the bill or deducted from the account in case of pre-paid. Furthermore, the billing system deals with the differences in interconnection tariffs with the other local operators. This is usually not settled through a clearinghouse but through local reports. These are also processed and generated by the billing system.

In case the session concerns a roaming user, a TAP-out file is created and sent to a clearing house. Evidently the scenario of a roaming user is more complex as the customer profile and account of the user must be communicated with the home network of the user. However, this complexity is out of the scope of our research. We only use the roaming scenario here to denote the role of the clearing house and the function of TAP files in the entire billing process. After the clearinghouse has processed the TAP files, the debits and credits of the different operators using the clearing house are created for further processing. Now that we have dealt with the billing for network resource usage we will turn to the part of the billing process only shortly introduced here; the billing for the content services.

3.5.3 Billing for content services provided on the network

On the mobile Internet WAP is the dominant protocol to condense mobile content to the mobile device. WAP lacks a standard way to bill customers for content services. With the specification of the WAP billing framework (Open Mobile Alliance, 2002) general guidelines are set out to aid application developers, content providers and operators in billing through standardization. It sets definitions and specifies several components in the WAP architecture that enable billing for content services. Usage of resources is charged at the WAP gateway and standards are set for the communication of charging data

between the content providers and the operator, i.e. charging for premium content. However, the standard does not unambiguously specify how these charging data should be communicated (Open Mobile Alliance, 2002). Essentially there are two primary ways; (1) "content provider recording", and (2) recording of tag-based information (in the HTML header). To enable the retrieving of data the user must be online, which is not the case in GPRS.

Therefore, when delivering content to users, frequently the so-called WAP push is used. WAP push essentially entails the transmission of an SMS to the user to notify the availability of a download through a link, but can also contain a script that automatically retrieves the content (WAP Forum, 2002). This mechanism enables billing through the SMSC, so-called (Premium Rate) SMS billing. This type of billing is good for a $4 billion business in Europe (www 11: Mobile Europe, 2006).

Another method used for billing content services is WAP billing, also termed content billing. This type of billing enables users to click through several steps in the payment process without leaving the established WAP session to obtain a link or script via a premium SMS. In the Netherlands this latter type of billing is currently offered by all four operators on-portal, but only Vodafone offers this type of billing off-portal (Interviews: Bergkamp, 2007; Egberts and Vlasblom, 2007; Wennekers and Theunissen, 2007). We discuss both billing methods and related processes in the coming paragraphs.

SMS billing

In this type of billing, frequently called Premium Rate SMS (PRSMS) (Garner et al, 2006) the user is billed on his subscription to the operator or on his pre-paid account by the operator billing system through the SMSC. There are two types of messages; mobile originated (MO) and mobile terminated (MT). MO refers to the costs of the message that is send from the mobile device (for example to an actor holding a short-code). MT refers to the costs that are incurred by the user when receiving an SMS.

SMS billing is supported by all operators in the Netherlands, both off- and on-portal. The SMS billing services are predominantly provided through SMS service providers. There are primarily two reasons here: (1) the short codes are expensive and need to be contracted at each national operator, (2) operators can use tariff schemes that reward economies of scale but for example providing higher kick-backs[9] on a premium SMS when the amount of messages send to the short-code exceeds a certain level. Such a tariff structure is for example used by Vodafone in the Netherlands that forces aggregation in the market, as this reduces the required amount of relations at the operator.

SMS billing has several advantages to the end-user, which predominantly relate to the flexibility of the model. Both post-paid and pre-paid are supported by the system that is easy to integrate in the systems of the content and application providers. Furthermore, the support of the service by the operator is rather straightforward to accomplish, and strong as they can remain the central point for billing through their existing relation. Due to the fact that users can consume services at any operator that supports PRSMS, the coverage is very high (Garner et al, 2006). Furthermore, due to the reselling of the SMS short-codes, smaller actors can also provide services to mobile user without requiring contact with the operator. Other actors, such as aggregators can handle all finances for these actors, hence eliminating the need to deal with banks and credit card companies. Nevertheless, despite of the third party role in PRSMS, eventually the customer is billed through the operator. Additionally, PRSMS is rather flexible in the type of services that can be billed for, which can also be external events.

Disadvantages of the PRSMS to both the end-user and mobile operator predominantly relate to the fact that SMS was not originally developed to support billing. Therefore it lacks sufficient guarantees of quality of service and fraud protection. For example a frequently occurring event is the usage of SIM pre-paid cards with insufficient credit to download content after which billing does not succeed (Mobile Europe, 2006). Furthermore, PRSMS does not support real-time billing (OMA, 2002), chargeback is difficult (Garner et al, 2006), message costs are incurred (BT Agilemedia, 2006) and user interaction can not be controlled in terms of his data tracks and hence it remains unclear who exactly bought what (Mobile Europe, 2006). The latter also involves the tracking of recurrent users which is

[9] In this thesis we frequently refer to the term kick-back to denote the ratio of the revenue that the operators share with PRSMS service providers and the latter with content providers. This is based on current usage of this term in the industry and should not be confused with another usage of the term in literature to denote transactions based on referrals.

not supported by PRSMS (BT Agilemedia, 2006). Finally, the method stimulates the use of spam messages by actors once the mobile number is known. This is an always-open channel to the customer that, despite of regulations in most countries, is frequently applied to lure customers into more purchases through soliciting a response that triggers a PRSMS. This type of customer spam is usually attributed to the operator since its close relationship with the end user makes the operator the first point of contact (Garner et al, 2006).

The advantage of strong operator support for SMS billing also has a drawback to actors active in content provisioning and aggregation. The operator has a great deal of power through the dependency of other actors on the SMS resources and hence can ask high fees for content provision, possibly up to 50 percent of the revenue compared to other (possibly more traditional) methods that range from 3 to 10 percent (e.g. NTT DoCoMo charges a 9 percent fee for using its billing services). This high charging for PRSMS services, despite of low handling costs, is rather consistently done throughout Europe (Garner et al, 2006).

3.5.3.1 IDEF-0 model of PRSMS billing

As PRSMS billing is primarily used off-portal we model the use of this content service billing type in the off-portal scenario. Furthermore, we model the common scenario in which the aggregator hosts the content of a content provider. Although the content provider frequently updates the information on the aggregator's platform (e.g. weather information), in case of a malfunction of this connection, the aggregator can still provide the hosted content (Interview: Bergkamp, 2007). However, when the update does not succeed for a longer period of time, evidently the content becomes outdated. Finally, we use an SMS billing provider to provide billing functionality that although modelled as a separate role, is frequently part of the content aggregator. This scenario is shown on a high level in the basic view of Figure 3.13. The information and technology requirements and inputs and outputs are visible here.

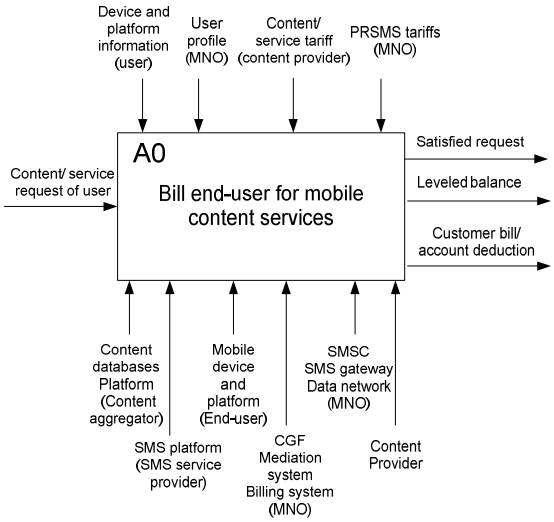


Figure 3.13 IDEF-0 model basic view of PRSMS billing for content services

To further drill down the actual process in terms of the different activities and information and technology requirements at these activities we created a first decomposition of the process in Figure 3.14.

As the first input in the PRSMS billing process we take the request of a user for a specific service or content. Given the fact that this process is based on the off-portal scenario with a content aggregator hosting the content, the request is received at the aggregator's platform that processes this request at A1. Based on the device of the user and the platform that runs on it, it is determined which specific content service should be provided. The content aggregator consequently requests for payment at the SMS service provider (usually these two roles are performed by the same actor and hence on the same platform. Given the fact that all traffic eventually passes the aggregator systems for billing and possibly optimization, the aggregator knows exactly which content consumptions belong to which ID (Interview: Wennekers and Theunissen, 2007).

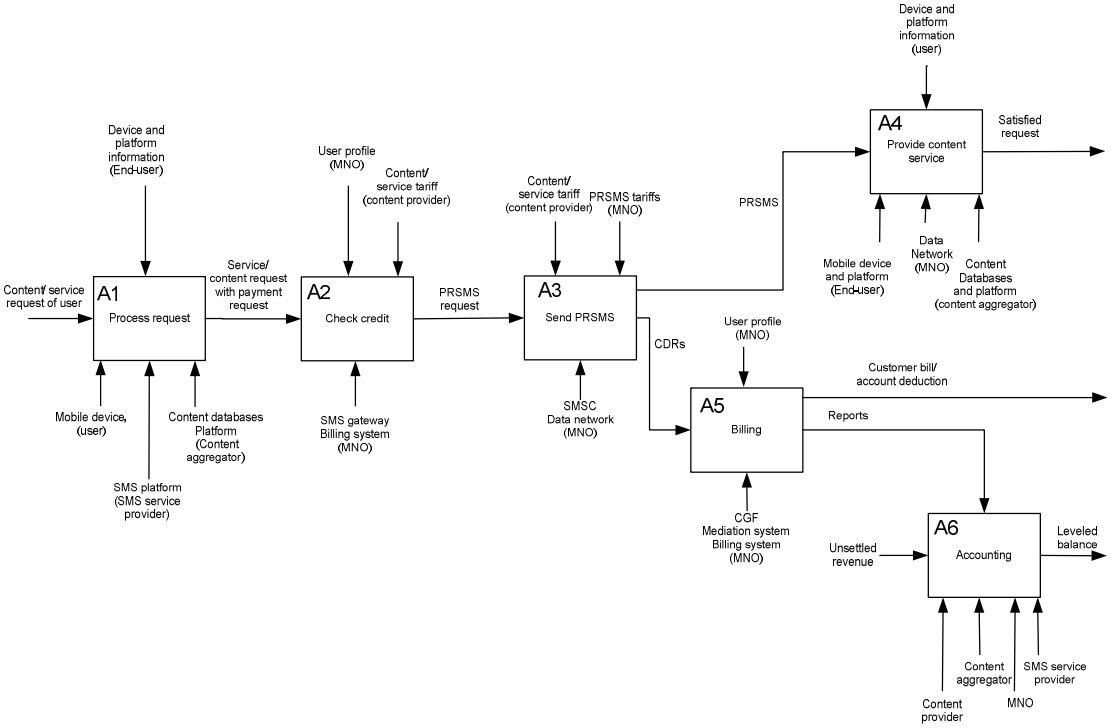


Figure 3.14 IDEF-0 first decomposition PRSMS content service billing

The SMS service provider connects to the SMS gateway of the operator to check whether payment is accepted at A2. At the operator the SMS gateway, based on the customer profile connects to the correct billing system (either post-paid or pre-paid) and reserves the credit in case the payment is accepted. Consequently, based on the content request with accepted payment a PRSMS is requested at the SMSC.

This PRSMS (or multiple in case the content costs more than can be charged in one PRSMS) is sent to the user at A3. Based on this message the user can obtain his content service, which is provided at A4 from the content aggregators databases and platform, through the MNO's data network. In this scenario where the content is hosted by the aggregator, the optimization for the user device is usually done at both the aggregator (i.e. ensuring the correct data format) and the MNO (i.e. resizing the content to fit the device's screen). In the on-portal scenario the optimization of the content for multiple mobile devices is partly perform by the content provider (e.g. at Hyperleap (Interview: Paula and Copius Peereboom, 2007). When sending the PRSMS to the user, the SMSC also generates CDRs which are sent to the billing mediation system where the CDRs are optimized and aggregated at the CGF and consequently billed on either the pre-paid credit or the customer post-paid account at A5.

Finally at A6 the accounting of the revenue of the content service provision is performed. This means that the billing reports generated by the billing system at A5 are communicated with the content and payment aggregator who receive the revenue minus a percentage kept by the MNO. The part received by the aggregator and SMS billing provider is what we defined as the kick-back earlier. The content aggregator subsequently shares part of his kick-back with the content provider. This accounting process is rather complex as it is predominantly done on the basis of self-reporting, i.e. the fact that many actors in the value network depend on the sale figures provided to them (KPMG, 2006a). The fact that not all transactions succeed creates several problems in the settlement of revenues. These problems are however out of the scope of this research. For a more thorough analysis of these issues in self reporting and related revenue assurance we refer to KPMG (2006a).

3.5.3.2 RID model of PRSMS billing

As discussed in chapters 2 and 3 the RID modelling method is complementary to the IDEF-0 method in further showing the manner in which the several roles interact. In this paragraph we shortly show this RID in the off-portal scenario using PRSMS billing. The diagram is shown in Figure 3.15, we shortly describe it below.

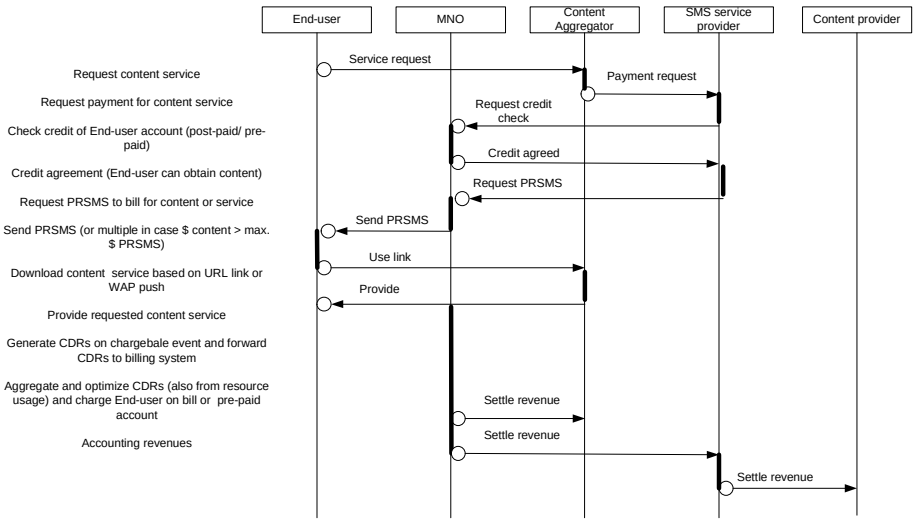


Figure 3.15 RID of off-portal PRSMS billing for content services

As evident from the diagram the MNO orchestrates the entire payment process. The end-user does not have any direct contact with the content aggregator, SMS service provider or content provider other than the request for content. All contact in between in the facilitation of the request goes through the MNO that controls the information flows.

WAP billing

The WAP billing methods are not part of the WAP standard as defined by the WAP forum, whose responsibilities are currently part of the OMA (Open Mobile Alliance). Therefore there is a great deal of diversity in the implementation of these methods as each WAP billing provider uses his own standards and each operator has a different interface (Interviews: de Buck, 2007; Bergkamp, 2007). The basic advantage of WAP billing compared to PRSMS billing is its user friendliness and potentially higher kick-backs (Interview: Bergkamp, 2007). The user only has to select his purchase and can click through only two steps to complete his payment without leaving the WAP session.

3.5.3.3 IDEF-0 model of WAP billing

As WAP billing is primarily used on-portal we model the use of this content service billing type in the on-portal scenario. Furthermore, in this scenario we model the content provider hosting its own content that is directly linked to the operator's portal and hence subject to the constraints of each operator. In this scenario the content provider hosts websites for each operator it is connected and potentially additional websites for off-portal PRSMS billing. This is for example the case at Sportsplaza (Interview: Staal, 2007) and Hyperleap (Interview: Paula and Copius Peereboom, 2007). Also in this scenario we first provide a high level overview of the billing process in the basic view of Figure 3.16.

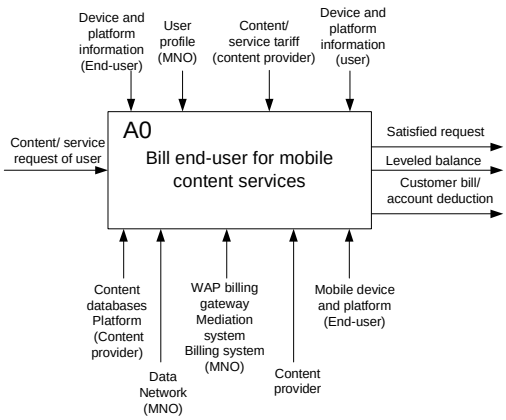


Figure 3.16 IDEF-0 model basic view of WAP billing for content services

In Figure 3.17 we decompose the A0 basic view to further drill down the several process activities and information and technology requirements here. From this figure the similarities differences between

PRSMS billing and WAP billing are evident. Whereas PRSMS billing required the sending of an SMS to generate the CDR or content charging, in WAP billing the WAP billing gateway has a direct interface to the billing system.

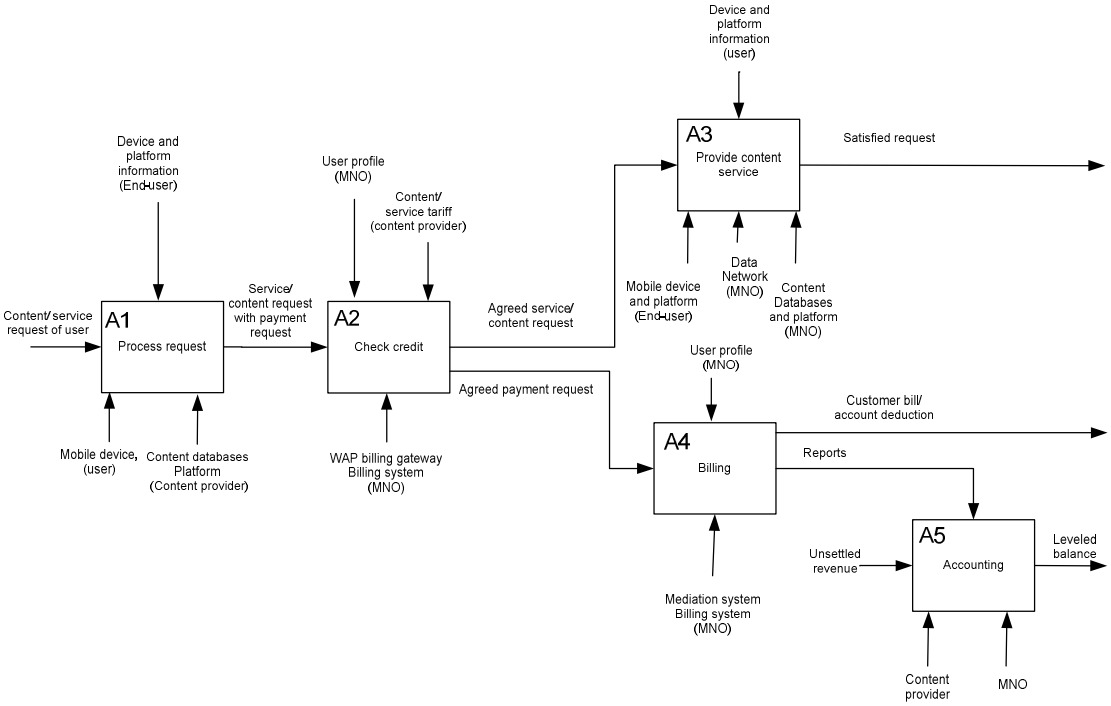


Figure 3.17 IDEF-0 first decomposition WAP billing for content services

The process starts with the selection of the required content by the end-user through the operator portal on the content provider's platform where the requested content is hosted. This request is processed at the operator at A1 where a payment request is made to the WAP billing gateway at A2. Here the WAP billing gateway checks the credit worthiness of the end-user and subsequently does two things. First it requests the billing system to deduce the content service charge for the requesting user at A4.

Second it provides the direct link to the user to download the content or activate the service, in the same WAP session. Finally the billing system generates the reports containing the consumed content and services and related billing information. This is accounted at A5 where the content provider receives his share of the revenue based on these reports. In this scenario the content provider is fully dependent on the MNO both in the provision of the content services, but specifically on the information of the MNO on the sales from the Content provider databases as the latter actor only has information on clicks on his website, not on sales (Interview: Staal, 2007). Evidently also good controls must be in place here.

3.5.3.4 RID model of WAP billing

Also in this scenario we provide an RID model to further focus on the interactions between roles.

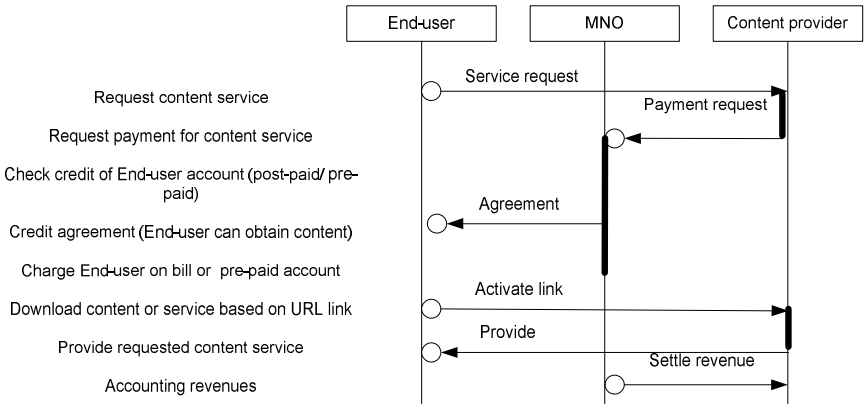


Figure 3.18 RID of on-portal PRSMS billing for content services

In this model it is further emphasized that in online WAP billing, content aggregators and SMS service providers do not play a role. The operator obtains the content from the content provider but handles all payment and end-user interactions internally. Evidently this model is the most simple of the billing models discussed which is exactly where the strength of the operator lies. Only few interactions are required with the user in completing a purchase which appears to be a very important determinant in the end-user purchase rate (Euroforum, 2007). This simplicity, combined with the visibility of specific actors on the portal of the operator makes that on-portal content provisioning remains an important channel for those content providers that deploy activities here, e.g. Hyperleap (Paul and Copius Peereboom, 2007) and Sportsplaza (Interview: Staal, 2007).

3.6 Conclusions

The mobile data industry is only moderately beginning to take shape. To provide a glimpse of its current size: in Europe only a subset of mobile subscribers (i.e. 21 percent) use the mobile Internet and SMS remains the dominant data service. In the Netherlands similar figures apply. The question answered in this chapter was:

How are end-user content services currently billed in the mobile Internet value network?

The first step in answering this question was defining which roles are precisely involved in the mobile value network in the provision of content services. These roles are shown in Table 3.3.

Table 3.3 Summary of roles in content service provisioning

Role	Description of functions
End user	Consumer of services and content
Portal provider	The "gate" to the mobile Internet. Presents content and services and enables navigation
Application and Service provider	Enables "the flow of business" through providing several services in a B2B context on which other roles build
Content aggregator	Aggregates, transforms, and preparers content to suit the end-user's needs
Content and service developer and owner	Can include a wide range of content and services. From artist to record labels to specific mobile Internet application developers.
Content provider	Delivers content and services that satisfy customer needs through an access channel.
Advertiser	Provides free content or paid content to reach the end-user.
MVNO	Reseller of capacity to end-users
Platform developer	Develops the technology that enable the functioning of services on the hardware in use.
Mobile Network Operator	Network owner and provider of access and transport services in the mobile domain.
Internet Service Provider	Provider of access and transport services in the fixed domain. Either owning a network or operating on a wholesale basis.

The second step was to define which roles are specifically relevant in the light of the billing for these content services. These roles are shown in Table 3.4.

Table 3.4 Summary of roles relevant in billing for content services

Financial service provider	Handles financial transactions such as payments on behalf of other organizations
SMS service and WAP billing provider	Provides a platform and interface (SMS short code) to parties wishing to bill their services through SMS or WAP billing on the user account at ther operator
Billing and collections provider	Compiles the end-user bill and arranges collections of this bill.
Authentication, Authorisation, Credit Reservation	Authenticaes and authorizes the user for specific content or services and ensures that sufficient credit is available to obtain the service or content.
Clearinghouse	Settles the roaming charging differeces between operators based on received TAP files

Based on this overview of the mobile value network we specifically regarded billing. Billing for content services can be divided into three basic activities: (1) charging for both network resource usage and the price of the content service (2) placing these charges on the monthly bill or deducing it from the pre-paid credit, and (3) settling the revenues of these charges with the actors involved in the provisioning.

Charging for network resource usage is, in the Netherlands, predominantly done on the basis of metered or packet charging which means users are charged based on the time or amount of data they consume online. This charging entirely takes place at the operator. Charging for the price of content services is done through primarily two different mechanisms. Premium Rate SMS billing is the dominant method off-portal and WAP billing is the dominant method on-portal in the Netherlands. On-portal refers to consumption of content services on the operator portal. Off-portal refers to content service consumption outside the operator domain. In Table 3.5 we summarize the currently critical roles in billing and their relation to actors and control of information and technology in both on-portal and off-portal billing.

Table 3.5 Overview roles on- and off-portal

	On-portal			Off-portal		
Role	Actor	*Relevant Technology*	*Relevant Information*	Actor	*Relevant Technology*	*Relevant Information*
Network operator	Operator	Radio network, SIM/ USIM	End user usage, demographics	Operator	Radio network, SIM/ USIM	End user usage, demographics
Billing and collections provider	Operator	Billing platforms	Tariffs	Operator	Billing platforms	Tariffs
Content aggregator	Operator	Content aggregation platform and server	none	Third party	Content platform	Usually all information of content usage at supported content providers
Content provider	Third party	Platform hosting several sites in different formats depending on operator portals	Very few information on usage available. Received from operator or monitored in click stream	Third party	Possibly hosting content, connection to content aggregator. Hosting one site.	Depending on aggregator, usually all usage information
SMS service provider	n/a	n/a	n/a	Third party, frequently combined with content aggregator	SMS platform	Prices related to phone numers
MVNO	Third party	CRM system	End user demographics	n/a	n/a	n/a
Portal provider	Operator	Restricting	none	Third party, usually combined with content provider	Platform hosting one or more sites depending on SMS Service Provider(s)	n/a

The billing processes are not only predominantly facilitated by the operator's technological infrastructure, the operator also controls the critical information. Information resources, such as the user's identity (SIM/ USIM) and demographic data (CRM database) are in the current situation inimitable and hardly substitutable. This also holds for technology such as the billing system. These can be considered technological and informational resource barriers that constrain the feasibility of other role division models. Additionally the ease of use of both billing methods, jointly with the already large established user base of these methods can be considered more intangible resource barriers in the operator-centric model.

Actors other than the operator have little information on the customer. Although an MVNO has customer information on demographics and monetary consumption, the operator controls the infrastructure and hence the access to the SIM identity. However vice versa, in this setting the operator does not have any demographic data on the customers served through an MVNO. Content providers, depending on the portal in use have little customer information. In the on-portal scenario they only have data on the amount of clicks on their site without knowledge on who exactly is using their services. Their revenue is based on the reports generated by the operator. In the off-portal scenario the content provider can either be hosting its content at an aggregator, in which case it is entirely dependent on the aggregator's usage information, or host its own content using the aggregators platform for traffic aggregation and frequently also the billing through PRSMS. In the latter scenario the information the content provider has, can be more specific, depending on the aggregator.

SMS service resellers and content aggregators have important platforms that support the billing at mobile operators. These platforms enable the operator to broaden its scope while explicitly dealing with a limited amount of actors. These aggregators only have moderate customer information. The purely content aggregator has no contact with customers at all, while the SMS service reseller basically only knows what amount to request to bill on which number, through the operator's SMSC.

However, the dependency relations of the content providers and aggregators on the operator may be subject to change. As already discussed in the introduction developments taking place in technology and at actors fulfilling these roles, may alter the current resource barriers. This is the subject of chapter 4.

4. Exploration

"My interest is in the future because I am going to spend the rest of my life there"[10]
Charles F. Kettering (American engineer, 1876-1958)

4.1 Introduction

The mobile Internet industry is in a constant state of flux. New services and roles are introduced, enabled by several technological and non-technological developments. In this chapter we explore these changes in the industry in which we specifically focus on the developments on the value network and process levels in the light of billing for content services. We use the current billing processes in the currently dominant role division identified and discussed in the former chapter to explore already visible and anticipated changes at the actors fulfilling roles and the billing processes as currently arranged. The dominant input of data in this chapter comes from our interviews of which we provide reports in a separate appendix and a high level analysis in appendix 8. In the text we frequently refer to specific findings from the interviews using short references. The interviews are supported by short case descriptions and findings from industry documents such as white papers.

In section 4.2 we first provide data on the expected industry developments to place this chapter into quantitative context. Then, in section 4.3 we discuss new types of services. Subsequently in section 4.4 we discuss the developments in the roles in the value network, the actors fulfilling these roles and the entry of new actors. In section 4.5 we elaborate on some specific developments in the light in billing such as the introduction of Internet billing methods in the mobile domain and new supporting technology. Finally we provide a conclusion on the insights in this chapter in section 4.6.

4.2 Figures on the future mobile industry

Whereas in the former chapter it was illustrated that the mobile Internet currently fulfils a moderate role in terms of revenue contribution and market uptake, growth is expected. Independent organizations such as Forrester are only moderately enthusiastic about the potential of mobile Internet, but industry participants such as Netsize and Nokia expect great revenues. This will most likely lead to renewed investments in the mobile Internet sector.

Forrester predicts that the third generation of mobile technology will be dominant in the mobile phone market in Europe but not until 2010 when penetration reaches 60 percent and GPRS (2,5 G) will not loose ground before the end of 2007. Currently over 70 percent of mobile users has GPRS enabled devices whereas this will lower to 38 percent in 2010. By 2010, 200 million Europeans will have a 3G mobile phone that is Internet ready. Although these numbers still look promising, Forrester expects that only half of the users with enabled devices will use the mobile Internet (Forrester, 2006).

The ideas on mobile Internet emerging from the industry participants are best captured by the statement of Olli-Pekka Kallasvuo (CEO of Nokia) that Internet will be the most important contributor to the growth of the mobile industry in the coming years (November 29, 2006)[11]. The UMTS forum estimates that the worldwide number of 3G subscribers will comfortably exceed 275 million at the end of 2007 (www 12: UMTS forum, 2007) and Informa Telecoms & Media predicts that mobile entertainment will be worth US$23.1 billion revenues in 2007, and US$38.1 billion in 2011 (Netsize, 2007a). These statements are supported by data such as the fact that the amount of searches on mobile phones in Europe in 2006 has been ten times the amount of searches in 2005 (Mobile people, 2006). Further examples of growth are evident from the online selling of music by 3 UK that is selling full track downloads at a rate of 1.2 million per month and music videos at 1.25 million per month. With the continuation of this trend the mobile market is forecasted to be worth US$8.76 billion in 2007." (Netsize, 2007a).

---

[10] Quote taken from http://thinkexist.com/quotations/future

[11] This statement was taken from the Euroforum website:
http://www.euroforum.nl/scripts/cgiip.exe/WService=eur_new/srcw/pd.htm?prg=E57434&categorie=&pdktype=&zoekwoord=content

In the Netherlands, the largest provider in terms of market share, KPN, expects strong growth in the uptake of mobile Internet and more specifically UMTS. Now that the business market is starting to use the service, KPN expects consumers to follow (www 13: Nu.nl, 2007a). Whereas currently the revenues on mobile data range between 75 to 80 million Euro, KPN expects to pass revenues of 100 million Euro in 2007 (www 13: Nu.nl, 2007a).

Most short-term growth in the industry is expected from the so-called "three pillars of mobile entertainment" which are TV and video, music and games. While mobile music and more specifically ring tones were the major driver of online content revenues in 2006 TV video and games will grow rapidly in the coming years. Furthermore, ring tones will subside with the emergence of full track downloads (FTDs) (Netsize, 2007a). This is aligned with the ideas at Jamba! and T-mobile who note that ring tones, although currently still the major driver of revenue will be replaced by full tracks (Euroforum, 2007; Interview: T-mobile, 2007). However, these content types are rather classical in the sense that they are extensions of the regular Internet to the mobile device. In the next section we more elaborately discuss new mobile services and the characteristics that differentiate the mobile Internet from the regular Internet.

4.3 New services

The focus in telecommunications has traditionally been on infrastructure and broadening coverage (Peppard and Rylander, 2006). However, this mindset is beginning to change and key assets such as billing, messaging, location and presence become more important (Peppard and Rylander, 2006). Bandwidth is becoming a commodity (Nokia 2006a) and mobile data speeds of respectively 14,4 Mbps and 50 Mbps are expected in the near future which matches the current regular Internet speeds (Interview: Hermans, 2007). With the convergence of the Internet and telecommunications world also the services converge (Bhushan et al, 2005; Pollet et al, 2006).

These multiple packaged value adding services (VASs) are the core driver of changes in the mobile industry. According to Kuo and Yu (2006) value added services generally comprise of four main categories; (1) mobile transaction services (such as mobile banking and mobile shopping), (2) mobile information services (such as news and traffic information), (3) mobile entertainment services (such as mobile games and mobile videos), and (4) mobile messaging services (such as SMS and video phone). The value these services provide is essentially derived from the characteristics of mobile devices, which mainly include the following four: ubiquity, convenience, localization, and personalization (Kuo and Yu, 2006). We discuss these below.

4.3.1 Mobile service value drivers

Ubiquity is the availability of applications anywhere and at any time (Tsalgatidou and Pitoura, 2001) and hence refers to the idea of being everywhere at a single moment. With the convergence of the IP and telecom worlds ubiquity is increasing; the possibilities of both worlds converge. Applications emerging from the IP world become available on mobile devices, drastically increasing ubiquity.

Convenience is closely related to ubiquity and combines ubiquity to the usability and ease of use of services. The availability of the right content at the right time and place can be considered part of convenience and relate this aspect to localization and personalization which we discuss next. From a billing perspective convenience is one of the core aspects in the organization of the billing processes in the value network. Developments driven by convenience are for example unified billing and single sign-on (Cuevas et al, 2006). These two concepts emerge from the user domain but have a strong potential impact on the role divisions of billing in the value network as they need a single actor to handle authorisation and authentication, and arrange the bill and money transactions. Another important aspect of convenience in the light of billing for services is transparency. Due to the diverse charging schemes and billing parameters and the amount of actors and money flows involved in delivering a service, the end-user has only little overview of what he is actually paying for.

Localization can refer to several aspects. In its traditional form localization referred to the ability to reach a specific type of content or a specific location, however currently it also refers to reaching a mobile worker or an item (e.g. tracking a shipment) (Coursaris et al, 2006). In terms of the use of services on a portal, localization refers to the supply of information that is relevant given the user's current location (Tsalgatidou and Pitoura, 2001).

Closely related to localisation is personalisation. Personalised services are defined as "seamless service usage across communication environments and applications that are adaptable to individual users' contexts" (Ballon, 2004: 373). Evidently the location of the user is part of this context, which we further discuss later in this paragraph. The amount of information available on the mobile Internet is tremendous. Therefore providing information in a manner that suits the individual user's preferences can not only increase the user's satisfaction but also improve the efficiency and effectiveness of using the system (Coursaris et al, 2006). As a mobile device is typically assigned to a single user, this personalisation can take place on this device. Search portals also play an increasingly important role here. The interaction path of the user can be optimized on the basis of personalisation (Tsalgatidou and Pitoura, 2001).

To provide customized services and user interactions, user knowledge is required. Shapiro and Varian (1999) discuss two ways to obtain user information on the Internet. The first is the billing relation which provides geographical data and demographic data and data on service usage. The other source is observation which can take several forms: (1) users can be tracked on the basis of their click stream, (2) analyze their search behaviour (the queries), and (3) analyze their purchase behaviour (Shapiro and Varian, 1999). The mobile Internet provides more possibilities to be personal than the regular Internet. These aspects were already mentioned in this section. Barnett et al. (2000) distinguish the following three features: (1) because mobile devices are carried by the user, he can be always online and present to receive time-critical information, (2) the device is usually personal and can thus be used to identify the user, and (3) operators can determine the exact location of the user. Barnett et al. (2000) even identify a separate role for personalisation; the actor that can provide the best customer information is a valuable link in the network. This role was termed the "Nielssen model by one of the interviewees to which he attributed large potential (Interview: Hermans, 2007).

Personalization can be taken one step further. Services can not only be customized and location aware, they can be adaptive to the entire context surrounding the user (Tsalgatidou and Pitoura, 2001). This entails a broader perspective on personalisation and localisation. For example Boda et al (2005) place personalization jointly with profiling under context-aware functionalities. Context can be defined as "any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves." (Dey and Abowd, 2004: 3). Hence in a user service perspective "a context aware system provides applications with the appropriate and relevant context information that enables them to adjust optimal to the user situation" (Kranenburg et al, 2006: 1). This also includes presence which closely relates to ubiquity as it enables the reaching of a user based on the technology best suited in his current context (e.g. IM in a meeting, voice in the car etc.). Evidently this next step in the personalisation of services requires more customer information, increasing the value of customer contact.

4.3.2 Bundled and parallel services

As mentioned above the infocommunications industry is expanding its reach. Services from different industries converge. This trend not only holds for services from outside the industry. Services are increasingly offered in bundles, frequently defined as "packaged services" (Bhushan et al, 2005) or "composite services" (Bhushan et al, 2002). The fact that services increasingly exist of service offerings of different actors makes the billing for these services more complex. Not only different roles interact but also multiple actors fulfilling similar roles. We return to the effects of service bundling on role divisions in section 4.4 and the more technological nature of convergence in section 4.5.3.

Another visible trend is the provision of service in parallel. Users increasingly demand abilities that enable the simultaneous usage of multiple services (Interview: Hermans, 2007). This is essentially similar to the experience on the regular Internet where many applications and services can be obtained simultaneously. A technological enabler of parallel services is the IP Multimedia Subsystem to which we return in section 4.5.3.

4.4 Value network role changes

Tapscott et al (2000) speak of the migration of the telecom sector onto the Internet as the introduction of new kinds of flexibility and choice where the end user can choose between a large number and variety of competing service providers. The convergence of customer and content providers would result in competitive commodity market for mobile communications, where customer choice and value

added services are more relevant than network assets. Seven years after the publication of these ideas the first signs of the open mobile Internet, required to facilitate these types of changes, are appearing. In this section we discuss these and related developments at the identified relevant roles in the value network.

4.4.1 Mobile Network Operator

Operators are starting to realize that the walled garden approach does not maximize profit. According to Barnett et al (2000) the "walled garden strategy" is flawed; (1) it fails to maximize demand for data traffic as users may be barred from their favourite online services, and (2) it runs the risk of driving away unsatisfied customers.

In the Netherlands operators are slowly deconstructing the walled gardens and Internet on the mobile device is increasingly provided on similar conditions both on- and off-portal. One of the major drivers of open mobile Internet is the global market. In most countries where mobile penetration currently vastly grows, users are experiencing the Internet the first time on mobile as other channels are not available. This leads to a tremendous push towards open mobile Internet which is also felt in the Western countries where the Internet is already a commodity (Interview: Hermans, 2007).

Vodafone terms this type of Internet "open mobile Internet"[12], Hi (KPN) advertises using the term "Hi society[13]", T-mobile uses "Web 'n' Walk[14]". KPN specifically targets a transition from operator push to market pull and sees its own role primarily as "managing openness" (Euroforum, 2007). This openness is not entirely new. For example Vodafone in the Netherlands has always provided access to the Internet outside the mobile portal, there was simply not enough content offering outside the portal. According to Vodafone, the Vodafone live! portal remained an oasis in the dessert of the mobile Internet (Interview: de Buck, 2007).

Additional to the slowly opening up of the walled gardens, new subscriptions to the mobile Internet are usually flat fee based, providing freedom to explore the mobile Internet without incurring additional costs. It appears that operators are focussing on their distribution channel (data network role) combined with their billing capabilities (BCP role), which is exactly the statement of T-mobile in the Netherlands (Interview: T-mobile, 2007). However, this notion should be tempered as current flat fee subscriptions in the Netherlands only apply to web browsing and related traffic; other services such as streaming are not part of the flat fee (Interview: Hermans, 2007). Examples of full flat fee access are available at for example 3 in the UK, but prices remain rather high.

Hence although the first signs of the open mobile Internet are visible, it is far from a mobile content commodity market. Many other factors are relevant here and a great deal of power remains at the operators since they control for example the location of the user and the access to the SIM or USIM which holds the identity (Interview: de Buck, 2007). The actual location of the user is only known by the operator (Tsalgatidou and Pitoura, 2001) who can determine the user's current position on the basis of triangulation (www 14: Openwave, 2002). However this latter technique frequently turns out to be rather inaccurate in the provision of location based services, especially in less rural areas which can generate large customer dissatisfaction (Interview: Paula and Copius Peereboom, 2007). Other techniques such as the Global Positioning System (GPS) and Near Field Communication (NFC) are increasingly used but also have their disadvantages. We discuss these technological developments further in section 4.5.3.

4.4.2 Content provider

As evident from chapter 3, actors fulfilling this role at present can have several connections. First they can be listed on the operator portals which generate traffic to their sites that are usually offered white label. This type of relation will become less important as the broad consensus among interviewees is that the operator portals will be less important as a first point of contact. On the open Internet the names, "i.e. eye balls" of companies will become more important (Interviews: Paula and Copius Peereboom, 2007; Staal, 2007; Bergkamp, 2007). As currently many of these actors rely on the traffic generated at the operator portals, they face the challenge of attracting customers themselves. A likely

[12] See http://www.vodafone.nl/prive/mobiel_Internet?cmpid=vfnl&attr=c1_prive_mobiel_Internet

[13] See http://www.eindeloosonline.hi.nl/#/watkunjeermee

[14] See http://www.t-mobile.nl/persoonlijk/htdocs/page/diensten_fun/Internet_email/mobiel_Internet_email.aspx

scenario here is that the smaller content providers are acquired by actors that can attract customers based on their name (Euroforum, 2007).

Second, companies fulfilling the content provider role can provide off-portal content through aggregators. If the content has sufficient value for customers, these sites will further proliferate. Given the expectations of customers that content on the open Internet is free, content providers are also starting advertisement based content service provisioning (e.g. Interviews: Paula and Copius Peereboom, 2007; Staal, 2007). As noted by Peter Cowley (managing director Digital Media Endemol UK): "We are big believers that you can't fleece the consumers for too much money. You've got to get the advertisers to pay" (www 15: Emerce, 2007). Evidently the same problem holds here. To generate revenue from advertisements, a large amount of visitors must be attracted. The larger actors already have this marketing experience and greatly welcome the openness of the mobile Internet. Smaller actors that relied on the operator portal face new challenges.

One of the possibilities is to use present portals, well visited on the regular Internet such as "Startpagina". Although these sites can generate tremendous amounts of user visits (e.g. Startpagina.nl registers 4 billion users a day[15] on the regular Internet), their sheer size, (i.e. the very large amount of links), makes it difficult to capture their offerings on a mobile screen. A possibility here is that users will create their own portals through RSS feeds, which provides flexibility and enables personalisation (Interview: Paula and Copius Peereboom, 2007). Another possibility is generating users through search portals such as Yahoo!, Google and Micrsoft live search. Given the limitations of mobile devices in terms of screen size, search engines are expected to play an increasingly important role in guiding the user through the mobile Internet. This is further emphasized by the fact that the amount of searches on mobile phones in Europe in 2006 has been ten times the amount of searches in 2005 (Mobile people, 2006). Mobile search portals may become the focal point of customers.

Mobile searching should not directly be interpreted equal to regular searching on the Internet. Given the fact that a mobile device is more personal and customer wishes can be more easily identified, mobile searching can be expanded to directly providing more in depth links on content (Interview: Bergkamp, 2007). Although this differentiates mobile searching from regular searching, the same mechanisms in terms of advertisement and sponsored hits apply. Hence, it makes sense for operators to provide search portals on their site, thereby obtaining part of the advertisement revenues. At any portal there are different options to provide search functionality. First it can be one of the strong names in this market offered white label or under its own name. Second, it can be a tailored portal offered white label by specialized actors. For example InfoSpace offers a meta-search function that uses the three large engines just mentioned to generate hits. This combined with the potential additional functionalities in mobile searching makes this market increasingly important in the mobile world (Interview: Bergkamp, 2007).

4.4.3 Advertiser

Given the shift to advertisement based models by many content providers and the increased focus on mobile searching, the advertisement on mobile is starting to gain momentum. Specialized advertising bureaus are gaining a more prominent position. Actors active in the mobile industry are looking at ways to exploit advertisement models on the mobile channel (Interviews: Paula and Copius Peereboom, 2007; Staal, 2007; Bergkamp, 2007). However, advertisement based models are outside the scope of our research and we only identify the changes but do not further develop these.

4.4.4 Content Aggregator and Application Service Provider

Barnett et al (2000: 166) stated that actors in the infocommunications industry, especially operators "need to focus on areas where they hold strong competitive advantage, otherwise the danger exist that they will spread their skills and resources too thin". Given the decomposition of the walled gardens and the decreasing focus of operators on providing their own content, this appears to be the case. This type of specialisation is also evident at InfoSpace who are selling their game design studios and are terminating their contracts with music labels to specifically focus on the technological enabling of delivery and payment of the aggregated content of content providers (Interview: Bergkamp, 2007). Current mobile content aggregators focus at what they are good at and provide facilitation of payment delivery for content providers as a single point of contact to all operators and possibly also payment

[15] See http://www.startpagina.nl (visited at June 27, 2007)

providers such as Paypal and Wallie. Hence at these actors end-users may be provided with multiple payment methods to purchase their content (Interview: Egberts and Vlasblom, 2007) but customer relations at these actors remains low; most likely limited to the service relation (Interview: Egberts and Vlasblom, 2007).

Opposite directions can also be observed. On the open Internet strong names will become more important. These names can be brand names but also artist or game names. Providers owning these names can exploit this. For example the Bertelsmann group (owning part of for example Sony BMG, Arvato services and RTL) has acquired Cellgate, which already provided many SMS services to RTL. Hence the Bertelsmann group controls strong names (e.g. RTL), its own content (Sony BMG, RTL), content aggregation and technological facilitation (Arvato Services), and SMS payment platform (Cellgate). Another example of a company expanding its role is 2Waytraffic. Whereas their current role is the provision of acquired content through aggregators, they currently also examine ways to create their own content (Interview: van den Bulk, 2007).

The rise of technology providers in the content market is evident, which was one of the major premises of Ballon (2004) who identified, additional to the three models of the UMTS forum (2002) a more ASP-centric or technology development-centric type of cooperation among actors. For example Nokia has acquired OD2 (www 16: Emerce, 2007), a large content aggregator, and Twango, an actor holding technology specialized in sharing content (www 17: Nokia, 2007). And Amdocs, which among others is a large vendor of billing systems, has acquired Qpass. Qpass aggregates content but also facilitates payment through the operator billing systems. By acquiring these companies, Nokia and Amdocs add aggregation to their portfolio. Another interesting case is the introduction of the Iphone by Apple. Apple has created its own handset that it directly linked to their music activities on the Internet, i.e. “ITunes”. If customers wish to use the phone it must be linked to the profile on Itunes for which billing data of the customer is required (www 18: Iphoneclub, 2007). Evidently this can be first steps towards creating a billing relation with the customer by this technology provider of origin. Apple has started a transition from pure technology provider to media company.

Furthermore, new types of aggregators emerge that enable content owners and providers to have more direct contact with operators and hence cut several steps in the process. An example of this new type of aggregator is “Independent IP”. This actor is a technical enabler of premium content delivery (specialized in music) that directly deals with large content owners and the mobile network operators. Essentially Independent IP provides an open platform to any actor wanting to distribute its content on the mobile channel.

4.4.5 Billing and Collections Provider

The BCP role in the mobile Internet is currently strictly controlled by the operator but supported by SMS service providers and WAP billing providers. One of the basic premises of this thesis is that other actors can also fulfil this role. We elaborately discuss the options identified in the introduction in the next chapter. Here we limit the discussion to several of the empirical developments we have found in the industry concerning the BCP role.

Google is starting to offer payment services under its service “Google checkout” and Microsoft is building customer relations through its “Microsoft Passport”. These companies represent some of the strongest brand names around and hence can be considered strong competitors in this role. These actors are currently predominantly focussed on larger transactions. Their kick-back on micro payments can not yet compete with current solutions (Interview: Haanstra, 2007). Another interesting example of changes in this role can be found in Belgium. Here two banking networks (i.e. Bancontact en Mister Cash) have started a company called “Banksys” (currently acquired by Atos Origin) that has made agreements with all three operators in Belgium to enable SIM based security to deal with financial transactions on the mobile phone. NTT DoCoMo in Japan is strengthening his position in the BCP role through cooperation with credit card companies. DoCoMo offers NFC combined with payment to bill customers on their phone bill or pre-paid account for assets such as train tickets. The banking license of the credit card companies is a critical resource contributed here as this allows for billing of non-mobile related services. However, as we predominantly focus on mobile content services in this research we do not regard these types of transactions.

ISPs can also assume the BCP role, as already discussed in the introduction. They already have customer relations to which they bill Internet access charges. Essentially they have similar options as

the operator and could deploy similar payment services as they also have billing systems in place (Interviews: Bergkamp, 2007; Haanstra, 2007). However, they do not have any control of the SIM card or the mobile device. An example of an ISP assuming the BCP role for content service charges is France Telecom[16]. France Telecom provides billing services similar to current MNOs on their fixed Internet account. In the BCP role also an aggregation function can be distilled. On the regular Internet, actors such as Global Collect, and Netsize on in the mobile domain have contact with many actors fulfilling a specialized BCP role (e.g. Wallie). The payment aggregators offer a broad range of payment methods to a content provider. In Table 4.1 we summarize the developments found at actors identified as currently fulfilling important roles in billing.

Table 4.1 Developments visible in roles currently active in the mobile Internet Value network

Role	*Major developments*	*Implications for mobile billing*
Network operator	Focussing on facilation of content provision and services.	Billing will be predominantly performed off-portal where the mobile operator has a strong foothold in the billing market. However, other methods are also enabled in this relatively open environment.
Content provider	Off-portal the name of the provider becomes more important as services are no longer offered white label. This forces current mobile content providers to reconsider their position as competitors enter the industry and the preferred location on the operator portal slowly vaporizes.	In the relatively open environment content providers used to the on-portal billing situation will have to find new ways to bill for their content. Similar to new entrants.
Content aggregator	Specialisation on enabling platforms and billing services. Given the increasing importance of brand names, B2B services appear to suit this role best. Current aggregators are of increasing importance in the hosting of content of providers as the portals of operators decrease in their usage. New types of aggregators enter the market. The aggregation role is increasingly obtained by technology providers to have a stronger foothold in the mobile content market.	These parties further specialize in enabling content provisioning on the mobile channel. Systems are tuned to operator (PRSMS and WAP) billing Technology providers do not have their systems tuned to the operator systems and may deploy other billing methods than currently supported by mobile content aggregators.
SMS service provider	Will provide these services on the short term as SMS will remain. These parties will further aggregate to exploit economies of scale. However, on the long term WAP billing will probably become the standard leaving only those that support this service in the content market. Other SMS services will remain.	SMS billing will remain, especially for voting services. WAP billing will grow in its share of total billing.
Billing and collections provider	Currently part of the operator but other role divisions are enabled by both technological developments and the entry of new players in the industry.	The role that is of primary interest of most parties involved in the industry. Other parties increasingly target this market, deploying innovations and methods already used on the regular Internet.
MVNO	Increasing in number and heterogeneity; entry of parties from outside the industry and ISPs.	These parties enter the industry and obtain the billing relation with the customer (essentially assumming the BCP role).
Portal provider	The operator portals are decreasing in usage and hence services and content formerly dominant on these portals are no longer offered white label. Portals will become more party specific and the portal provider role is increasingly part of content providers and aggregators. Portals are hard to realize on the mobile phone and mobile searching will become important. Strong brand names can attract customers as well as high hits on search engines.	On their own portals content providers or aggregators have a billing environment in which they can use either the operator billing functionalities or search for alternatives which are increasingly available.

4.4.6 Mobile Virtual Network Operator and Mobile Virtual Network Enabler

MVNOs are rapidly growing in number and their diversity is large. As already discussed in chapter 4 there are multiple categories of MVNOs. Those emerging from other industries can include banks but also large content providers such as Disney. This enables these actors to build customer contact. To be able to bill customers, evidently more than just the relation is required. This is where the MVNE role comes in. An MVNE positions itself in the market between the MNO and the MVNO, taking over specific functions from the MNO to offer to the MVNO (Kiiski, 2006). This is visible in Figure 4.1.

[16] See http://www.valista.com/customers/customers_testam.php

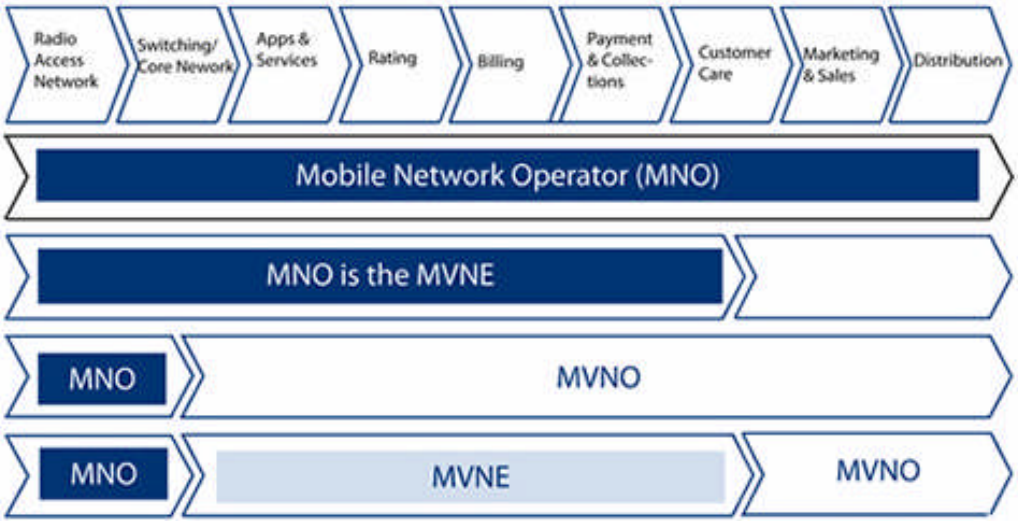


Figure 4.1 MNO, MVNE and MVNO (www 19: Lasalle, 2006)

Essentially, offering services as an MVNO that also deals with the MVNE functions allows actors to build their own customer contact (purely MVNO) and bill accordingly (MVNE). Evidently, the relation is only build with customers of the MVNO. Hence to bill customers of other operators or MVNOs, either these operators are required or a specialized BCP such as Paypal. Hence an actor that deals with both MVNE and MVNO activities nearly equals the role of the MNO. This is also visible in Figure 4.1. An MVNE basically places itself in the gap left by operators in the enabling of MVNO activities. Current MNO systems are not suited for the provision of wholesale services to MVNOs and are hence rather rigid. MVNEs do not face this legacy and deploy their systems to suit the wholesale market (Interview: Hermans, 2007).

Rabobank is the first bank in Europe that started MVNO activities (www 20: CDRator, 2006). Banks that also uptake the MVNE position have a rather advantaged position as they can not only bill their customers that have subscribed to their network, they can also bill customers that already have a bank account. Furthermore, as they have a banking license they have more freedom in the billing for non-mobile service related assets. Whereas typical MNOs can for example not charge pre-paid users for non-mobile consumable services, banks can (Interviews: Bergkamp, 2007; Haanstra, 2007). Another example is the merger of financial institutions with 2G and 3G operators which is for example evident in Taiwan (Kuo and Yu, 2006). In their operator role the financial services will not directly profit from access and traffic charges but from payment commissions. This would make the financial institutions competitors to operators with whom competition will be fought on an entirely different level of economics (Li and Whalley, 2002), which is essentially the domain of the banks and not the operator (Interview: de Buck, 2007).

Another relevant development in the MVNO market is the introduction of ISPs in the market. The step of ISPs to start as MVNOs makes sense. Actors in the infocommunications industry are focussing on their know-how based resources, on flexibility and on market reputation (Buellingen and Woerter, 2004). In essence an ISP serves as the MVNO in the wired world. The capabilities of these actors also apply in the mobile market. Examples of ISPs not directly owning physical infrastructure entering the Dutch mobile market are Scarlet (currently only voice) and XS4all (currently only UMTS). An example of an operator owning physical network assets that entered the Dutch mobile market is UPC. The latter type of actor has particular advantages in terms of billing as they can use their existing billing infrastructure. Moreover, ISPs do not require entering the mobile market as they already have connections to the Internet and billing capabilities for their users. Nevertheless, so far, also on the wired Internet, ISPs in the Netherlands do not provide any wholesale billing capabilities (Interview: Bergkamp, 2007). In Table 4.2 we summarize the findings on developments in new roles.

Table 4.2 Roles entering the mobile Internet Value network

Mobile search portal provider	Given the increasing focus on searching, a new role can be distuinghuished: the search engine provider	The search portal is very important in the advertisement based models. However, these are outside of our scope.
MVNE	Entry of the MVNE as an answer to the gap left by operators in the wholesale enabling market	Provide MVNOs with tailored flexibility. Can deploy similar billing funcationality as the operator but still require access to SIM or USIM.
Financial service provider	Given the increasing attention to the mobile channel and related turnovers, banks are interested in the market to take a share of the transaction fees. Furthermore, they can exploit their existing customer relations and banking license.	Banks that provide billing solutions are competing in their own business and can become strong competitors to the mobile operators or be compelementary as they can provide collections.
Advertisement aggregator	As the increasing convergence of the mobile Internet and the regular Internet compels parties to consider the advertisment model, advertisment bureaus also target the mobile industry.	Another middleman to deal with in terms of interconnections and accounting of revenues.
Payment aggregator	With the growing number of payment methods, similar to the Internet, these payment methods are also aggregated. The most likely actors to obtain this role are the current mobile content aggregators.	Another middleman to deal with in terms of the collections and settlement of revenues. Payment providers can more easily reach a broader range of content providers.

4.4.7 Competition with the Internet players

From the former discussions it is evident that the lion share of the new actors entering the mobile industry with the opening of the mobile Internet are actors experienced on the regular Internet. According to Barnett et al (2000) the Internet players will compete with mobile operators, exploiting the distinct advantages (e.g. brands, experience) these players have already developed on the regular Internet. This creates more complex market structures as these actors not only compete on these levels but also bring new resources.

An illustrating example is Google that increasingly targets the mobile Internet and plans to expand its portfolio of Gmail and Google Maps with more inter-customer oriented communication services (Automatiseringsgids, 2007). There are signs that Google may be interested in 3G licenses or is even developing its own mobile device (www 21: Nu.nl, 2007b). Furthermore, with the increasing need for search engines on the mobile Internet, Google can play an important role. Operators want to exploit these possibilities and resources to their advantage and hence cooperate with Google. For example Vodafone cooperates with Google and Startpagina to enhance their search capabilities and profit from the strong brand names of these partners (www 22: Vodafone, 2007). KPN increasingly cooperates with Google and MSN on both wired and mobile Internet (www 23: Planet Internet, 2007).

In contrast to cooperation the operators also compete with these players. When consumers directly go to Google off-portal, operators would not obtain any advertisement revenues whereas this is the case when using the search function of Google on the operator portal. To further secure mobile advertising revenues, the larger operators in Europe also cooperate to create their own mobile phone search engine (www 24: Allen, 2007). Furthermore, other actors such as InfoSpace target this market as an independent meta-search functionality provider (Interview: Bergkamp, 2007).

4.5 Developments on the billing process level

In this section we deal with the developments specifically visible on the billing process level and supporting information and technological architectures. We first discuss some developments in billing methods; subsequently we focus on some aspects relevant in pricing and finally discuss some primary technological developments that impact billing in the mobile value network.

4.5.1 Billing method developments

Based on our study and interviews we see primarily two developments: (1) increasing use of WAP billing at the expense of PRSMS billing, (2) increasing focus of Internet payment methods on the mobile Internet and mobile phone in general. We discuss these below.

4.5.1.1 Increasing attention to WAP billing in the Netherlands

As discussed earlier, in the Netherlands the dominant on-portal billing method is WAP billing. Primarily driven by greater ease of use, higher kick-backs and fewer overhead compared to PRSMS billing discussed earlier, it is expected to gradually replace the latter type also in the off-portal billing

scenario. This is a view broadly supported by the interviewees. The currently large SMS service providers will be the most likely partners to provide WAP billing services in off-portal scenarios.

The off-portal provisioning of WAP billing does not impose any additional requirements on operators other than providing a separate API to their billing system by WAP billing service providers. The use of billing service providers makes sense to deal with the great diversity of premium content providers. Although operators do not prefer the provision of direct access to their billing systems, they are forced by the market (Interview: Egberts and Vlasblom, 2007). For example Vodafone in the Netherlands has already accomplished this task and in Germany WAP billing is the absolute standard (Interview: Bergkamp, 2007).

However, PRSMS is not dead yet. This type of billing may become extinct on the online content services market, its position in charging for non-mobile services (e.g. voting) do not appear to be compromised in any way. WAP billing is thus not a must for SMS service providers to survive and not all of these actors intend to change their business (Interview: SMS service provider, 2007).

4.5.1.2 Increasing targeting of Internet payment methods on the Mobile Internet

In Internet payment methods we see several types which we divide into three types: (1) payment methods originated at banks, (2) payment methods related to payment with credit cards, and (3) purely pre-paid methods. Each has its own focus and customer segments.

Online banking and payment methods

The first are already widely available in the Netherlands. Several banks offer payment services which are aggregated under the name “Ideal”. These methods are directly linked to the bank account through a diversity of security mechanisms. These types of payment methods typically require several interactions and have rather high transaction costs. Therefore, compared to for example PRSMS and WAP billing they are not user friendly and generate a lower kick-back (Interview: Haanstra, 2007). Also initiatives better suited at micro payments can be distilled. For example the Rabobank offers Minitix which is currently also available on the mobile phone. As this service provides a good example of what billing methods originating from banks typically would be like on the mobile channel, we exemplify this method below.

Example: Minitix

Minitix is a payment method that is linked to a bank account. Users buy credit through for example Ideal that they can spent based on their account login. Hence it does not require a bank transaction at every payment. Through a simple SMS procedure the mobile number is linked to the minitix wallet. Based on an SMS the user is consequently recognized, and can use the service. The Minitix account is not linked to Rabo mobile (the MVNO activities of the Rabobank and can be used jointly with an account at any other bank (www 25: Minitix, 2007). The service functions rather similar to PRSMS; a messages is sent to a shortcode (stardard tariff MO), and the Rabobank (possibly after confirmation, depending on the settings) deduces the amount (until 99,99 Euro) from the bank credit of the account which is linked to any Dutch bank account. The credit of the account is automatically recharged when it reaches a certain point (www 26: Webwereld, 2007). Essentially it can be considered an alternative for PRSMS. SMS is used but the premium and hence low kick-back is avoided. Instead the premium for the SMS is replaced by a fee that is paid to the Rabobank. Minitix currently has about 10.000 subscribers whereas the total amount of users of online banking at the Rabobank is 3 million (www 27: Boogert, 2007).

Credit card related payment methods

A credit card basically requires a secure connection on which the credit card data can be entered. This widely used method is not suitable for smaller payments due to its high costs, and fraud in this type of payment is rather high (Interview: Haanstra, 2007). Therefore companies have established payment methods that make the use of the credit card on the Internet easier. Examples of these types of payment methods are Google checkout and Paypal.

These methods enable the charging of an account with the credit card and subsequently using this credit on the sites that support the payment methods. Essentially they make paying on the Internet with the credit card easier (Interview: Haanstra, 2007). Although Google already requests for the mobile number when establishing an account, it does not yet specifically target the mobile channel. Given the focus of Google on the mobile Internet, it will probably become available on the mobile phone shortly. And given its strong brand name, it may become a strong competitor of current payment methods (Interview: Bergkamp, 2007). One of the strong points of Paypal is that is enables cross-payments

across accounts making it perfectly suitable for peer to peer purchases such as on eBay. Paypal has recently launched its mobile payment version. Although this system appears to be predominantly targeted at selling physical goods on the Internet and not micro payment, it provides a good example of how such a system would be typically organized. Therefore we exemplify it below.

Example: Paypal mobile checkout (source: Paypal, 2007)
Paypal mobile checkout is an extension to the regular online Paypal services. Payment services are provided to merchants wishing to sell goods or services through the mobile channel. There are three basic steps: (1) the customer selects a product and clicks the checkout with Paypal link, possibly in an SMS, (2) the customer is transferred to Paypal where he logs in and provides the shipping address, and (3) the customer is transferred to the merchant's site and Paypal returns the shipping address, email, and other customer information needed to fulfil the order.

The payment method is rather straightforward and open. This is primarily accomplished through invoking (mobile) web services. A merchant that wishes the use the Paypal service only has to comply with the standards laid down in the web services. The user device and browser must support the following: (1) WAP 2.0 phones, (2) XHTML or HTML markup language, (3) SSL connections, (4) cookies enabled, (5) no carrier "WAP Gap". The latter is essentially also captured in the need to use WAP 2.0[17]. Signing in on Paypal is based on the information received from the user (and hence operator). When the phone number can be distilled (e.g. from cookies) the user name and password login is provided, when the number is lacking, the phone number and PIN option is provided. The processing flow is provided in Figure 4.2.

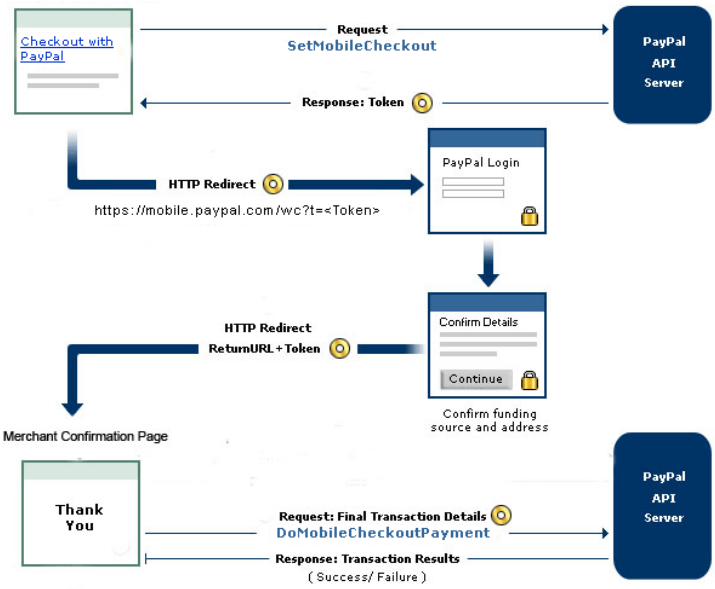


Figure 4.2 Paypal processing flow (Paypal, 2007)

Purely pre-paid methods
Although Paypal works with a credit system that can be charged, it still is linked to a credit card. Also other types of payment methods exist that are purely pre-paid and usually based on existing sales channels through which credit can be purchased. This is rather similar to pre-paid charging cards frequently used by MNOs and MVNOs. The main difference with payment methods such as Minitix and Paypal is that the user essentially remains anonymous as the payment cards are bought without the need for an ID. As the actor distributing the pre-paid cards basically governs an account holding money, these actors usually require a banking license. A typical example of this type of payment method is Wallie. We illustrate this method below.

Example: Wallie (source: Interview Haanstra, 2007)
Wallie provides merchants and content providers with a payment method purely based on pre-paid credit. So-called Wallie cards are sold through regular retail channels such as the Hema and Free record shop and can have values ranging from 5 to 50 euro. These cards contain a 19 digit code that is used online to buy goods and services.

To use the Wallie service the content provider implements a small software module that connects the merchant in a

[17] See http://mrcorp.infosecwriters.com/wireless/wireless.htm#_Toc11138656

secure way to Wallie. On the content provider's site, the user starts payment by entering the code on his Wallie card. The software module subsequently checks at Wallie if there is sufficient credit and deduces it from the card. When the credit is insufficient the credit of multiple cards can be used, ensuring that all cards can be fully depleted.

As the card can be purchased anonymously and no customer data is required for the purchase, the actual customer is not known by Wallie and does not need be known by the content provider. Although this anonymity has several advantages that can be used to facilitate for example adult entertainment and gambling, Wallie strictly targets "friendly entertainment". This is not only an explicit choice, latter two can not be supported by Wallie due to regulation in the Netherlands. If Wallie were to support this type of payment, it will risk losing its banking license.

This also reflects in the primary audience of Wallie; the youth. The fact that Wallie does not support adult entertainment and gambling makes the card a safe and controlled means to buy goods and services on the Internet.

The developments in billing and payment are summarized in Table 4.3.

Table 4.3 Developments in billing methods

Current billing methods	*Major developments*	*Implications for mobile billing*
PRSMS	Expected to decrease in usage but will remain in the coming years especially for voting applications outside the mobile Internet	PRSMS billing will eventually vaporize on the mobile Internet.
WAP billing	Expected to be used also off-portal.	Further increasing the off-portal usability of operator billing methods.
Internet billing methods		
Bank account related	Methods that directly or indirectly deduce credit from the bank account at every purchase. Given the relatively high costs, pre-paid systems are better competitors to PRSMS	Examples of these accounts are emerging such as Minitix of the Rabobank. These methods provide a proper alternative for PRSMS but have a relatively low penetration.
Credit card related	Methods that charge credits on the basis of a credit card. Potentially low kick-back due to credit card costs and insurance risks.	Currently not real competitors to PRSMS or WAP billing, as they currently predominantly focus on e-commerce of physical goods. However, increasingly targeting other online payments and the mobile channel.
Pure pre-paid	Simple methods that do not require charging but are based on existing retail channels. Similar to the cards used in pre-paid telephony.	Are anonymous and hence do not attribute to the customer relation. However, provide a very high kick-back and are in that sense a good competitor for PRSMS on which the kick-back is relatively low.

4.5.2 Pricing developments

In this paragraph we shortly discuss the dominant developments in pricing of the two types of charging; network resource (or bearer) charging and charging for premium content services.

4.5.2.1 Network resource usage

As clear from chapter 3 the currently dominant applied billing methods in the Netherlands for network (data) resource usage are Metered and Packet pricing. Nevertheless, as discussed earlier operators are increasingly offering flat fee data subscriptions. Currently offered flat fee subscriptions are however not entirely flat fee as operators tend to restrict certain services (Interview: Hermans, 2007). Especially the implementation of the IMS which enables differentiation of pricing depending on QoS characteristics may point to non-flat fee subscriptions. The flat fee price is not a roof price; QoS differentiation may provide operators with additional ARPU (Interview: de Buck, 2007). Nevertheless, especially from the Internet world the view is that flat fee will further proliferate and eventually entirely replace metered and packet charging (Interview: Hania, 2007).

4.5.2.2 Content and services

With the convergence of the mobile world to the Internet, customer expectations shift as content on the regular Internet is usually free. The migration to the Internet of the mobile industry thus creates a clash in pricing. The traditional differences are shown in the table below, for a more elaborate list of pricing parameters we refer to Appendix 6.

Table 4.4 Pricing of content

Telecommunications	Internet
Cost based: Time of day, distance, duration	Value based: Information goods, Experience goods, Customer perception (subjectivity)

As evident from chapter 3 the operator currently has a dominant position in the determination of the prices of content. However, there is shift going on in telecommunications and an increasing amount of control is placed at the content and service providers in the determination of their prices (UMTS Forum, 2002). For an overview of strategies in value based pricing, we refer to Appendix 7. A core lesson here is that content on the Internet should provide a strong differentiated value, will users be willing to pay for it. Many types of content, especially information that is currently paid for through for example subscriptions on the mobile Internet, will become free of charge, requiring other ways for the providers of this content to generate revenue. As discussed earlier in section 4.4, advertising will become more important, changing and introducing new roles. The content that will prove to be of sufficient added value is expected to be increasingly provided on the basis of subscription models. From interviews with content providers it was evident that the model in which content is sold piecewise is hardly feasible and subscriptions are an important tool to generate more profit on marketing (Interviews: Staal, 2007; van den Bulk, 2007). The non-viability of piecewise selling of for example full track downloads is doubtful (see e.g. Voermans, 2007). We summarize the developments in pricing in Table 4.5.

Table 4.5 Developments in pricing

Pricing	*Major developments*	*Implications for mobile billing*
Network resource usage	First signs of flat fee are visible. On the long term it will most likely become entirely flat fee. However, IMS also enables Qos and differentiated pricing which should still be regarded a future possibility.	Flat fee better enables other models than the current operator-centric as it greatly enhances transparancy.
Content and services	On the open internet customers expect content to be free. Especially information content. Only content and services truly adding value can be provided on premium basis. Another trend is visible towards usage of subscriptions. The seperate selling of content is hardly feasible.	Many content types will have to be provided based on advertisment revenues. Those that have specific added value will to a large extent be provided based on subscription models.

4.5.3 Technological developments relevant in billing

Earlier we discussed the changing roles in the industry and the developments in services and pricing. And that services are increasingly provided in bundles. This service convergence also has a technological component. We discuss this and two related developments in middleware in the next paragraph. Subsequently we discuss technological developments on mobile devices that interviewees perceived as most important as enablers of new billing methods and processes.

4.5.3.1 Technological convergence

A full discussion of convergence is far beyond the scope of our research, therefore we strictly regard technological convergence on the Internet infrastructures. Here there are primarily three fields visible: (1) the fixed net (e.g. DSL, cable), (2) the mobile infrastructure, and (3) the wireless (Unlicensed Mobile Access (UMA)) infrastructure (e.g. WLAN, Wimax, and Bluetooth) (Nokia, 2006a). These are increasingly interconnected to access the Internet on the user's preferred connection, depending on the availability.

The IP Multimedia subsystem

A technology enabling the interconnections between different infrastructures is the IP Multimedia Subsystem (IMS). According to Ericsson Telecommunications, it is not a question of whether IMS will be implemented, but when (Interview: Hermans, 2007). However, other actors doubt whether the system actually provides added value to their customers as it further enhances thinking in terms of differentiated tariffs instead of flat fee like propositions (Interview: Hania, 2007). The value of the IMS to any network operator depends partially on the proposition this actor uses in his tariff structures. The IMS is based on IP version 6 and open IETF standards, and has the goal of being interconnected to any access network. It is a service platform designed to facilitate and manage multiple parallel multimedia sessions at the user (Interview: Hermans, 2007). The IMS was not designed to replace OSA or I-mode standards but is complementary (Cuevas et al, 2006). Hence, the IMS does not enable new services but rather standardises the interfaces and platform, and provides functionalities to services on the network such as billing, QoS, and identity management (Interview: Hermans, 2007). The QoS capabilities of IMS enable differentiated pricing for usage of different services (e.g. video conference versus e-mail) (Nokia, 2006a). This could mean that this type of differentiation will continue. The position of the IMS between infrastructures is shown in Figure 4.3.

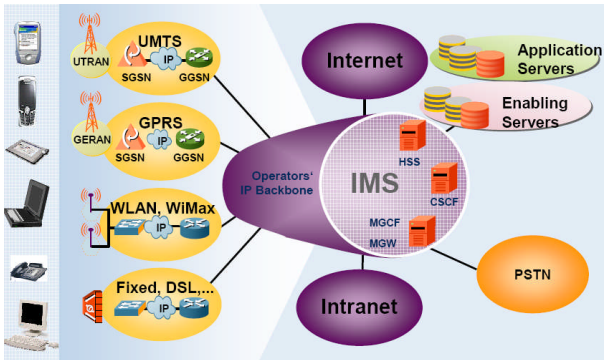


Figure 4.3 The IP Multimedia Subsystem (van Otterlo, 2007)

The IMS is not limited to the mobile domain but can be implemented by any actor operating an access network. This can concern fixed operators, Wifi operators, but also MVNEs (Interview: Hermans, 2007). The IMS both charges for content service usage, and network resource usage. To establish the first, two nodes (i.e. P-CSCF and S-CSCF) are in place. To enable the latter the IMS is connected to the CGF to charge for network resource usage, which can be differentiated to traffic type. However, charging for network resource usage may remain based on current processes, outside the IMS (Koutsopoulou et al, 2007). Both types of traffic are related based on the charging identifier (CID) (Cuevas et al, 2006).

Mobile Web Services

Another important development we shortly highlight is the proliferation of (mobile) web services. The main goal of web services can be described as "to provide interoperability between typically distributed application components. Applications may have been built on a variety of different systems (e.g. Unix, Windows, legacy mainframe systems), using different programming languages, on different middleware, using different data stores" (Farley and Capp, 2005: 202). The main differing characteristics of mobile web services relate to (1) the portability of the device, (2) the association of the device with a user ID, (3) the personalization of the service, and (4) the constraints imposed by the device (Farley and Capp, 2005).

Web services enable the exposing of information and functionality across the boundaries of organizations. This makes them perfectly suitable to provide modular Internet services that are highly interoperable with many actors and many different devices (Farley and Capp, 2005). Hence, mobile web services will most likely become an increasingly important part of mobile services. Furthermore, they can also be used in providing billing services. In essence modular highly interoperable billing methods could be designed based on mobile web services. Mobile web services are already implemented in for example Paypal mobile checkout (Paypal, 2007) and Netsize's m-payment solution to communicate with content providers (Netsize, 2007b; Interview: Egberts and Vlasblom, 2007). The two technological developments discussed in this paragraph are summarized in Table 4.6.

Table 4.6 Technological developments: platforms and middleware

Platforms and middleware	*Major developments*	*Implications for mobile billing*
IP Multimedia subsystem	Sharing of service components; silos are reduced. Support of parallel services. The perspectives on IMS differ in the market. It remains to be seen who will implement it.	One billing solution at the operator is accessible through any technology at any device; unified billing at the operator
Mobile Web Services	A technology vastly growing in its usage. Enables interoperability of services and service components.	Billing solutions are better able to be modular and interoperable through these services. Furthermore, they require little prior installation and any user can use the service at any provider, using any access technology.

4.5.3.2 Device intelligence and possibilities

From our interviews it was concluded that developments on the mobile device have an impact on the availability of relevant information in the billing processes. The first trend is the larger, enhanced screen, more memory and processing power (Nokia, 2006a) and increasing support of HTML on mobile browsers. Devices are increasingly capable of showing regular web pages and content and applications developed for PDAs and PCs. This potentially reduces the control of operators on the

content on the device. Nevertheless, some reformatting still occurs in these types of devices, not to change the data format but to fit the screen size. This type of software enhances usability but can also cause problems for specific applications (see e.g. www 28: Emerce, 2007).

Second, several interviewees (e.g. Interviews: Paula and Copius Peereboom, 2007; Haanstra, 2007; Bergkamp, 2007; Hania, 2007) pointed to an increasing independence of the SIM or USIM card. As devices become more intelligent, they can communicate their identity more similar to the regular Internet. The device could also include a separate, open accessible identity chip that enables any actor wishing to provide specific services to securely establish the customer identity (Interview: Haanstra, 2007).

A third trend is related to the convergence of fixed and mobile Internet. Devices increasingly support WLAN connections and hence can access the Internet irrespective of the mobile communication infrastructure. Hence it not only enables users to connect to wireless hotspots but also to their home network. The ability of mobile devices to connect to multiple networks is frequently defined as "terminal convergence" (Nokia, 2006b). Fourth, devices are increasingly capable of determining the location of the user to provide the location based and context based types of services discussed earlier. Additional to the triangulation technique, other techniques are available that can provide location information. GPS can be very accurate in the determination of the user location and is increasingly available on mobile devices. The problem with GPS is the fact that it requires a line of sight connection and hence performs badly in indoor contexts (www 29: Openwave, 2002). Furthermore, GPS can be used to determine the location of the device locally; it is not directly possible to monitor a user's location remotely such as possible with triangulation.

Finally a technique that is currently being piloted is the so-called Near Field Communication (NFC). This technique enables identification of the mobile device on a short range and can be used for example to provide context aware services and micro payments. It is not restricted to the SIM or USIM. Mobile operators have great expectations of this technique (Interview: de Buck, 2007). The main advantage of applying NFC on a mobile phone over the application on for example a credit card is the fact that it provides a return channel (Interview: de Buck, 2007). The developments on the mobile device are summarized in Table 4.7.

Table 4.7 Technological developments: devices

Device aspect	*Major developments*	*Implications for mobile billing*
Screen size and browser	Devices increasingly support HTML, XML, can deal with the SIP protocol and have larger screens.	Services and content require less tailoring to devices and can be complexer. Communication with the device is easier.
SIM and USIM identity	The identity will no longer be restricted to the operator's SIM or USIM. Devices are increasingly capable of secure identification seperately from the identity module. It may even be an additional identity module.	Billing for content services will become easier to perform without the operator support.
Multiple infrastructure support	Devices also converge and can connect to many different infrastructures (e.g. WLAN/ WIMAX/ GPRS/ UMTS/ HSPDA)	With the use of different access infrastructures, other payment methods will proliferate.
Location awareness	Devices become increasingly location aware through e.g. GPS and NFC. The operator knows the location based on triangulation. Eventually the location of the user will become a commodity, possibly based on a fee to the operator.	With the location becoming a commodity, dependence on the operator is reduced which also further enables seperate billing.

4.6 Conclusion

In this chapter we noted that despite the current lack of uptake of the mobile Internet in Europe, expectations are still promising and strong growth is visible in quantitative terms but also in the increasing focus of actors on the mobile Internet as a revenue driver. In this chapter we analyzed these developments in the mobile value network, the billing processes and related technology and information. The question answered was:

> *What are the developments in the mobile Internet industry in terms of roles and billing processes?*

To answer this question we used iterations between our interviews and (grey) literature to build knowledge on the industry developments. We dealt with primarily three aspects: (1) changes in

services, (2) visible and anticipated role changes, (3) technological, pricing, and billing method developments.

The primary drivers of new services essentially point to one notion: *customer-centricity*. The customer must obtain content as rich and diverse as possible, easy to use personal parallel consumable services, given his current context and location. Hence customer information becomes more important and billing relations must be transparent.

The operator portals are decreasing in their usage and walled gardens are slowly opening up. Although cheered by many this also affects content providers who formerly depended on these portals for the generation of customers. Content aggregators, although functioning off-portal have their systems customized to the diversity in operators' billing systems and gateways. As the aggregation role is predominantly combined with the SMS and WAP billing provider role, PRSMS or WAP billing available to content providers here, in some cases additional to other payment methods. Other actors also enter the aggregation market (i.e. assume the aggregation role), which are predominantly technology providers such as Nokia and Apple. These actors target a more intense customer relation and since they do not directly own content, the aggregation role is a logical step into the market. Given the fact that these actors have strong brand names, combined with technological know-how and even control of the mobile device, this is a strong impulse towards non-operator centric models. Essentially these actors control resources that challenge the inimitability of the operators' resource barriers.

The proliferation and increasing diversity of MVNOs is a strong trend. They require wholesale (data) relations with the operator that does not have its organization in place to deal with this, especially in the data market. A response to the gap left in the wholesale market by operators is the MVNE role. MVNEs essentially bridge this gap by deploying back-office systems similar to the operators. However, they lack access to the SIM or USIM for the user identity and the network for the user location. Another new role in the market is the mobile search portal provider. Given the tremendous growth in the availability of content on mobile devices, current portals can hardly capture this offering. Mobile search portals enable faster and easier browsing through what an operator defined as "the dessert of the mobile Internet". The search engines can be provided on the operator portal, on the portal owned by an established own engine (e.g. Google, Yahoo), or white label to actors that can attract customers as first contact. These white label engines can also be meta-search engines and on the mobile domain be more intelligent in terms of direct linking to content. The financial service providers are also taking a more prominent position in the mobile Internet value network. Given the growing revenue of mobile content these actors are lured to the fees that can be obtained in this multi billion industry. These financial institutions tailor their Internet payment methods to the mobile device to provide better kick-backs than currently earned with PRSMS. Finally advertisement aggregators active on the Internet also enter the mobile domain and further stimulate mobile advertising. Although this type of advertising is currently only moderately applied, it is expected to become one of the dominant enablers of online mobile content provisioning.

Current technological developments impact the inimitability and in substitutability of the resource barriers identified in chapter 3. From our interviews it was concluded that most actors expect the device intelligence to grow which further enables identification without explicitly requiring the operator. Additionally handsets could have separate identity modules, additional to the SIM or USIM that is controlled by the operator. Furthermore, devices will have better and larger screens and increasingly support HTML and XML which reduces the need for operators to adapt the content to the mobile device, which is frequently perceived as an inhibitor of applications such as payment services. Finally, devices will become more location aware through the inclusion of GPS and will support multiple infrastructures. Hence, the device will no longer be restricted to the operator but also directly accessibly by for example fixed ISPs.

In the field of technology used in billing we identified two additional developments as relevant. The first is the IP Multimedia subsystem. This platform is based on the premise that networks will entirely be based on IP and provides network operators with the means to facilitate and integrate services on their networks. Its basic premise is that it facilitates and manages multiple parallel sessions with the user possibly on different access technologies. The facilitation and management includes among others QoS differentiation. This enables operators to charge differing tariffs for different types of services which essentially is not aligned with the trend towards flat fee tariffs. Although any operator of any network as well as MVNEs can implement the IMS, it appears to suit the mobile operator best as it

enables this actor to remain central in the value network. In this position the operator can offer the QoS differentiation, location information, identity and other service building blocks on the basis of wholesale. Second we identified web services as enablers of interoperability between systems of aggregators and provider. Web services used for communication with the end user device are currently hardly deployed but are expected to become important in future service interoperability.

Concerning payment methods we identified primarily two types of developments. The first is the expectation that PRSMS will gradually be replaced by WAP billing at the operator. Although, especially on the short term PRSMS will remain an important driver of revenue and enabler of payments, in the field of micro payments it will eventually disappear. Second Internet payment methods grow in their number and increasingly focus at the mobile domain providing alternatives to the (rather expensive) PRSMS billing methods, hence competing with WAP billing.

Finally we regarded developments in pricing and charging. First, in charging for network resource usage the trend appears to be in the direction of flat fee pricing. However, current flat fee models are limited in their application as they do not hold for all services and usually have a limited amount of data included. Furthermore, depending on the adoption of the IMS, price differentiation may remain based on QoS parameters. In pricing content services, content providers face the challenge of creating highly differentiating value as users usually expect content to be free on the open Internet. This will lead to many content providers adapting advertisement based models, which is already visible. Furthermore, content services are increasingly offered on a subscription basis as the event-based offering is hardly feasible and generates too much overhead. These two developments provide greater ease of use of content services, but more importantly here, remove a great deal of complexity in billing and remove some of the resource barriers as less information and technology infrastructure is required to bill content services in the mobile domain.

5. Specification of anticipated archetypes

5.1 Introduction

In the introduction we already mentioned three role division archetypes identified by the UMTS Forum (2002): the content provider centric, content aggregator centric and MNO centric models. Furthermore, from literature two other archetypes were identified. These archetypes are theoretical extremes in the sense that they show the types of relations that typically would exist in a specific model. Therefore they are a good means to capture the developments discussed earlier into a more concrete specification of the potential future billing processes as they enable a more isolated analysis.

The first is what we defined as the payment provider centric archetype which is based on the idea that actors such as financial institutions may step into the market purely targeted at obtaining transaction fee revenues (see e.g. Li and Whalley, 2002; Farley and Capp, 2005), the second is what we defined as the ISP centric archetype. Essentially this archetype does not directly relate to content provisioning on the mobile channel but rather is an extension of the current billing capabilities of ISPs on the fixed network into mobile content provisioning (see e.g. Bhushan et al, 2002; Bhushan et al, 2005; Farley and Capp, 2005). The differentiating factor between these role division archetypes is the role that handles the billing and collections. In each archetype, the centric role performs these functions with the payment provider centric model being a specialized BCP.

Of the five archetypes, currently the operator-centric model is dominant, of which the layout was widely discussed in chapter 3. Within our focus on the billing processes and related technology and information, several resource barriers where identified. In the former chapter the already visible and anticipated developments in the industry where discussed which provided several means to overcome the resource barriers currently imposed by the operators. In this chapter these insights are applied to design feasible specifications of the five role division archetypes.

Similar to the former chapter, the dominant input of data in this chapter concerns our interviews of which we provide reports in a separate appendix and a high level analysis in appendix 8, which we complemented with short case descriptions and industry documents. In the text we frequently refer to specific findings from the interviews using short references. From our interviews and based on further identification of developments we learned that the archetypes, other than the operator centric, in their high level theoretical form are not feasible and require further specification. This specification entails the design of the business process models, specifically in relation to technology and information.

In the following sections we discuss each of the model archetypes in a separate section, first based on what we encountered in literature on their high-level layout and subsequently how we expect they could concretely take shape, in terms of the business processes. This means that we discuss more elaborate role division models and if applicable the billing processes that potentially reside in these models. Evidently we can be hardly exhaustive here and therefore we stick to the scenarios we found feasible given the current situation, identified developments, and ideas of the interviewees. At each business process specification we use the criteria, i.e. customer usability, interoperability, leverage of legacy, and information quality, to evaluate our design and analysis.

5.2 The MNO centric model

5.2.1 MNO centric archetype

The first archetype is the MNO centric. In this model content is delivered on the operator's portal and all contact with the end user lies at the operator. It reflects the classical situation in the telecommunications industry where the operator assumes the roles of: (1) network operator, (2) BCP, (3) Portal Provider, (4) Content aggregator, and (5) AAC. This model is shown in Figure 5.1 where the four additional roles extend the MNO. The billing relation in this figure is aggregated and can refer to charging, billing and accounting denoted above the arrow.

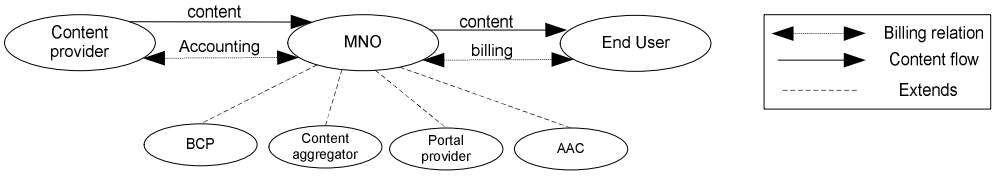


Figure 5.1 MNO centric archetype

The billing relation between the MNO and the content provider is limited to accounting as the MNO provides the information on the consumption of end users and compensates the content provider accordingly. The charging, billing and related collection for both network resource usage and the price of the content is entirely performed by the MNO. This archetype was discussed as on-portal content provisioning in chapter 3.

5.2.2 Specification of the MNO centric model

The Operator centric model is dominant at present and most interviewees expect a version of the model to remain the most widely used model for mobile content service billing. The general view among interviewees was that the classical on-portal content service provisioning (which is highly similar to the archetype discussed above) will disappear. The off-portal scenario will become dominant. All interviewees involved in the current billing processes believed that current PRSMS billing services will gradually be replaced by WAP billing. This replaces the role of the SMS service provider by the WAP billing service provider. It will be a business to business solution offered predominantly by the actors currently offering traffic and content aggregation, and PRSMS billing. The role division of this off-portal WAP billing scenario is shown in Figure 5.2.

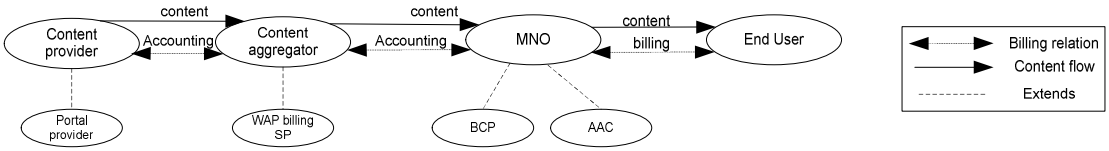


Figure 5.2 Off-portal operator centric model

In contrast to the archetype which is similar to the on-portal scenario, the only the BCP and AAC roles extend the MNO in this specification. The SMS service provider role is replaced by the WAP billing service provider role which is assumed by the content aggregator. The portal of the operator may still exist but does not offer any content services. In line with current off-portal content provisioning the content provider will maintain its own site on a portal it hosts itself or is hosted at the aggregator.

The MNO has the billing relation to the end-user which includes the billing and collections for both network resource usage and the price of content services. The content aggregator that also performs the role of WAP billing service provider has an interface to the operator's billing system to facilitate billing on the account of the end-user. The relation with the content provider is maintained by the aggregator. Hence the aggregator has an accounting relation with the MNO and further distributes the revenue to the content provider. Several of the aggregators (e.g. Netsize) currently also offer other payment methods, based on specialized BCPs such as Paypal (Interview: Egberts and Vlasblom, 2007). This is part of the payment provider centric model which we discuss later. The control of information and technology in the anticipated operator centric model are presented in Table 5.1.

Table 5.1 Summary of operator centric model

Operator-centric	*Relation to end-user*	*Control of technology*	*Control of information*
Network operator	Exclusive: Billing both network resource usage and content services.	Network infrastructure, IMS, billing system, WAP gateway, partially on mobile device (SIM/USIM)	End-user network ID (SIM/ USIM). All customer details on both usage and demographic data
Content provider	None direct. In some cases has the service relation. The content provider can build a relation through profiling.	Content database	Usage data received from aggregator. Dependent on other information by requesting it at the uer
Content aggregator and WAP billing service provider	None direct. In some cases the aggregator/ WAP billing provider can have the service relation.	Aggregation and payment platform	Usage of all content consumed at the providers that use the aggregation services

Where the billing for network resource usage is concerned, some interesting developments and contradictions can be found with the introduction of the IMS. The IMS fits metered and packet charging while the current trend on the mobile Internet is towards flat fee. We shortly discuss this contradiction below.

According to literature the IMS places the operator central in the value network, further emphasizing the operator-centric model (Cuevas et al, 2006). This is not entirely aligned with the opinions in our interviews. Potentially any actor owning network facilities (i.e. ISPs, MVNEs, MNOs) could implement the IMS, as it is not restricted to the mobile operator (Interview: Hermans, 2007).

This situation is similar to the illustration of charging for network resource usage in chapter 3. The only difference is that additional CDRs will be generated by new network elements of the IMS that are filtered by the CCF (Charging Collection Functionality) instead of the CGF performing this function in the current packet switched domain. On the longer term the IMS provides online billing functionality. This is essentially a step further than current WAP billing solutions as not only content but also services can be billed real-time (Interview: Hermans, 2007). Evidently this points to metered charging or packet charging. These types of charging models are not aligned with current Internet models (Interview: Hania, 2007) and are also against the trend of flat fee on the mobile Internet. The latter would remove complexity in this part of the billing process as not every megabyte or minute is charged and only monitoring mechanisms are in place to ensure fair usage (Interview: Hania, 2007).

5.2.3 Processes in the MNO centric model

When the IMS is implemented, operators can charge their own content services more easily as the IMS can deal with more advanced services and charge according to usage on the billing system. Nevertheless, given the differing opinions on the actual deployment of the IMS, WAP billing in the off-portal scenario will most likely carry the operator-centric model in the years to come. Given the fact that we already showed on portal WAP billing and off-portal PRSMS billing in chapter 3, we do not show off-portal WAP billing here and directly discuss the processes on the basis of our criteria.

Usability

The usability of the business processes in the MNO centric model is very high. The session does not need to be ended and the total amount of required activities is rather low. The activities are not complex, especially since the identity of the user does not need to be validated as the ID is present in the mobile operator's network.

Interoperability

The complexity in interoperability is nearly entirely placed at the WAP billing provider. Each operator has a custom WAP billing gateway to which the WAP billing providers connect. Therefore, they have to deal with different interfaces. With the deployment of the IMS this would become easier and interfaces will be more standardized. At the other side the WAP billing provider connects to content providers that are offered different interfaces, depending on the wishes of the content provider. This makes the interoperability of the different systems very complex. Standardisation through the usage of web services can reduce this complexity, especially in the connection to content providers.

Leverage of legacy

WAP billing does not impose any drastic changes at the operator. Basically a separate API must be provided to the billing system through the WAP billing gateway. Most customization again occurs at the WAP billing provider that deploys a custom billing solution (e.g. mPayment at Netsize). This is usually offered on top of the PRSMS billing solution. Furthermore, existing relations and connections to content providers and operators used to provide PRSMS services can be further leveraged. Content providers do not require any new technology or interfaces but can use their existing relation to the PRSMS billing provider or switch to another.

Information quality

The WAP billing provider deals with the largest part of the information. The identity of the user is received from the operator to bill on its account. The information on prices is received from the content provider. The quantity of the information required for the WAP billing solutions to function is rather low. Whereas the pricing information can be communicated ex-ante the identity must be communicated real-time. The presentation of the information to the user depends on the solution of the WAP billing providers. Given the fact that only few steps are required and the presented information predominantly

consists of a confirmation request of the user on the payment gateway, this information is expected to be easily interpretable, locatable and convenient.

5.3 The content aggregator centric model

5.3.1 Content aggregator centric archetype

In this archetype the content providers deliver content to the aggregator that delivers it through the operator to the end user that pays the aggregator who consequently distributes this revenue through the network. This model is shown in Figure 5.3.

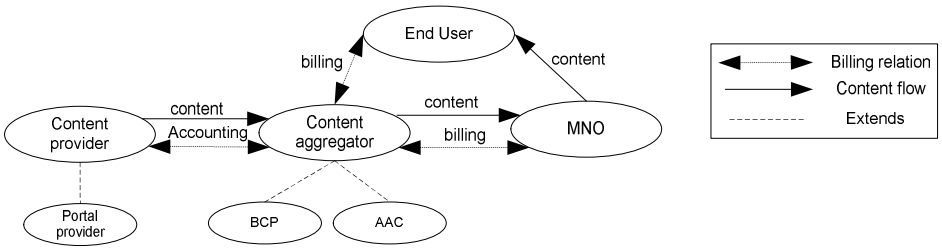


Figure 5.3 Content aggregator centric archetype

In this model the content provider maintains its own portal and receives a fee from the content aggregator for its services similar to the current off-portal model. The content aggregator handles billing and payment with the end-user for the content services, based on information of billable events received from the MNO. Hence, the relation between the content aggregator and the MNO is based on the exchange of information on billable events and the settlement of revenues.

5.3.2 Specification of the content aggregator centric model

Content aggregation in the mobile domain is currently predominantly performed by actors that additionally to hosting the content of several content providers also provide SMS and WAP billing gateways. The content aggregator centric model is hard to realize for these actors as they are hardly visible to the end-user as they play a purely intermediate role. Therefore it is valid to say that these aggregators have no name when it comes to generating customer base and have little direct customer marketing experience. The lack of these resources makes it extremely difficult to realize this model (Interview: Bergkamp, 2007). Furthermore, these actors at present have relations in place with many content providers and operators and have tuned their systems accordingly. Realizing any direct end-user relation other than the support of customers of business clients is considered highly unlikely by these actors (Interviews: Bergkamp, 2007; Egberts and Vlasblom, 2007).

However, in their current position these actors do have the critical information on the customer usage of the services they host and of which they facilitate billing on the operator system. Furthermore, they already have flexible platforms in place that can deal with many different interfaces with content providers and payment providers. Hooking up these platforms to existing billing systems would enable the latter actors to bill customers for content service usage (Interview: Egberts and Vlasblom, 2007).

The actors entering the content aggregation industry sufficiently capable of generating customer base are frequently the technology providers such as Nokia (acquired OD2), Amdocs (acquired Qpass) and Apple (Itunes, Iphone). With these acquisitions it is not the aggregator moving towards the customer but the technology provider which is one of the primary statements of Ballon (2004). Through providing its own payment facilities and the customer relation this type of aggregator surpasses the operator in this respect. The billing for network resource usage is expected to remain at the operator as no real options were identified that may change this situation. It may be possible to compensate the operator and have the services billed on tariff 0, but this would require the aggregator to have relations with all operators which is not a likely scenario. The operator can charge the end-user in this case either on the basis of flat fee or on the basis of online, packet or metered charging. The basic layout of this model is shown in Figure 5.4.

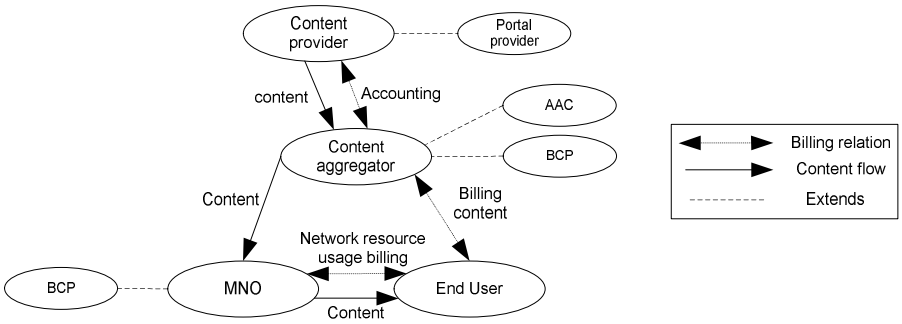


Figure 5.4 Content aggregator centric model

This model resembles the archetype. The main difference is the fact that the billing for network resource usage remains at the operator to which literature on the content aggregator centric archetype is inconclusive. To emphasize this difference and more clearly differentiate among billing for network resource usage and billing for the price of the content we illustrated this at the arrows in this figure. The basic characteristics in terms of control of information and technology and customer contact in this model are presented in Table 5.2.

Table 5.2 Summary of anticipated content aggregator centric model

Content aggregator centric	*Relation to end-user*	*Control of technology*	*Control of information*
Network operator	Network provisioning and billing network resource usage	Network infrastructure, partially on mobile device (SIM/USIM)	End-user network ID (SIM/USIM). Demographic data and network resource usage data
Content provider	Possibly the service relation	Content database	Possibly end users'content service usage data, or nothing (in case of white label provisioning)
Content aggregator (technology provider)	Billing for content services	Content databases, platform, possibly mobile device. CRM system, billing system	Demographic and content service usage data of all content obtained at the platform. Customer profile.

5.3.3 Processes in the content aggregator (technology provider) centric model

In this type of content aggregator model, supported by a strong brand name the process is actually rather straightforward. As the aggregator that also entirely facilitates the payment, also hosts the content, the user remains at this platform while his connection is established by the operator for which he is paid based on flat fee. Prerequisites of this model are that the aggregator has its own platform and CRM and billing facilities. These can also be obtained from MVNEs and platform providers (e.g. similar to Disney). The fact that the operator only has a moderate role in this model is further shown in Figure 5.5. All interactions take place between the end-user and the content aggregator. The only role of the operator here is to provide the network, possibly complemented with the end-user ID and location (shown in dotted lines).

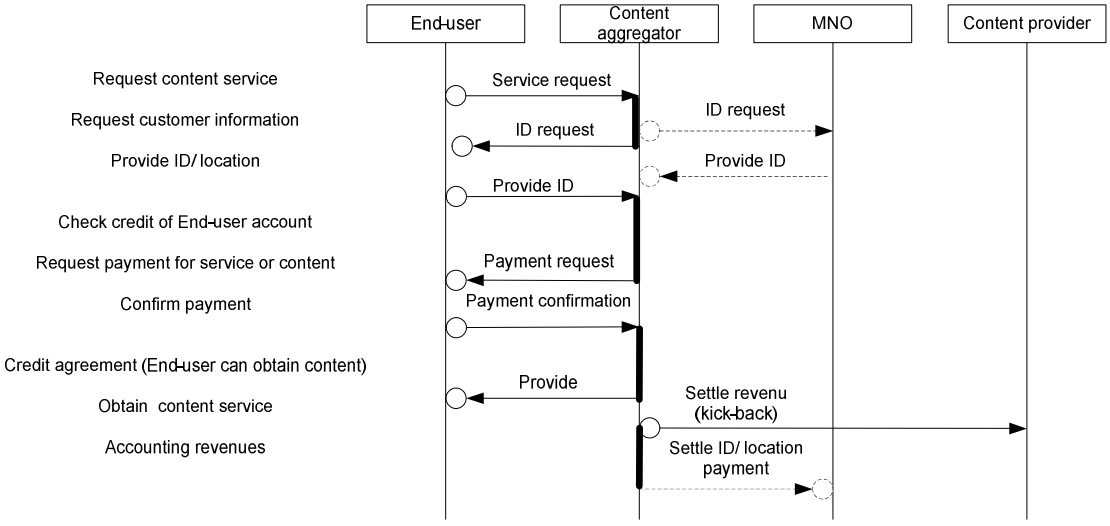


Figure 5.5 RID of content aggregator centric model

Figure 5.5 provides a clear overview of the different process activities and the roles that perform these activities. The analysis of the billing processes in terms of the contribution of information and technology of the involved roles is performed in Appendix 9, by means of the IDEF-0 modelling method. We discuss the main findings of the analyses in the RID diagram and IDEF-0 method on the basis of our criteria.

Usability
The content aggregator model provides similar usability to the operator centric model given the assumption that the identity of the user can easily be established from the device. Only few interactions are required with the end-user. The complexity depends on the solution deployed by the aggregator.

Interoperability
The interoperability issues are placed at the aggregator that connects to both content providers and the mobile device of the end user. It would require a great deal of effort to establish connections with content providers similar to current mobile content aggregators. Therefore in this model it is more likely that content is bought on wholesale or from a few large content providers. However, developments towards for example a broader usage of web services could be leveraged. This would make interfacing with systems of content provider easier. The interactions with the mobile device can be properly managed by the aggregator, especially since the actors anticipated to fulfil this role have a great deal of technological know-how. A major constraint here can be the technology at the operator that optimizes the content to suit a specific device which challenges the direct link between the aggregator and the device. This may harm the usage of payment solutions.

Leverage of legacy
The actors anticipated to assume this role have hardly any legacy in place to deal with the payment on mobile devices. This is an advantage in terms of the ability to use new, standardized and modular technology. It is a disadvantage in terms of the required investments in new technology and systems and the establishment of interconnections and relations with for example content providers. However, the technology providers expected to assume the content aggregation role have know-how and probably their own technology in place. This mitigates the investments they require in technology and systems.

Information quality
As visible from Figure 5.5 the content aggregator deals with most of the information exchanges with the end-user, the content provider and mobile network operator. The user is only asked for confirmation of his purchase without requesting any identity details. This ensures that the quantity of the requested information remains rather low and interpretability of the information is high. The content aggregator depends on the content providers for the prices of the content services. As these can be specified ex-ante this is unlikely to create any timeliness or completeness problems. There is no real-time interface to content providers required.

5.4 The content provider centric model

5.4.1 The content provider centric archetype

In this model the content provider delivers its content to the operator who delivers it to the end user. The end user pays the content provider. To deliver a full service package the content providers can settle the costs of network resource usage with the operator. In the provisioning of these content services the operator has no billing relation with the end-user. This model is shown in Figure 5.6.

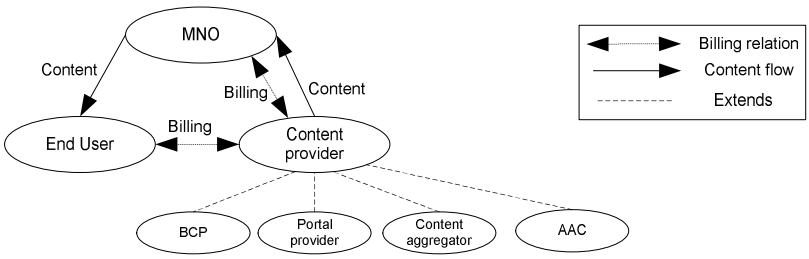


Figure 5.6 Content provider centric archetype

Clearly the content provider has many other roles here which are extended in the figure. The billing relation between the content provider and end-user encompasses both network resource usage and the price of the service. Therefore the billing relation between the MNO and the content provider can not be characterised as accounting as the content provider requires the information on chargeable events from the MNO. According to the UMTS forum (2002) the content provider centric archetype could also be supported by a specialized payment provider. In this case the customer billing relation is controlled by this provider. Content providers can build customer knowledge irrespective of this relation. For example questionnaires and click stream analysis can be used to create customer profiles (Shapiro and Varian, 1999). Nevertheless, this is not necessarily valid as users can provide any info they want since it is not linked to payment. Therefore we see this type of model as a separate archetype in which the specialized BCP, i.e. the payment provider, is centric.

5.4.2 Specifications of the content provider centric model

The value of content on the Internet should be truly differentiation or otherwise provided free (i.e. sponsored) which leads to content providers adopting advertisement based models. In these models there is no billing relation with the end-user. As discussed earlier these models are out of the scope of this research. We focus on premium content services here.

As discussed by the UMTS Forum (2002) a problem in the content provider centric archetype is the fact that content providers must build their own billing functionalities. This is a rather challenging step and only few actors are sufficiently capable of accomplishing this task (see e.g. Google checkout). To deal with this problem we identified two options. The first solution here is to use an existing billing relation that is complemented with the services on the mobile channel (see Interview: de Buck, 2007). A second solution would be to start activities on the mobile channel through an MVNO.

Adding the user to an existing billing relation

Many actors already have an existing customer billing relation in another market that can be used to bill on the mobile channel. An example could be the access to online newspaper content by the subscribers of this newspaper for an additional fee on top of their subscription. Users that do not have a subscription evidently can subscribe to the regular channel where all mechanisms to fulfil the addition of a subscriber are already in place. Basically this model is expected to function through using subscription based, i.e. flat fee, models that are added to the monthly bill. As identified in the former chapter, subscriptions are a strong trend and are considered to be more viable than event-based selling of content services.

This type of model, shown in Figure 5.7, is a small deviation from the archetype of content provider centricity as the billing for network resource usage will remain at the mobile operator. However, given the fact that flat fee subscriptions are increasingly used off-portal and bandwidth most likely becomes a commodity (Nokia, 2006a; Interview: Haanstra, 2007) the charges for network resource usage will not influence the delivery of the service.

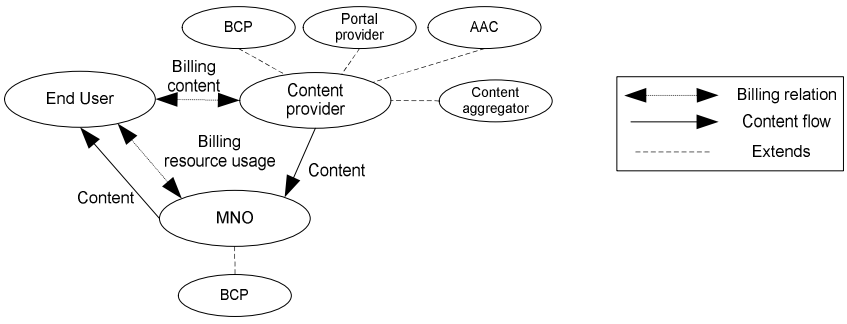


Figure 5.7 Adding the end user to an existing relation

In the figure it is shown that both the MNO and the Content provider assume a BCP role. In case of the content provider this refers to the billing of the price of the content, in case of the MNO this refers to the billing of network resource usage. The content provider has a portal and aggregates and enables its own content. To establish who can access the mobile channel of the content provider a verification of the identity of the customer is required. This is the function of the AAC. The three options here (i.e. purchase from operator, obtain from handset, and use login) were discussed earlier. In this case, in line

with the regular Internet, this role is placed at the content provider who uses login mechanisms on top of a current subscription of the end-user.

Start a Mobile Virtual Network Operator

To establish as close a relationship as possible with the customer, content providers can deploy their own MVNO. The introduction of MVNEs as a response to the problems operators encounter when deploying wholesale of their capacity and back-office resources has made this relatively easy. Although many MVNOs operate in a niche market serving specific demographic areas or ethnographic groups with primarily voice services, some also specifically provide their own services tailored to their niche market, e.g. Lycamobile and Toscos (Interview: Hermans, 2007).

Probably the best known example is Disney mobile. Disney cooperates with an MVNE (in this case Visage Mobile). This MVNE does not have billing systems in place but does provide a platform for hosting content services in connection to the mobile domain. The billing and HRM capabilities are offered by a separate actor that specializes in these platforms. This is Convergys (www 30: OSS news review, 2006). Through this channel Disney provides its own branded content and specific services tailored to families with children (www 31: OSS news review, 2006). In this model the content provider rents capacity from the MNO to start the MVNO and pays the MVNE to host its services. Hence all billing and contact with the end-user lies at the content provider. The content provider – MVNO model is shown in Figure 5.8.

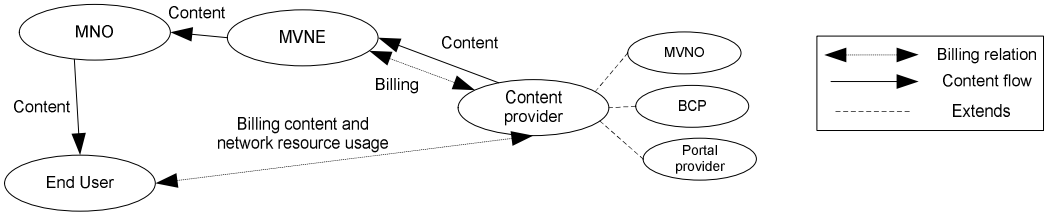


Figure 5.8 MVNO – Content provider centric model

In this model the content provider creates a situation similar to the on-portal provisioning of content of the mobile operator. The content provider in his MVNO role provides its own content on a portal, in contrast to the operator-centric on-portal scenario where content is bought on a wholesale white label basis. The billing and hosting services are provided by the MVNE that handles all interactions with the MNO. The MVNE could potentially build all back-office and front-office support systems except the radio network infrastructure (i.e. all network functionality until the so-called "international roaming interface") (Interview: Hermans, 2007). The MVNE is compensated for providing the billing information and the hosting services. The basic characteristics in terms of control of information and technology and customer contact in this model are presented in Table 5.3.

Table 5.3 Summary of anticipated content provider - MVNO centric model

Content provider centric	*Relation to end-user*	*Control of technology*	*Control of information*
Network operator	None	Network infrastructure, partially on mobile device (SIM/USIM)	End-user network ID (SIM/USIM). Network resource usage data
Content provider	Exclusive: billing for network resource usage and content and services.	Content databases, CRM system	Demographic data and content and service usage data of all content obtained at the platform.
MVNE	None	Billing system, content platform	Usage information on both network resource usage and content and service consumption.
MVNO	See content provider	See content provider	See content provider

5.4.3 Processes in the content provider centric- MVNO model

In this paragraph we discuss the billing processes in the Content Provider – MVNO centric model. We select this model out of the two discussed in the earlier paragraph. The model, in which subscribers are added to the current subscription, does not incorporate any other processes than using the current customer channel to obtain additional revenues.

A unique aspect of this model is that through using an MVNO construction the end-user is also billed for network resource usage by the content provider. As the MVNO purchases capacity from the MNO

it is possible for this actor to use its own charging scheme at the MVNE. Although it is highly likely that this will be flat fee, the MVNE could also implement the IMS. Hence, charging could also be based on QoS parameters. In this construction (rated) CDRs are received from the operator or MVNE and placed on the bill (Interviews: Meijering, 2007; Hania, 2007). These processes are visible in the RID diagram in Figure 5.9.

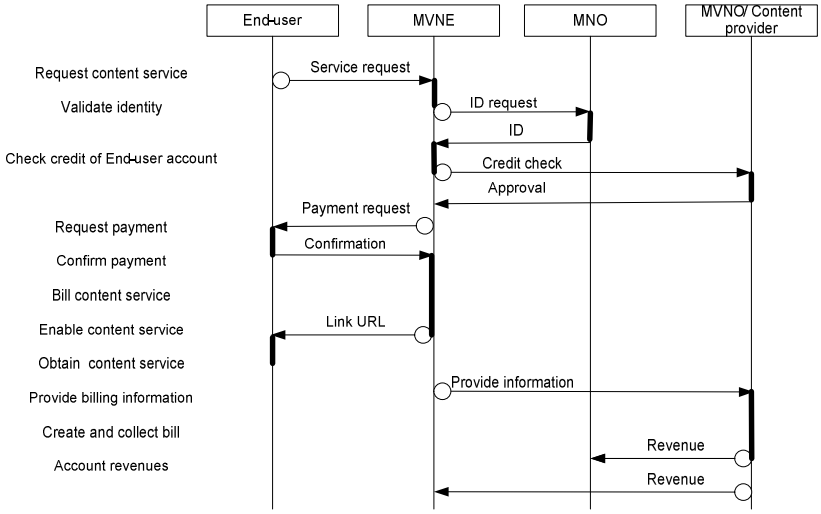


Figure 5.9 RID of MVNO - CP centric model

The analysis of the content service billing processes in terms of the contribution of information and technology of the involved roles is performed in Appendix 9, by means of the IDEF-0 modelling method. We discuss the main findings of the analyses in the RID diagram and IDEF-0 method on the basis of our criteria.

Usability
In this model it is assumed that the identity is purchased from the operator on a wholesale basis which is a likely scenario (Interviews: de Buck, 2007; Hermans, 2007). Especially since the operator is already involved in the accounting of revenues with the content provider, this can easily be integrated. This reduces the amount of process activities at the user as the identity does not need to be requested or validated. The content provider - MVNO centric model is complex in terms of the amount of required activities between the different actors. This is due to the fact that the actor that bills the user on his account does not control the infrastructure on which the data is collected, or processed. The information exchanges between the content provider and MVNE are frequent and consist of potentially large amounts of information. The end-user experiences only a moderate amount of this complexity and has the advantage of a single bill.

Interoperability
The communication between the MVNE and content provider is a complex issue which most likely requires the content provider to adapt the standards that the MVNE uses. The billing interactions of the MVNE with the end-user depend on the deployment of methods of the MVNE.

Leverage of legacy
The billing method of the MVNE could make use of existing WAP billing methods as used in on-portal WAP billing by the operator. As MVNEs are rather new to the market they can adopt new technologies and prevent the stove piping that is currently present at most operators. However, given this lack of legacy they also require large investments.

Information quality
The MVNE depends on the operator for information and the content provider on the MVNE. Trust is very important in this relation and accurate controls should be in place. Given the fact that the content provider deals with the credit of the user while the MVNE deals with purchases of content and network resource usage information of the operator, timeliness and completeness are critical issues in this model.

5.5 The payment provider centric model

5.5.1 The payment provider centric archetype

The fourth model is the PAYMENT PROVIDER centric model. The specialized BCP, which can best be considered the outsourcing of the BCP role was identified but not further discussed by the UMTS forum (UMTS Forum, 2002). This model is shown in Figure 5.10.

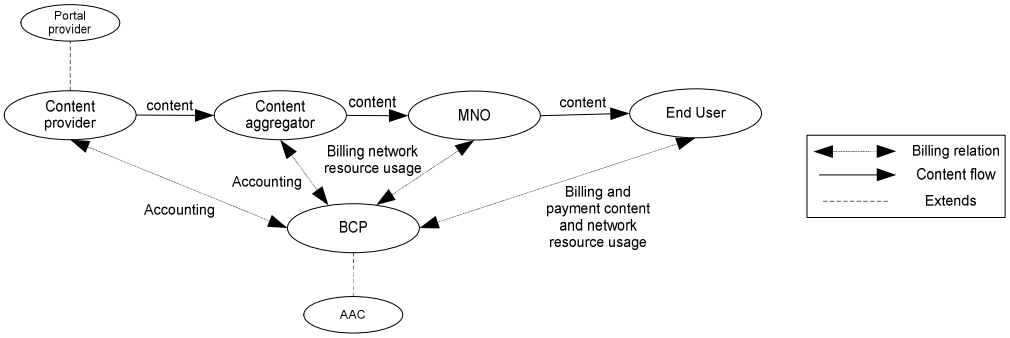


Figure 5.10 Payment provider centric archetype

In this model a new actor, possibly a financial institution such as a bank or a currently specialized payment provider on the Internet, holds the billing relation with the end-user who pays this actor for all the content services obtained on the network. This actor distributes these fees among the other involved actors. Any actor could deploy a portal on which content can be obtained but most likely this is the content provider.

5.5.2 Specifications of the payment provider centric model

Content providers that are developing their customer relation face the problem of providing a payment method to bill for their content services. In chapter 5 we already discussed three main types of payment methods independent of any actor in the industry and provided a concrete example of each. Many payment methods are available and their number is increasing. For example Google introduced a competitor to Paypal, and all Dutch banks currently offer bank account related payment methods that will become available on the mobile Internet. These payment methods can range in their intensity of the customer contact.

For example the bank account and credit card related payment methods require many customer details whereas the pure pre-paid methods such as Wallie do not require any customer details at all. This distribution affects the payment provider centric model. Pure pre-paid models do not entirely fit in this type of model as no customer relation is build. Wallie does not have, and maybe should not want to have a customer relation. This is the strength of the pure pre-paid models and should not be extended (Interview: Haanstra, 2007). The customer details in this case are entirely the domain of the content provider and operator. However, for this actor it is difficult to realize a valid customer profile as the payment method does not require validation.

In line with the regular Internet, also multiple payment methods can be offered by an actor aggregating the billing methods, which may cost a small fee but this can be returned due to economies of scale (Interview: Haanstra, 2007). This is already done by mobile aggregators such as Netsize (Interview: Egberts and Vlasblom, 2007). This actor would not create its own customer databases but rather limit its services to B2B services and potentially customer support. The model is shown in Figure 5.11.

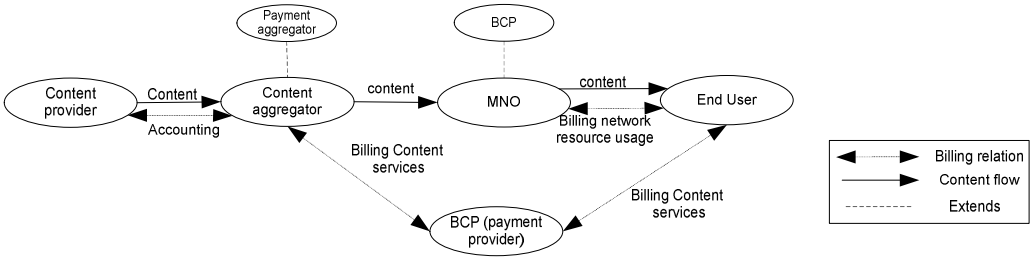


Figure 5.11 Payment provider centric model

In this model the content aggregator also assumes the payment aggregation role. This enables the payment provider to deal with many content providers through a single actor. The content aggregator handles this contact with the content providers and settles the revue of their content. Although a specialized BCP is used in this model, the MNO also assumes this role as the billing for network resource usage and this billing relation remains at the operator. The basic characteristics in terms of control of information and technology and customer contact in this model are presented in Table 5.4.

Table 5.4 Summary of anticipated payment provider centric model

Billing aggregator centric	*Relation to end-user*	*Control of technology*	*Control of information*
Network operator	Network provisioning and billing network resource usage	Network infrastructure, partially on mobile device (SIM/USIM)	End-user network ID (SIM/USIM). Network resource usage data
Content provider	None direct, possibly the service relation.	Content database	Usage data, demographic data depending on payment method. Also profiling is possible.
Content aggregator	None direct, possibly the service relation.	Content platform	Usage data of content passing through the platform
Payment aggregator	None	Payment provider aggregation platform	Monetary usage data per end-user
Payment provider (specialized BCP)	Billing relation for content and services.	Payment platform	Demographic data of the end-user and content and service usage data of all content that is billed for.

5.5.3 Processes in Payment provider centric model

In the payment provider centric model it was shown that six different roles interact of which the BCP role is assumed twice; once by the MNO and once by a specialized actor that we defined as payment provider. In Figure 5.12 the interaction between these roles on a process level are shown in a RID.

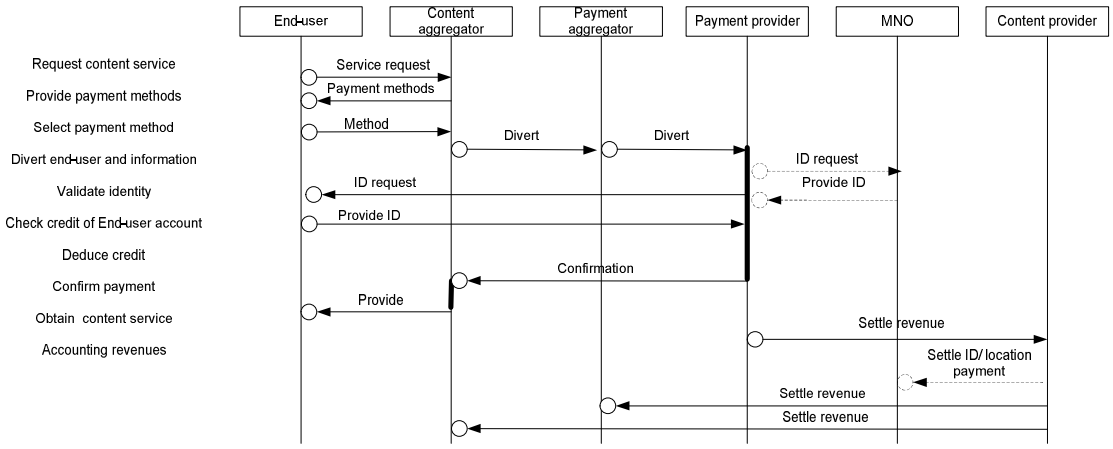


Figure 5.12 RID of payment provider centric model

The analysis of the billing processes in terms of the contribution of information and technology of the involved roles is performed in Appendix 9, by means of the IDEF-0 modelling method. We discuss the main findings of the analyses in the RID diagram and IDEF-0 method on the basis of our criteria.

Usability

The amount of activities required in this model, especially at the end-user side is rather high especially since the identity of the user or specific payment codes, in case of pure pre-paid methods, will be requested. This complexity depends on the operator and the capabilities of the device that is used. As was evident from the discussion of Paypal Mobile Checkout in the former chapter, the more information is received from the operator the less complex the identification procedure and requested amount of information.

In terms of the interactions between the payment provider, content aggregator and provider it is less complex. The content aggregator and payment provider can monitor the content provisioning process while strictly payment is handled by the payment provider. From the sequences of activities throughout the roles it is clear that the payment of a service is entirely separated from its selection and provision as it entirely lies at the payment provider who separately validates the identity. Hence this identity is only

established at the moment the payment process starts and can not be used by the content provider to provide more specific tailored services. Therefore the content provider remains dependent on the operator for this resource.

Interoperability
Payment providers use different interfaces to the end-user and content aggregator. Whereas for some a specific piece of software needs to be in place at the content aggregator, others already use web services technology or other standardized interfaces. This complexity is hidden from the end-user that deals with the custom interface of the payment provider.

Leverage of legacy
Most payment providers already have relations with payment aggregators and have payment methods in place on the Internet. These need to be tailored to suit the mobile device. Although mobile devices will become capable of handling the current methods on mobile browsers, some additional aspects must be built in current solutions to further benefit from the personalisation of the device. Another issue here is the fact that operators use their own optimization technology for content services to suit the mobile device that may hamper the functioning of existing payment methods.

Information quality
Since current legacy at payment providers is tailored to the regular Internet on a larger screen, customization is required not only in terms of the technological enabling but also on the aspects of convenience and interpretability. The quality of the presentation, the locatibility of the required information and the convenience of the interface are critical as the amount of activities is already fairly high. Payment methods on the Internet, at present do not accomplish this task.

5.6 ISP centric model

5.6.1 The ISP centric archetype

In this model it is the ISP or wireless LAN provider from the wired world that deals with the billing relation with the customer. This ISP centric archetype is shown in Figure 5.13.

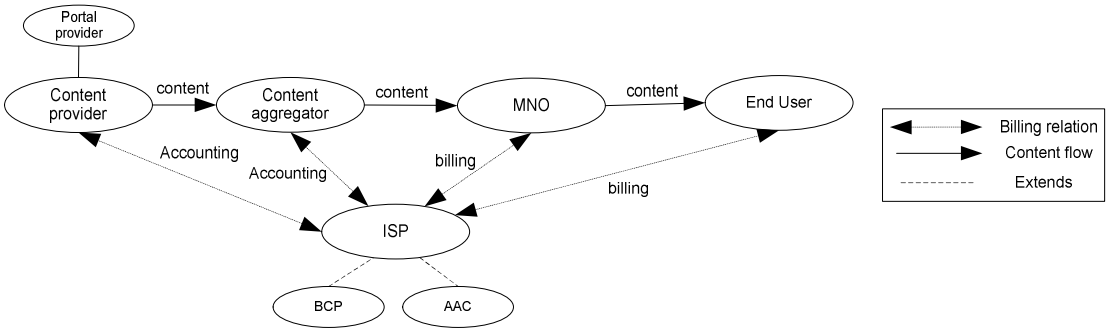


Figure 5.13 ISP centric model

The ISP starts relations with content providers and aggregators to bill for content services. In literature the archetype is identified but is not further developed. Hence we interpreted it rather strictly; the ISP handles all payments with the end-user and settles the revenues with the other involved actors.

5.6.2 Specifications of the ISP centric model

ISPs already have an Internet channel and can hence also provide the content on the Internet. To take this provision one step further the ISP can also enter the mobile market as a service provider, taking the shape of a MVNO. Bandwidth is expected become a commodity and access service providers on both the fixed net and the mobile network emerge, frequently defined as xVNOs (Nokia, 2006a).

As the relation between the fixed ISP and the MVNO-centric on the fixed net is essentially similar to the relation between the mobile operator and the MVNO on the mobile domain, there are basically two options in this model. First an actor that currently owns network infrastructure and provides services on the fixed domain steps into the mobile domain, deploying MVNO activities. In the Netherlands an example is a cable operator and ISP (UPC) that entered the mobile market as a MVNO, expanding his

portfolio to offer so-called “quadruple” services. Second an actor can function as virtual operator on both networks. In the Netherlands examples of this type of service providers are Scarlet (currently only voice in the mobile domain) and XS4All (currently only data in the mobile domain).

We already discussed a variant to the MVNO model earlier when focussing on a content provider assuming this role. Therefore we do not elaborate on it here and focus exclusively on the role of an ISP from the fixed domain owning network infrastructure that provides billing services on a mobile phone. Evidently many of these aspects also apply to virtual ISPs.

ISP from current fixed domain

ISPs have similar technological capabilities as MNOs as they have large billing systems in place from the time regular Internet connections where metered (Interview: Bergkamp, 2007). These ISPs already have an existing channel to the Internet and a customer relation. Based on these two aspects these ISPs can easily provide their own value adding services on a subscription basis. In essence this is similar to content providers that add subscription to additional VAS to their current billing relations. The latter makes sense in this model as ISPs are already more accustomed to flat fee based models as they emerge from a different domain (Interview: Hania, 2007). This type of service provisioning is not aligned with the archetype where the ISP’s billing functionalities are considered on a wholesale basis to be used by content providers.

The latter requires relations and connections with content providers to bill for their content. This is a tremendously complex and challenging task as the content offering of potentially many different providers is very large and the amount of relations between these actors and for example current MNOs is very high. Given its complexity and size the market demands for aggregation (Interview: Egberts and Vlasblom, 2007). Operators have, similarly to regular ISPs in earlier days tried to capture the market in their portal but did not succeed and now offer their service increasingly on a wholesale basis (Interview: Haanstra, 2007). Offering separate connections to the billing systems and dealing with payment separately with each content provider can only work on a small basis. Therefore it would make sense for ISPs to also deal with content and payment aggregators if they were to provide premium content services of third parties.

These content and payment aggregators already have established large amounts of relations with content providers and operators. Furthermore, they can also deal with the customer support in those areas where the ISP is not represented (Interview: Egberts and Vlasblom, 2007). The billing support they provide to operators could nearly be copied to be provided to ISPs. The billing systems of ISPs are rather similar to MNOs’ billing systems and hence current WAP billing solutions can be applied, making the ISP channel another channel for paying for content services (Interview: Egberts and Vlasblom, 2007). In Figure 5.14 we show the model we discuss in this paragraph, and in Table 5.5 we present the basic characteristics in terms of control of information and technology and customer contact in this model.

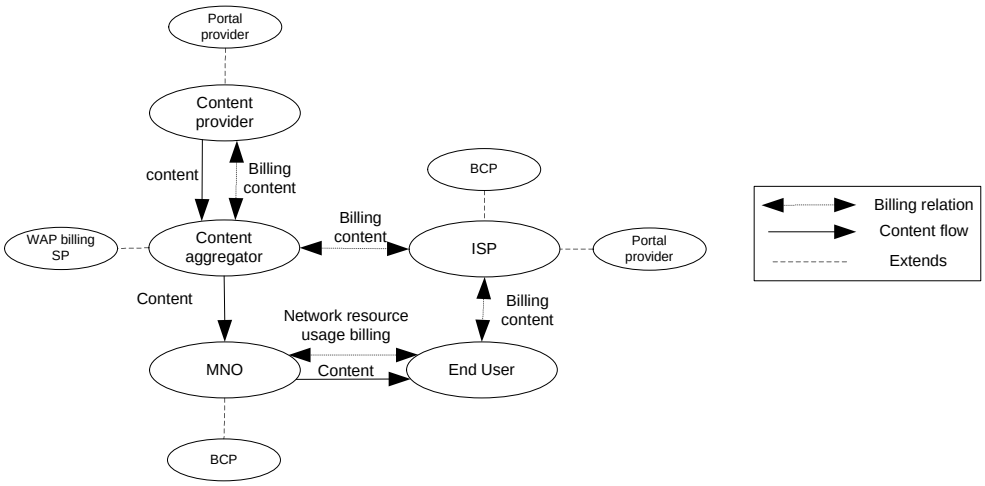


Figure 5.14 ISP (fixed operator) centric model

Table 5.5 Summary of the anticipated ISP (fixed operator) centric model

ISP centric	*Relation to end-user*	*Control of technology*	*Control of information*
Network operator	Network provisioning and billing network resource usage	Network infrastructure, partially on mobile device (SIM/USIM)	End-user network ID (SIM/USIM). Network resource usage data
Content provider	None direct, possibly the service relation.	Content database	Usage data, demographic data depending on payment method. Also profiling possible.
Content aggregator	None direct, possibly the service relation.	Aggregation platform	Usage of all content consumed at the providers that use the aggregation services
WAP billing service provider	See content aggregator	Payment platform	Similar to content aggregator
ISP	Billing for content and services on the mobile channel. Billing for network resource usage on the fixed channel.	CRM systems, billing systems, WAP billing gateway	All customer details on both usage and demographic data

As in all models other than the operator centric, a problem remains that the user must be identified. In earlier sections we already discussed the three options: (1) pay for the identity at the operator, (2) request login with ID, and (3) use the intelligence available in the device. In this model we select the third option. Although the amount of devices currently sufficiently capable of for example SIP session establishment remains rather low, ISPs are already used to this type of authentication.

Finally, the above primarily considers billing for content services. Billing for network resource usage in this model is left to the MNO. ISPs have proven expertise on the Internet market and could rather easily assume the MVNO role to buy the capacity on a wholesale basis and apply their own billing mechanisms. The latter would make sense given the convergence of the mobile and fixed domain and increasing offering of bundled services. However, it is not a requirement for the functioning of this model. Therefore in this model we choose to have the MNO bill for network resource usage, either by flat fee or based on QoS parameters.

5.6.3 Processes in the ISP centric archetype

In the above discussions it was already evident that our interpretation of a feasible ISP centric model closely resembles the current MNO centric off-portal model. In Figure 5.15 we show the WAP billing provider and content aggregator as separate roles and hence also the accounting of revenues is separated between these roles. Both roles are usually integrated in the mobile domain and therefore it is hard to determine who would compensate who. Basically the ISP would usually compensate one actor for providing both WAP billing and content aggregation services. The activities in this process are more thoroughly related to roles in the RID shown in Figure 5.15.

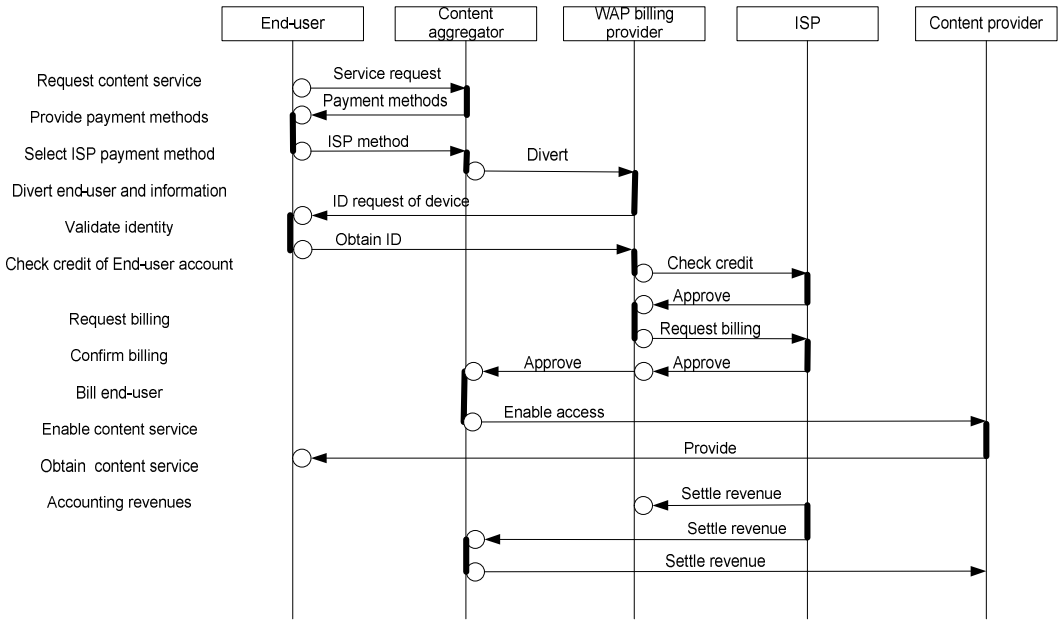


Figure 5.15 RID of ISP centric billing processes

The MNO role is not shown in this figure as it does not play any role in this process. Although the content provider does contribute to the process, all interactions run through the gateway of the content aggregator and WAP billing provider that restrict or enable access to the content of the provider, depending on the payment status in the ISP system. The analysis of the billing processes in terms of the contribution of information and technology of the involved roles is performed in Appendix 9, by means of the IDEF-0 modelling method. We discuss the main findings of the analyses in the RID diagram and IDEF-0 method on the basis of our criteria.

Usability
The usability of the business processes in the ISP centric model is very high. The session does not need to be ended and the total amount of required activities is rather low. The activities are not complex, especially since the identity of the user does not need to be validated in case it is provided on the basis of the device.

Interoperability
Similar to the operator centric model the complexity in interoperability is nearly entirely placed at the WAP billing provider. Each operator but possibly also each fixed ISP has a custom WAP billing gateway to which the WAP billing providers connect. At the other side the WAP billing provider has interfaces to content providers. WAP billing providers offer different interfaces, depending on the wishes of the content provider. This places a great deal of complexity at these actors but also emphasizes the importance of their role. Standardisation is starting to take shape here through the usage of web services.

Leverage of legacy
ISPs have the billing systems in place from the time the Internet used metered charging mechanisms. The WAP billing solutions provide a unique opportunity to leverage this legacy. Only a moderate amount of new technology is required, for example a WAP billing gateway.

Information quality
The WAP billing provider deals with the largest part of the information. The identity of the user is obtained from the mobile device to bill on its account at the ISP. The information on prices is received by the content aggregator from the content provider. The quantity of the information required for the WAP billing solutions to function is rather low. Whereas the pricing information can be communicated ex-ante the identity will be communicated real-time, in this case obtained from the device. The presentation of the information to the user depends on the solution of the WAP billing providers. Given the fact that only few steps are required and it predominantly consists of a confirmation request of the user on the payment gateway it will be easily interpretable, locatable and convenient.

5.7 Conclusion

In this chapter we placed the developments identified in the former chapter into perspective by designing the billing processes in alternative role divisions. The question answered in this chapter is:

> *What are feasible designs of the billing processes in terms of the role divisions, process activities and the control of information and technology?*

We learned that in their high level theoretical form the role division archetypes are not feasible.
Aspects such as technology and information require a more concrete specification. Therefore we expanded the models. In
Table 5.6 we summarize the archetypes and interpretations that we further designed on the basis of the knowledge of the industry we built from iterations in interviews and desk research. The responsibilities for the two core aspects of billing for content services, i.e. billing for network resource usage and billing for the premium content are shown.

Table 5.6 Summary of archetype interpretations

Role division archetype	*Billing for network resource usage*	*Billing for content services*
Operator-centric	Mobile operator	Mobile operator
Content aggregator centric	Mobile operator	Content aggregator
Content provider centric		
MVNO-CP model	Content provider (MVNO)	Content provider
Advertisment model	Mobile operator	N/A
Add to current subscription	Mobile operator	Content provider
Billing aggregator centric	Mobile operator	Payment provider
ISP centric		
Fixed ISP	Mobile operator	ISP
xVNO	MVNO	xVNO

In most interpretations of the archetypes the mobile operator directly bills the end-user for network resource usage. The start of an MVNO is the only manner to fully accomplish a single bill by other actors. Hence the billing for network resource usage will remain the domain of the mobile operator in most models. In any model not based on an MVNO construction this can be on the basis of packet charging such as shown in chapter 3, based on a flat fee, or use differentiating tariffs depending on quality of service characteristics in the IP multimedia subsystem. We conclude the billing for the price of content services for each archetype interpretation below.

The operator centric model is an extension of the on-portal WAP billing solution at the expense of the off-portal PRSMS model. In this model the operator remains in control of the customer demographics and the billing process whereas content aggregators and providers are limited to usage data that they measure themselves or are reported of by the mobile operator. The WAP billing solution makes this model highly usable to the end-user as the amount of required information of the user is very low due to the fact that the identity is already known by the operator. The complexity of interoperability is nearly entirely placed at the WAP billing provider. As this is already part of this actor's current portfolio and many relations are already in place, legacy is leveraged making the implementation of this model rather straightforward. The billing systems and CRM systems of the MNO are interconnected through one additional component; the WAP billing gateway. The MNO-centric model in the light of our criteria is summarized below.

Customer usability	*Interoperability*	*Leverage of legacy*	*Information quality*
Very high, only few effort of user required	Complexity mostly placed at WAP billing provider	Both WAP billing provider and MNO leverage current legacy.	Identity is guarenteed by operator, quantity of required information is low

The content aggregator centric model is hard to realize by the mobile aggregators at present active in the industry that preferably remain in a pure business-to-business context. Aggregators that could become centric may emerge from the regular Internet where technology providers are starting to move into the media market. These have established brand names and technological know-how to deploy their own systems. Given the trend of aggregating aggregators, it makes sense that these actors are the major players in the industry such as Apple and Nokia. As the billing for network resource usage remains at the mobile operator and premium content is billed by the aggregator, both have a customer demographic profile but the aggregator controls the usage data. The billing processes for content services in this model can be supported by custom build solutions, possibly integrated in the device. The processes are summarized on the basis of our criteria below

Customer usability	*Interoperability*	*Leverage of legacy*	*Information quality*
Very high, nearly all activities take place at aggregator's platform and customer interactoin is limited due to control of device.	Control and knowledge of the device mak interoperability with the device easy. The challenge here is interfacing with content providers that have many different systems.	These actors do not have existing systems and can build innovative and scalable solutions. However, this requires a great deal of resources.	Know-how of technology provides advantages in delivering high quality interfaces to users. Information communication with content providers is a challenge in this model.

The content provider centric model in which content providers use an MVNO construction to offer their content is the only model additional to the MNO centric model that enables a single bill to the end-user. To overcome most of the resource barriers, relations with MVNEs could be established, reducing the function of the mobile operator to a bit pipe. Control of information is entirely placed at the content provider. Basically this model resembles the current on-portal WAP billing model where the MVNE must support this process in which the content provider strictly offers its personal content (which can also be acquired white label). Evidently an actor can also have both the MVNO and MVNE role. The model is summarized on the basis of the criteria below.

Customer usability	*Interoperability*	*Leverage of legacy*	*Information quality*
Interactions between CP, MVNE and MNO are rather complex, but this is hidden from the user.	Most of the complexity resides in the interface between the CP and the MVNE.	MVNEs systems are customized for wholesale, investments in legacy of the content provider are rather low.	The dependencies between MNO, MVNE and CP and MVNE make the information exchanges complex requiring proper controls.

The billing aggregator centric model is rather ambiguous as it can also easily be part of the other models. The payment methods provide differing amounts of information to the content provider. When this data is more elaborate, the content provider can establish his own customer relation. However, the direct and actual customer contact is placed at the payment method. These will probably be aggregated at either current mobile aggregators or actors entering the mobile industry from the regular Internet. The payment processes will very much resemble the processes as currently in use on the Internet, with the difference that potentially secure customer identity can be established without the need for a login or password procedure. This model is summarized on the basis of the criteria below.

Customer usability	*Interoperability*	*Leverage of legacy*	*Information quality*
Compared to the other models the usability of this model is rather low. The validation of the identity requires additional steps and decreases the possiblity of content providers to deliver customized services	The content and payment aggregator will have to interface with diverse payment methods. Interoperability at the device will mainly be based on current Internet standards.	Current Internet payment methods require only moderate changes in order to function on the mobile device. The existing relations and interfaces of current content aggregators are also leveraged.	Current payment methods may function technically, a proper presentation to the user is crucial since the amount of interactions and the quantity of required information are high.

The ISP centric model could become a strong competitor to the current MNO centric model as similar functionality could be offered. In this model the ISP controls the billing system and customer demographic and usage data but the processes are to a large extent orchestrated by the mobile content aggregator that also has the usage data. By offering the same payment solution of the WAP billing provider on the Internet account of the user similar usability can be offered. ISPs already have the technology and customer relation in place. This model is summarized on the basis of the criteria below.

Customer usability	*Interoperability*	*Leverage of legacy*	*Information quality*
Very high as the session does not need to be ended and the total amount of required activities is low. The current MNO solutions apply here.	The complexity is similar to the MNO centric model mostly placed at WAP billing provider.	Existing billing and CRM systems can be leveraged at ISPs and be combined with existing hightly interoperable systems of the WAP billing provider.	Especially since predominantly subscription models will be used, timeleness is a less critical issue. Proper presentation is guarenteed by current solutions.

6. Conclusions

6.1 Introduction

In the provision of mobile content services the mobile operator is the central actor in the value network and controls the critical resources for both exploiting and billing these services. Especially the billing relation with the end-user is a strategic imperative of the mobile operator that enables this actor to charge high billing fees and orchestrate the introduction of new services. For several years other role division models are discussed in literature that point to a more central role of other actors than the mobile network operator. We identified five role divisions with the actor role in the value network controlling the billing relation respectively being: the operator, the content aggregator, the content provider, an independent billing provider, or the Internet service provider. These alternative role divisions could provide more freedom to the actors in the industry to deploy content services and introduce competition in the billing market.

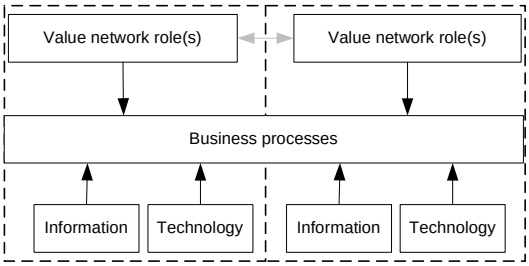
Many authors have laid down technological architectures and information models for specific role divisions but an overview of the billing processes in terms of the activities and control of information and technology for the different role division models lacks. Hence, it remains unclear how these models would concretely take shape and how they are affected or enabled by current legacy systems and relations, and developments in the industry. Obtaining this knowledge was the goal of this research thesis and provided the following research question:

> *What are the options that organisations have in the realisation of the billing processes in terms of the control of technology and information in the several role division models of content service provisioning on the mobile Internet?*

6.2 Theory

The value network and underlying business processes, are two levels of analysis that are defined and related. We define a value network as a structure in which different actors, fulfilling one or several roles exchange value to provide end-user value. A business process consists of several sequentially structured activities that provide output to a specific market or customer.

We conclude that the value network and the underlying business processes can be related in two ways. First through focussing on value exchanges across the boundaries of firms, and subsequently translating these in transactions. Second through the focus on technological and informational resources that the actors, assuming the various relevant roles in the value network, control, and contribute to the business processes. We assume the premises that the resource perspective better captures the importance of legacy and provides more flexibility to incorporate technological developments, than the value perspective. Therefore we selected the resource perspective. The framework shown in Figure 6.1 illustrates the demarcation of our theoretical focus.



Value network roles and business processes can be related by establishing the deployment of informational and technological resources in the business process activities by actors fulfilling roles in the value network.

Figure 6.1 Conceptual framework

This framework provided a theoretical lens to study the billing of mobile content services. To analyze the value network we focussed on the resources that actors fulfilling the various roles in the value network contribute to this network. To analyze the billing processes we regarded the business process activities in relation to the technology and information that support the business processes. To this end we established that the IDEF-0 method and the Role Interaction Diagram are the most applicable modelling methods. Furthermore, we established criteria from literature to evaluate inter organizational

business processes. These criteria relate to activities (customer usability), technology (interoperability and leverage of legacy), and information (information quality).

We obtained the majority of our data from thirteen semi-structured interviews that we complemented with a literature study into the domain. We did not specify direct expectations from literature but have build our knowledge of billing in the mobile industry by iteratively attending literature and performing interviews. The framework provided focus in our data collection.

In the application of the framework it turned out that the analysis and identification of business processes in potential role divisions was a highly iterative process. Roles relate to activities that require specific informational and technological resources to enable the activities related to these roles on a business process level. Vice versa developments in informational and technological resources can also enable processes to be performed in another manner. Due to these interactions it was impossible to directly specify either of the levels under analysis.

6.3 Billing in the mobile Internet value network

We studied literature on billing and concluded that billing for content services is a broad concept. We used a definition of the concept that consists of three high level activities. The first is charging for usage of network resources and the price of the content service. The second is placing these charges on the customer bill and arranging the collection of the bill. The third concerns the accounting of the revenues of the provided content services among the actors involved in these processes.

Charging and billing
From literature we learned that the charging for network resource usage is entirely performed by the operator. Several Charging Data Records (CDRs) are created at the various components of the mobile operator's data infrastructure. These records hold the user ID, amount of minutes or kilobytes consumed and the origin of the traffic. The latter can be used to identify the traffic type to which the ratings of the CDRs can be adapted (e.g. the network resource usage charges of an MMS can be set to tariff 0). The rated CDRs are aggregated and consequently placed on the bill of the user. The charging and billing for the price of premium content services involves more roles, such as the content provider and aggregator, but literature is not conclusive on the interactions among these roles. From our interviews with industry participants we learned that there are at present two types of operator-centric billing constellations in place in the Netherlands; on the operator portal and outside of the operator domain, i.e. off-portal.

In on-portal provisioning of content services the mobile operator controls the content obtained at content providers, aggregates and enables this content and provides this under its own brand. Content providers have to adapt to the mobile operator's constraints and therefore host several different sites as each operator demands a different format. In literature specific billing methods are hardly discussed. From our interviews we learned that the dominant on-portal billing method in the Netherlands is what is defined as WAP or content billing. This billing method directly charges the consumption of content services on the customer bill through a direct interface to the billing system.

Off-portal the traffic aggregation of the content services and possibly the hosting is performed by an independent aggregator. This aggregator usually also performs the role defined as SMS billing provider, which is directly related to the dominant off-portal billing method, defined as Premium Rate SMS (PRSMS) billing. In this method the operator provides a separate gateway to the SMS Centre (SMSC) where the SMS service provider can request the sending of a message to a specific number. These messages are Mobile Terminating which means that the receiver of the message pays. These Mobile Terminating messages can be used for billing premium content services and can charge up to 1.5 euro of value. The SMSC in this case uses the already existing relation to the billing system and generates so-called CDRs that are placed on the customer bill.

From literature it was already evident that the operator holds the central position. In our interviews this was confirmed as we found that in both billing methods the operator entirely controls the customer relation. The operator controls the technology that is critical in this process. First the operator controls the SIM or USIM card that holds the customer identity, the infrastructure that holds the location, the CRM system that holds the customer details. Furthermore, the operator controls the billing system that can deal with a tremendous amount of small charges in a short time frame on many different accounts, and the SMSC and related gateway that enables charging. Additionally the operator also controls the gateway towards both WAP and the open Internet where a large part of the content enabling and reformatting takes place. These resources are hardly substitutable and inimitable providing resource barriers to other actors.

The billing processes in the mobile Internet value network are entirely orchestrated by the mobile operator through the control of business process critical technological resources such as the (U)SIM, the billing system, the SMSC and mobile Internet access gateway.

Accounting of the revenues
We learned from literature that the accounting of the revenues of the content services is based on reports that are generated by the operator billing system. The operator informs the other actors that only have little information on the successful amounts of content delivery and settles the revenues accordingly. However, from our interviews we learned that especially in off-portal content provisioning the content aggregator and provider do have information on content delivery but that the identity of the users remains hidden.

6.4 Developments in the value network and underlying billing processes

As mentioned in the introduction it is unclear how the future billing processes will take shape. When designing feasible future billing processes the visible and anticipated developments affecting these processes must be incorporated. They provide the basic frame of reference under which the processes will be deployed and may challenge the current inimitability and insubstitutability of the resource barriers controlled by the mobile operator. Furthermore, changes in services may require new resources or decrease the value of current resources. The developments can be structured in three categories: (1) changes in services, (2) changes in the roles assumed by actors, and (3) developments in information and technology.

Services
We learned from literature that the primary drivers of new services essentially point to one notion: *customer-centricity*. The customer must obtain personalized context and location aware content services that are as rich and diverse as possible, easy to use, and parallel consumable. Hence customer information becomes more important and billing relations must be transparent.

Roles assumed by actors in the industry
With the convergence of the mobile and the regular Internet the actors active in the industry face a new environment. In literature it is proposed that actors in the mobile industry increasingly have to focus on their core functions. This was also evident from our interviews where we learned that mobile operators increasingly focus on two core assets; providing network access and facilitate billing. Content aggregators and SMS service providers pointed out that they expect to remain focussed on their business to business services as at present.

Content is increasingly provided off-portal and hence the portal of the operator is no longer at the centre of mobile content service provisioning. Actors fulfilling the content provisioning role will have to attract end-users to their own environment. Actors in the industry expect that in this context mobile searching will grow in importance as the quantity of content offering grows. Mobile searching is expected to be different from regular searching since users can be identified and their preferences can be used to provide more direct links than on the regular Internet.

The convergence of the mobile – and regular Internet forces many actors to rethink their business and start new relations among the actors active in, and entering the mobile industry.

Actors strongly present in the regular Internet enter the market and assume roles in the mobile domain. Interviewees expected that especially these parties will become strong competitors to the mobile operators in their customer relation. A related trend is the entry of technology providers in the content

market, becoming both technology and media players. These actors bring in new resources which also enable alternative role divisions.

Not only in scientific literature but also emphasized in our interviews was the fact that MVNOs grow in number and heterogeneity and are considered important enablers of new billing role divisions. As a result of the proliferation of MVNOs, mobile operators need to enable wholesale of several of their services to which many are not yet organized. This gap is where the Mobile Virtual Network Enabler (MVNE) role operates. The MVNE offers services such as charging and connections management to the MVNO on top of the capacity and connection it rents at the MNO. The MVNE facilitates actors to assume the MVNO role, and hence obtain direct customer contact on the mobile channel.

Technology and information

The entry of new players in the mobile industry, combined with anticipated technological developments decrease the inimitability and insubstitutability of the resource barriers mobile operators control.

We identified four major trends in technology and information that are expected to affect the billing of mobile content services. Three directly relate to technology and one to information. First, most interviewees expected the increasing intelligence and capabilities of mobile devices to enable identification of the user and its location, which may challenge this resource barrier controlled by the mobile operator.

Second, we found two technologies that are expected to affect the billing processes: (mobile) web services and the IP Multimedia Subsystem (IMS). Web services enable for example content aggregators and payment providers to expose their functionalities to content providers in a highly interoperable and easily deployable manner. The IMS is a platform expected to be implemented by mobile operators. The IMS enables differentiation in QoS and hence can provide differentiated pricing. Several authors, but also an interviewee in this research regarded the IMS as a further enabler of the walled gardens. Although we found that flat fee is expected to become the dominant charging scheme for network resource usage, other schemes are still possible and potentially stimulated by the deployment of the IMS.

Among interviewees the general view is that billing methods providing less overhead, greater ease of use and higher kick-back will eventually replace PRSMS billing for content services.

The third technological trend we found is that the PRSMS solution accustomed in the mobile domain is expected to be replaced. Additional to off-portal WAP billing we identified three types of billing methods: (1) those directly related to the bank account, (2) those related to a credit card, and (3) purely pre-paid methods. These alternatives are already frequently aggregated at current mobile aggregators to offer a broad payment portfolio to content providers. Several interviewees expect this aggregation to further expand, basically aggregating various role divisions.

The dominant trend in information we found is that the pricing of content services is subject to radical changes. With the migration of the mobile domain to the regular Internet, end-users expect the majority of content to be free. This drives advertisement based models; especially at those providers delivering content that insufficiently differentiates to provide premium value. The majority of content that will be delivered on a premium basis is expected to be offered through subscription based models. Many interviewees pointed to the fact that this, in contrast to event-based billing, is more viable, which is supported by recent research.

6.5 Specification of the role division archetypes

Based on the present situation and the identified developments impacting the billing processes in the mobile Internet value network we assessed the various role division archetypes from literature on their feasibility and likelihood. From the knowledge we built through the iterations in interviews and literature study we conclude that these role division archetypes in their theoretical form are not feasible and require more thorough specification. We designed feasible models on the basis of the ability to bill content services through billing processes. The various models and their interpretations are discussed below.

The mobile operator centric archetype
This archetype represents the classical on-portal content service provisioning, but will be extended off-portal. Billing for network resource usage is expected to be increasingly performed on the basis of flat fee but differentiation in QoS and pricing may be used by operators to generate more revenue. To bill for the price of content services PRSMS will decrease in its usage and the WAP billing solution will be offered off-portal. Similar to the PRSMS solution at present, to enable the dealing with the large amount of content providers, aggregators will be used. These offer payment solutions to charge end-users on their bill at the operator. We show our specification of this role division model in Figure 6.2.

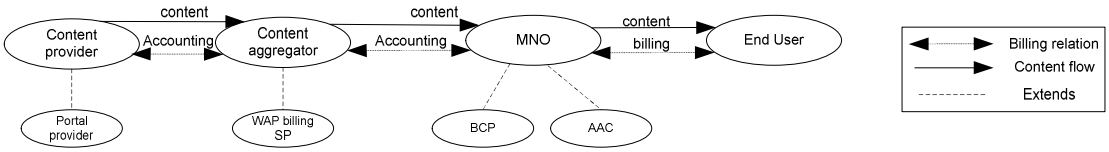


Figure 6.2 Off-portal operator centric model

This model places most of the complexity in the billing processes at the content aggregator and WAP billing provider. These actors have to deal with different interfaces to the mobile operators as each operator has a different WAP Billing gateway. On the other hand they have to interface their systems to content providers that have many different interfaces. Both the mobile operator and the content aggregator and SMS service providers can leverage their legacy to deploy the WAP billing solution. Given the tight integration with the operator systems, the customer usability and information quality are high. These aspects provide sufficient rationale to conclude that this model will be one of the primary means to bill end-user mobile content services in the coming years.

The content aggregator centric archetype
From our interviews we learned that the content aggregator centric archetype will not be realized by the actors that at present aggregate content in the mobile domain. These actors stressed that they will remain in their business to business role as they do not intend to build a direct customer relation. Given their resources and current relations, these actors can become important in other role division models. A development that can best be placed into this archetype is the focus of technology providers on the media market. The aggregation role is a suitable place in the network to establish a customer relation without the need to create content. The technology providers can deploy their own payment mechanisms on top of the customer profiles they are already establishing. To overcome the identity barrier these actors can use their technological know-how and influence on the functionalities of the mobile device. Billing for network resource usage in this scenario is expected to remain at the operator as there is no direct relation between the aggregator and the operator here. We show our specification of this model in Figure 6.3.

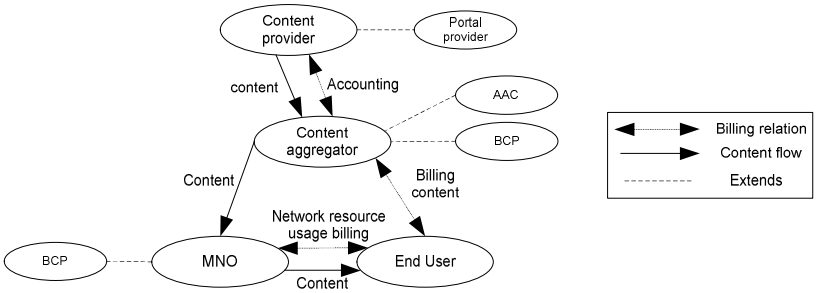


Figure 6.3 Content aggregator centric model

Given the know-how of these actors and their potential control of the functionalities of the mobile device they are likely actors to use identification on the basis of the mobile device. This enables them to remove this step from the payment process and deploy solutions with similar usability as the WAP billing solution of mobile operators. The proliferation of technology such as Web Services, enables easier integration with other actors which removes part of this barrier. However, establishing relations with content providers remains a challenge in this model as guaranteeing trust and information quality, as well as the required interoperable systems requires significant effort.

The content provider centric archetype
We found that for premium content the dominant model in this archetype will concern adding the end-user content services in the mobile domain to an existing billing relation such as a subscription to a newspaper. Several interviewees pointed to this option that is comparatively easy to realize. Several interviewees stressed the fact that identification of the user will remain a problem here. However, when this identity is not provided by the operator, or can be obtained from the mobile device, it is possible to apply login mechanisms. Our interpretation of this model is shown in Figure 6.4.

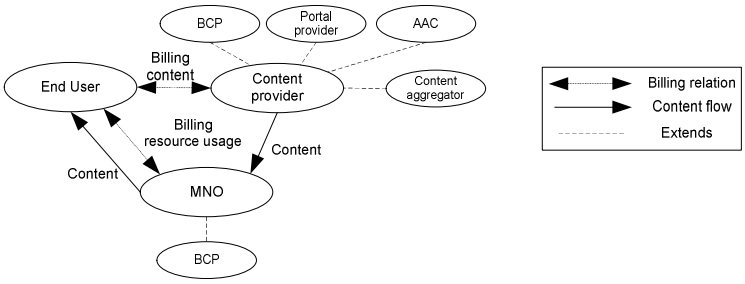


Figure 6.4 Content provider centric model; Adding the end user to an existing relation

Another identified option is the start of an MVNO by content providers. The entry of MVNEs in the market has made this step rather easy. Content providers can build their own portal with content, similar to current mobile operators, without requiring technological know-how or infrastructure. Billing processes could be similar to on-portal WAP billing but more likely are offered in packages together with the subscription. In this latter scenario the content provider can choose how to bill the end-user for network resource usage. When this is done on the basis of packet charging, the rated CDRs of the MVNE can be used. When this is done on the basis of flat fee, the subscription contains a flat fee for both network resource usage and the content services, i.e. a "single bill". Our specification of this model is shown in Figure 6.5.

The content provider centric archetype will predominantly be based on adding subscribers to an existing customer billing relation, but can also include MVNO activities combined with personal content portals.

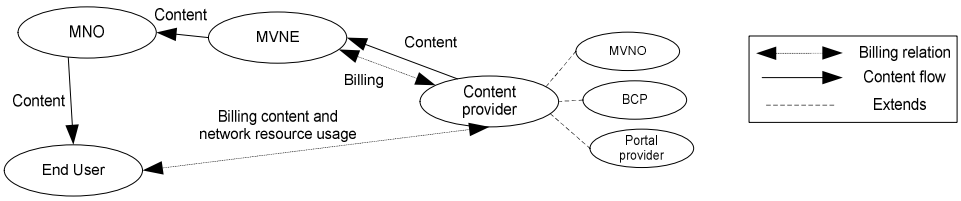


Figure 6.5 Content provider centric model; assume the MVNO role

The single bill, combined with an intelligent manner to establish the customer identity provides this model with high usability to the end-user. However, interpretability between the different actors poses a significant challenge. Whereas the mobile operator controls the radio infrastructure, the MVNE provides the back-office (billing) infrastructure and the MVNO has the CRM systems in place. This fragmentation requires many interfaces between potentially very different systems of the MNO, MVNE and MVNO, making this model complex. Furthermore, to guarantee timeliness the rated CDRs must be provided near-real time making the interactions between these systems highly frequent whereas the quantity of the information is high. This challenges information quality especially since monitoring is difficult.

The payment provider centric archetype
We learned that the payment provider centric archetype differs from the other four archetypes in one dominant respect. The actor fulfilling this role is not predominantly interested in the customer details in terms of its usage and demographics to tailor its content services, but targets the transaction fees. The details of the customer are frequently forwarded to the content provider or aggregator using the payment services. According to the interviewees the actual communication of this information is different for every payment method. Essentially it is the payment provider that holds the billing relation and other actors depend on their information. It remains unclear how much of this information is actually shared. In this archetype the billing for network resource usage will remain at the mobile

operator as the payment provider has no relation to the operator and strictly bills for the price of the content services. Our specification of this model is shown in Figure 6.6.

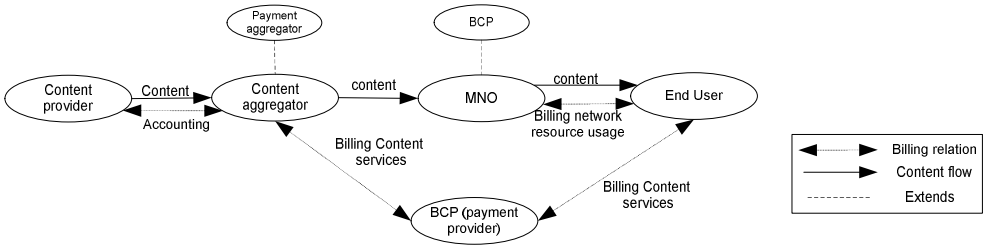


Figure 6.6 Payment provider centric model

The amount of information that the payment provider has, differs significantly depending on the method. Pure pre-paid methods generate no information at all whereas the payment methods that relate to a bank account generate a full customer profile. The provision of multiple payment methods by a billing aggregator is a likely scenario and hence, although the payment providers have the customer contact another strictly business to business role is added to the network. The required identification of the user through login mechanisms makes the usability of this model rather low. Similar to the operator centric model most of the interoperability issues will be dealt with by the content aggregator that in the current situation also frequently has the function of payment aggregator. This actor exposes the billing functionality to a diversity of content providers to which it interfaces. The interface of the payment provider to the device will be an extension of the current Internet payment methods and hence it requires the intelligence of mobile devices to enable this. Despite of being interoperable, usability of the method and demands on the quality of the information require these methods to adapt to the mobile channel.

The Internet service provider centric archetype
We found that the Internet Service Provider centric archetype can be divided into two types: (1) the model in which a fixed operator further exploits his existing billing relation, and (2) the model in which an ISP not owning physical infrastructure in the fixed domain further exploits his billing relation. The second is not further developed as it is highly similar to the content provider-MVNO centric model. The first model is of particular interest due to the legacy that these ISPs have in place. Our specification of this model is shown in Figure 6.7.

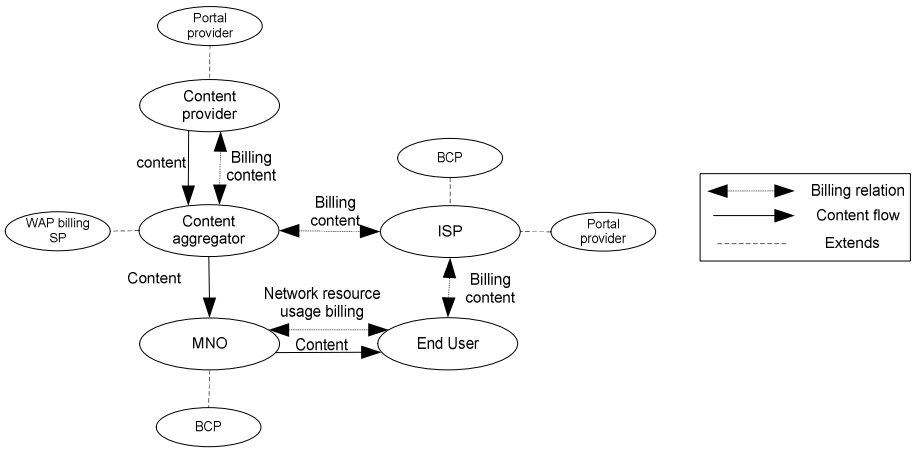


Figure 6.7 ISP (fixed operator) centric model

Through leveraging their legacy billing systems they remove this resource barrier and fixed operators could potentially offer billing capabilities similar to mobile operators. However, fixed operators are not used to establishing (wholesale billing) relations with content providers and do usually not own their own content. Therefore cooperation with current mobile aggregators makes sense. These have existing infrastructure in place to deal with micro payments on similar billing systems though WAP billing. This would provide similar usability to the end-user and the ISP does not have to deal with interoperability issues other than providing a gateway to the WAP billing provider.

6.6 Integration and projection

We further specified the archetypes and designed feasible business processes in these specifications. Although the process activities and related control of technology and information can be feasible in each model they are subject to their own constraints. The models differ significantly in terms of the customer usability, information quality guarantees and interoperability. Only the very large actors, usually emerging from the Internet or having a solid technological background, are likely to build entirely new billing systems and lay down the related processes. Others can leverage their relation or legacy, or cooperate with mobile content aggregators that deal with most of the interoperability issues and relations. Given these differences we can provide a projection on the potential use of the different models, which is shown in Figure 6.8.

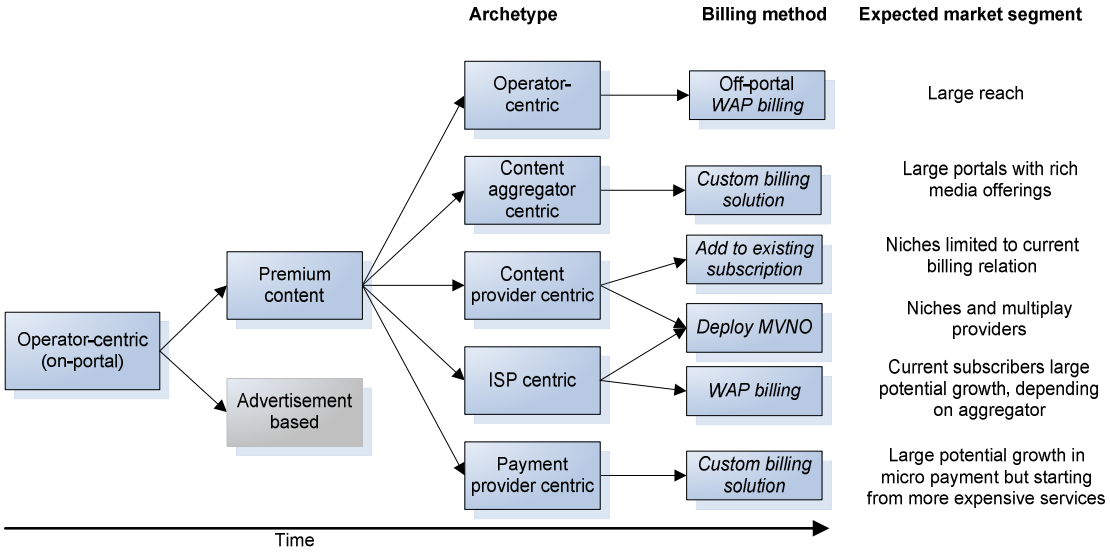


Figure 6.8 Development path of billing in the mobile content industry

The operator centric model that is presently dominant is expected to change from predominantly on-portal to full off-portal content provisioning, supported by the WAP billing solution. Given the high customer usability of this billing method, the advantage of a single bill and the existing payment relation we expect this to remain the dominant model in the coming years. The content aggregator centric model, that we expect to be supported by large technology providers, can provide similar usability and can become a strong competitor for those content services that will become part of the aggregator's portfolio. The content provider centric model where users are added to the current subscription is limited to flat fee services within the present subscriber base. This also holds for ISPs who can expand their service offerings and increase ARPU through obtaining a fee for the billing of content services on their current relations. Hence this model will basically serve niches.

Especially the model in which the ISP leverages its billing legacy and cooperates with current content aggregators can become a strong competitor to the operator-centric model. Similar usability can be offered with the same information quality. The payment provider centric type of model will be used complementary to other models and can establish a large user base across many different content providers and aggregators. Their solutions will most likely apply to subscription payments and more expensive services as the usability remains comparatively low for micro payment.

Summarizing, the operator centricity in the mobile value network in terms of the billing for content services is expected to be increasingly challenged. With the convergence of the mobile and regular Internet, the mobile content industry evolves to a more open value network. We conclude that the various specifications of the different role division archetypes are feasible. Hence, there are many opportunities for actors in the mobile industry to start an end-user billing relation in which they have more control of the billing process and related information and technology. The end-user is expected to be offered different billing methods, which provides freedom of choice. The increase in competition in the billing market will lower the billing fees, resulting in less expensive content services. Furthermore, the alternative role divisions are likely to enable more rapid introduction of new value adding services.

7. Reflection

This final chapter reflects upon this thesis research project. We discuss the research focus, the research method and validation, and propose directions for further research.

7.1 Research focus

The scope of our study was broad, including both the value network (roles) level and the business process level of the mobile content services industry. This study has resulted in relevant in-depth insights in the potential future role divisions in the mobile industry with respect to billing. In this section we reflect upon the focus of our research.

7.1.1 Geographical scope

Although, experiences from other countries were also used, the results apply most to the Netherlands as most data was collected at Dutch actors. Actors should take caution when applying the results of this research in other regions. For example in the mobile industry it is very hard to determine which country or region is actually "taking the lead". For example Japan is widely regarded to be the forerunner in mobile services. Nevertheless, the stringency that mobile operators in Japan use to provide services of third parties is frequently considered a drawback in Europe. Furthermore, while developing countries are frequently considered running behind, interviewees also pointed to the fact that the deployment of mobile Internet in these countries is one of the strongest drivers of the open mobile Internet. Also actors active in other countries perceive different problems and use different solutions.

Hence, the starting premises in other regions may be different therefore specific directions identified in this study may not apply to other countries. However, the generic framework, relevant factors in the industry, and developments in roles, and information and technology can provide valuable insights to actors active in the global mobile content industry.

7.1.2 Future services

The actual deployment of new innovative services and their impact on the billing processes were not investigated to their full extent. We identified that mobile services will become more personal, location and context aware, bundled and parallel, which we captured under customer centricity. This emphasizes the importance of having the customer contact. However, we did not specifically regard the implications of these service aspects on the billing processes due to time constraints.

Similarly, user generated content was not discussed exhaustively. Several of the identified directions in the mobile Internet point to the ability to also bill for user generated content (e.g. the platforms of Netsize and Independent IP incorporate the openness required here). On top of the current results it would be interesting to assess the impact of drastic innovations in these types of service on the results on billing as presented in this research.

Another aspect relevant in future services is the fact that they will increasingly be offered on a sponsored, i.e. advertisement, basis. This was recognized in this study and emphasized throughout all interviews. Although we frequently identified their expected proliferation, the design of these models and the related billing processes did not fit in the time scope of our research. Advertisement would not affect our results but rather provide new starting points for additional models.

7.2 Research method

In this section we reflect on our conceptual framework and related perspective, and our exploration and data collection.

7.2.1 Conceptual framework

We created a conceptual framework from literature analysis to demarcate our perspective and provide a theoretical lens on the domain under study. This framework is shown in Figure 7.1.

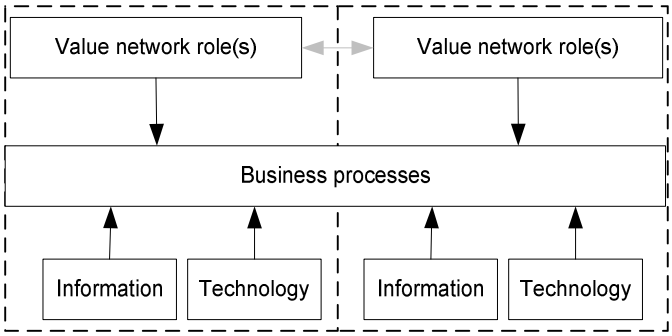


Figure 7.1 Conceptual framework

This framework emphasizes that we regard the interactions among actors fulfilling roles in the value network on the basis of the business processes they participate in. We specifically focussed on information and technology contributions to this process, and the control of these assets by the involved actors. The arrow directly relating the roles of actors is marked grey because this relation is not part of our focus. It concerns the direct exchanges of value between actors; reciprocal relations and transactions across the boundaries of firms. This is an entirely different perspective that we identified but did not further specify. It is thoroughly represented by the work on the e^3-methodology (e.g. Gordijn, 2002; Gordijn and Tan, 2001; Gordijn and Akkermans, 2002, 2004). An approach within this perspective that targets the relation among the value network and business processes can be found in Pijpers and Gordijn (2007).

We regard both perspectives to be highly complementary as they basically refer to feasibility and viability, both of which are requirements of a service. It would be an interesting research to model the different archetypes in terms of the value exchanges and map these on the business process activities identified in this study. One of the things we learned that really complicates matters when intending to relate both perspectives is that the roles that are relevant in each perspective are different. Whereas in our perspective the enabling roles such as aggregators, SMS service providers and platform provider are important, in the value perspective the owners of rights and assets instead of their enablers become more important (see e.g. Voermans, 2007). Hence a first challenging step in relating both models would be to establish the roles under analysis.

7.2.2 Framework application

We applied our conceptual framework in the domain under study both descriptively and explorative. For analyzing and describing the situation at present the framework provided a good perspective and demarcation. When using the framework to explore the future situation, the framework turned out to be rather constraining.

We believe the focus on resources to be of great value, but the focus on information and technology limits the perspective. Aspects could be added to framework as it fails to capture the required resources of more intangible nature. Examples are the importance of an established user base and a brand name. Hence, in our framework the resources attributed to specific roles of less tangible nature are lacking. As a consequence we were forced to move beyond the boundaries of our framework. This may have compromised completeness in the discussion of the less tangible resources.

Assuming a specific role in the value network relates to performing specific functions. These functions can be performed in several ways using different informational and technological resources. The selection of the specification of the functions in terms of resources is a strategic choice. This choice is frequently not only made on the basis of available (informational and technological) resources but can also be the result of weighing many more factors and actor relations such as market power. Therefore a layer could be added to our framework that incorporates strategic choices and thereby sharpens the perspective of our framework. For example

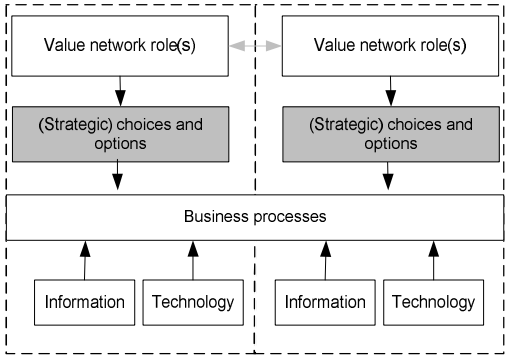


Figure 7.2 Proposed new layer

within the content provider centric archetype, two different models were designed. The coexistence of two feasible models in a single archetype illustrates that the actor that assumes a specific role has a choice in laying down the related business processes. Based on our experiences with our framework we propose a new layer that illustrates this type of strategic choices, shown in Figure 7.2. The specification of this layer is subject to further research. We believe that especially concepts from business architecture theory such as described in Versteeg and Bouwman (2004) will prove helpful in further specifying this layer.

7.2.3 The explorative character of our research

Our exploration shows that we primarily regard the situation at present and current trends as starting points. We extrapolated the current situation through visible and anticipated developments. This meant that we primarily regarded actors that are currently active in the market and technological developments visible by these actors. This makes it difficult to reveal what is defined as "perking information": "emerging conditions, changes and developments that are already taking shape just below the surface, but are not yet visible (Sanders, 1998, u.q. Aaltonen and Sanders, 2006: 29).

This is a shortcoming that could be reduced by using other research methods for the exploration that depend less on extrapolation and currently visible trends. It would also have been valuable to regard more roles that may become important in the industry, additional to ISPs and technology platform providers that we did incorporate. These actors hardly reveal their concrete strategies in exploring other markets such as the mobile content industry. Examples of these actors are Apple, Google, Yahoo!, and Amazon. As a consequence our empirical focus regarded to a large extent an extrapolation of the current telecommunication domain and the actors strongly represented on the Internet were less elaborated upon. To provide more in-depth insights on the Internet domain this study could be further expanded by interviewing actors such as the ones mentioned here.

7.2.4 Data collection; interviews

As mentioned one of the main methods to collect our data was semi-structured interviews with industry participants. The approach was iterative; starting from literature we expanded our knowledge and each interview provided new insights and cases that we assessed in literature. This approach proved to be very effective but several aspects must be noted.

First, the planning and execution of the thirteen interviews was a highly time consuming task and placed additional pressure on the thesis project process. Nevertheless, no concessions were made on the starting premises of the interviews regarding selection of roles, respondents and interview setup.

Second, the interviews were performed semi-structured on the basis of our knowledge at that point and not on concrete questions. The semi-structuring of the interviews through a topic list provided the interviewees with the freedom to bring new and additional perspectives and valuable information. This freedom also has a downside. As we iteratively build our knowledge, each interview was different with respect to the thoroughness of assessing specific topics. The interviews can hence be compared on the main topics that were covered in each interview but only in a general respect.

Third, not all role division archetypes were discussed to a similar extent during the interviews. Although similar topics were discussed, evidently the interviewees reasoned from their own strategic perspective and background which emphasized certain role divisions over others. The likeliness of role divisions was frequently assessed accordingly. Another factor that affected the emphasis on certain scenarios was the extent to which scenarios astonished the interviewees. Those role divisions that are most recognizable, frequently the operator centric model, and the models least recognizable, usually the content aggregator centric model, were discussed in detail. Furthermore, interviewees preferred to future developments on the basis of the situation at present. This means that their frame of reference usually was their current business situation. This is inevitable in any interview and requires effort of the interviewer to keep the data obtained in the discussions in balance.

Fourth, terms and concepts are rather differently interpreted between industry participants. It turned out to be difficult to align interpretations of concepts during the interviews. We therefore took great caution in directly adopting viewpoints of interviewees. All interviewees approved of the interpretation of their views documented in the reports sent to them for validation purposes.

7.3 Validation of findings

This research started with the goal of identifying and exploring the different directions and dominant changes in the billing processes of mobile content services. However, it soon turned out that exploration could be taken a step further into the actual design of potential billing processes in different value network constellations. The insights in and knowledge of the mobile content industry obtained through iteratively studying literature and interviewing actors were translated into concrete artefacts. As mentioned in the introduction this design step can be considered a science as well as an art. The design process has been pragmatic and certain aspects required integration of a diversity of findings. Evidently these steps should be subject to validation. We discuss the different deliverables of this study with respect to their validation.

We already tested our theoretical framework on its applicability through the mobile content billing case and reflected upon it in this chapter. A subsequent case could be used for further validation. The process models we provided in chapter 3 were already validated during our interviews as they frequently provided the starting point for further discussions. Equally, the identified developments in chapter 4 are also strongly empirically rooted as they are translated directly from our interviews. The results of chapter 5 should be the major subject of validation; these designs involve many different actors, each performing different roles. Although the input to these designs to a large extent emerged from the findings in chapters 3 and 4, the integration required an additional step to be made by the designer. Below we discuss how the validation of the latter design step into concrete artefacts should be performed.

We have taken a rather holistic approach to the industry and hence it does not apply to one specific actor but involves all roles within our scope. To validate our results we see primarily be two options. The first is validating at actors, jointly representing the ten roles within our scope, the latter is validating at experts. These can have a similar holistic perspective on the industry and can be either persons actively researching in the industry from universities, or consultants active in this field. Both types of experts have a holistic but differing perspective. Hence ideally we would include both.

Our results lay down scenarios that provide options and require choices of the actors fulfilling the relevant roles. Experts having a holistic perspective could assess the likeliness and viability of these options and choices within the scenarios and hence can assess the scenarios itself. Therefore when using experts to validate our findings we would prefer interviews, possibly performed through online questionnaires which greatly improves applicability in a narrow time scope. To actually verify the choices and options we lay down for the actors fulfilling the roles we identified as relevant, we would prefer to confront these actors with our results. This could also be done on the basis of interviews or questionnaires but, these methods rather miss out on interrelations. To provide actors with the possibilities to assess both our results in terms of their own choices, but also react on options and choices of other actors we would prefer to confront these actors with each other. The ideal setting for this more interactive discussion of our results would be in a group decision room (GDR). As the name implies this method enables the assessment of interactive decision making, ideally suiting our scenarios. Here, we would lay down our scenarios and the critical choices that are required in these scenarios to validate whether actors comply with these choices.

The latter method, although being ideally suited for our validation purposes, would take tremendous effort to organize. This effort lies not in the facilitation, which is for example available at the faculty TPM at Delft University of Technology. The major challenge is bringing together persons that can sufficiently represent the companies fulfilling the roles we identified as relevant. Evidently these can not include any of the persons already interviewed in the light of our research as this would incline validating their own ideas. The latter is already performed through having the interviewees check on our interpretations in the documented interview transcripts. Although all representatives of the actors we have contacted have been very generous in contributing time and effort to our research, they generally have a full agenda. Hence this type of validation method should be planned far ahead.

Another method that incorporates the interactions between actors is the Delphi method. This method does not require actors to be available at similar times and places but rather uses questionnaires or interviews. Here actors are confronted with both ideas laid down by the researcher and the responses of their peers. This method can hence also be used to asses our scenarios. Nevertheless, given the fact that we have five generic scenarios this would require many interactions which are very demanding of the respondents.

Summarizing, in the validation of our results we primarily see two options. The first is an online questionnaire at experts from universities, research institutes or consultants and have these experts assess our findings. The second is a GDR session with representatives of actors fulfilling the roles we identified as relevant. Although we would prefer the latter in terms of its validating strength it is highly time consuming, requires a great deal of effort and can not be performed on a short notice. Therefore we do not point to one single method of validation here but rather lay down our two preferred options, both having their pros and cons.

7.4 Further research

On the basis of the discussions in this chapter, we summarize that further research on the theory elaborated on in this research should focus on:

- The impact of strategic choices on the manner in which functions within roles in the value network are performed, i.e. the layer identified as missing from our framework.
- Further relating our resource “feasibility” perspective to the value “viability” perspective.

We summarize that further research in the domain should focus on:

- The validation of our design results.
- Assessing the developments in the mobile Internet from an Internet perspective, focussing on actors currently not active in the mobile industry.
- Assessing our results on the financial viability of the business process and role division designs.
- The use of our framework in a different case to validate its more generic applicability.

References

Interviews

Bergkamp, L. (2007) Personal announcement. InfoSpace. June, 19, 2007: Papendrecht.
De Buck, M. (2007) Personal announcement. Vodafone. June 12, 2007: The Hague.
Egberts, P. and Vlasblom, A. (2007) Personal announcement. Netsize. July 18, 2007: Capelle aan den IJssel.
Haanstra, R. (2007) Personal announcement. Wallie. June 29, 2007: The Hague
Hania, S. (2007) Personal announcement. XS4All. July 10, 2007: Diemen
Hermans, F. (2007) Personal announcement. Ericsson Telecommunicatie B.V. July 9, 2007: Rijen.
Meijering, H. (2007) Personal announcement. Scarlet. July, 6 2007: Lelystad.
Pauala, A. and Copius Peereboom, P. (2007) Personal announcement. Hyperleap. June 14, 2007: Nijmegen.
SMS Service provider (2007) Personal announcement. June 7, 2007.
Staal, M. (2007) Personal announcement. Sportsplaza (Infostrada). June 13, 2007: Nieuwegein.
T-Mobile (2007) Personal announcement. May, 24: The Hague.
Van den Bulk, R. (2007) Personal announcement. 2WayTraffic. July 11, 2007: Hilversum.
Wennerkers, N. and Theunissen, R. (2007) Personal announcement. Orange. May, 11 2007: The Hague.

Literature

Aaltonen, M. and Sanders, T.I., (2006). “Identifying systems’ new initial conditions as influence points for the future.” Foresight **8** (3): 28-35.
Abels, E. (2002) “Hot topics – Environmental scanning”. Bulletin of the American Society for Information Science and Technology February/March, 2002.
Aguilar-Savén, R. S. (2004). "Business process modelling: Review and framework." International journal of production economics **90**(2004): 129-149.
Allee, V. (1999). "The art and practice of being a revolutionary." journal of knowledge management **3**(2): 121-131.
Allee, V. (2000). "Reconfiguring the value network." Journal of Business Strategy **21**(4): 36-39.
Allee, V. (2000). "The value evolution Addressing larger implications of an intellectual capital and intangibles perspective." Journal of Intellectual Capital **1**(1): 17-32.
Alter, S. (1999). Information Systems: A Management Perspective. Amsterdam, Addison-Wesley.
Amit, R. and Schoemaker, P. J. H. (1993). "Strategic Assets and Organizational Rent." Strategic management journal **14**(1): 33-46.
Andreu, R. and Ciborra, C. (1996). "Organisational learning and core capabilities development: the role of IT." Journal of Strategic Information Systems **5**(1996): 111-127.
Ary, B. D., Debrei, G. and Imre, S. (2005). Real-Time Charging in Third-Generation Mobile Networks. 8th international Conference on Telecommunications - ConTEL 2005. Zagreb, Croatia.
Attaran, M. (2004). "Exploring the relationship between information technology and business process reengineering." Information & Management **2004**: 585-596.
Automatiseringsgids (2007). Google ziet mobiele telefoon als prioriteit. Automatiseringsgids. **41**.
Ballon, P. (2004). "Scenarios and business models for 4G in Europe." Info **6**(6): 363-382.
Barnes, S. J. (2002). "The mobile commerce value chain: analysis and future developments." International journal of Information Management **22**(2002): 91-108.
Barnett, N., Hodges, S. and Wilshire, M.J. (2000). "M-commerce: An operator's manual." The McKinsey Quarterly **2000**(3): 162-173.
Barney, J. (1991). "Firm Resources and Sustained Competitive Advantage." Journal of management **17**(1): 99-120.
Barney, J. (2001). "The resource-based view of the firm: Ten years after 1991." Journal of management **27**(2001): 625-641.

Bauer, J. M., Lin, Y.-C., Maitland, C.F. and Tarnacha, A. (2004). Transition paths to next-generation wireless services. 32nd Research Conference on Communication, Information and Internet Policy. Arlington, VA.

Bergholz, M., Jayaweera, P., Johannesson, P. and Wohed, P. (2003). Process Models and Business Models - A Unified Framework Advanced Conceptual Modeling Techniques. Heidelberg, Springer Berlin.

Bhati Salvi, A. and Sahai, S. (2002). Dial M for Money. WMC ' 02, Atlanta Georgia, USA.

Bhushan, B., Gringel, T., Ryan, C., Leray, E., de Leastar, E. and Cloney, J. (2002). "Federated Accounting Management System Architecture for Multimedia Service Usage Management." MMNS **2002**: 12-24.

Bhushan, B., Hall, J., Kurtansky, P. and Stiller, B. (2005). "OSS Functions for Flexible Charging and Billing of Mobile Services in a Federated Environment." Integrated Network Management **2005**: 717-730.

Bititci, U. S. and Muir, D. (1997). "Business process definition: a bottom-up approach." International journal of operations & production management **17**(4): 365-374.

Boda, P. B., Kernchen, R., Moessner, K., López Dávalos, F., Storgards, J., Sutterer, M., Droegehorn, O. and Giuliani, G. (2005). Developing context-aware and personalised multimodal applications in the MobiLife EU project. International Conference on Multimodal Interaction (ICMI' 2005), Trento, Italy.

Bout, D., Bekx, W. and Achterberg, E. (2006). Dutch Mobile Virtual operators Market overview third quarter 2006, Telecompaper B.V.: 1-67.

Bouwman, H. and MacInnes, I. (2006). Dynamic Business Model Framework for Value Webs. Hawaii International Conference on System Sciences, Hawaii.

Bouwman, H., van den Hooff, B., van de Wijngaert, L. and van Dijk, J. A. G. M. (2005). Information and Communication Technology in Organizations: Adoption, Implementation, Use and Effects. London, Sage Publications Ltd

BT Agilemedia (2006). Whitepaper - WAP billing for Premium-rate Services, BT Agilemedia.

Buellingen, F. and Woerter, M. (2004). "Development perspectives, firm strategies and applications in mobile commerce." Journal of Business Research **57**(2004): 1402-1408.

Butyka, Z., Jursonovics, T. and Imre, S. (2004). A Real-Time Charging Model for UMTS Mobile Network, Budapest University of Technology and Economics, Department of Telecommunications.

Castano, S., De Antonellis, V. and Melchiori, M. (1999). "A methodology and tool environment for process analysis and reengineering." Data & Knowledge Engineering 31 **1999**: 253-278.

Chae, M., Kim, J. Kim, H. Ryu, H. (2002) "Information Quality for Mobile Internet Services: A Theoretical Model with Empirical Validation." Electronic Markets, **12** (1): 38 - 46

Cool, K. and Henderson, J. (1998). "Power and firm profitability in supply chains: french manufacturing industry in 1993." strategic management journal **19**(1998): 909-926.

Coursaris, C., Hassanein, K. and Head, M. (2006). Mobile Technologies and the Value Chain: Participants, Activities and Value Creation. Fifth IEEE International Conference on Mobile Business (ICMB' 06), Copenhagen, Denmark.

Cuevas, A., Moreno, J. I., Vidales, P. and Einsiedler, H. (2006). "The IMS Platform: A Solution for Next Generation Network Operators to Be More than Bit Pipes." IEEE Communications Magazine **August 2006**(Advances in Service Platform Technology).

Cushnie, J., Hutchison, D. and Oliver, H. (2000). Evolution of Charging and Billing Models for GSM and Future Mobile Internet Services, Multimedia Research Group, Lancaster University.

Das, T. K. and Teng, B.-S. (1998). "Resource and Risk Management in the Strategic Alliance Making Process." Journal of management **24**(1): 21-42.

Das, T. K. and Teng, B.-S. (2000). "A Resource-Based Theory of Strategic Alliances." Journal of management **26**(1): 31-61.

Davenport, T. H. (1993). Process innovation. Boston, MA, Harvard Business School Press.

Dey, A. K. D. and Abowd, G. D. (2000). Towards a better understanding of context and context awareness. 2000 ACM Conference on Human Factors in Computer Systems (CHI 2000), The Hague, Netherlands.

Dijkman, R. M., Quartel, D. A. C., Pires, L. F. and van Sinderen, M. J. (2003). An Approach to Relate Viewpoints and Modeling Languages. Seventh IEEE international enterprise distributed object computing conference (EDOC' 03), Brisbane, IEEE computer society.

Ericsson (2005). White paper: Prepaid postpaid convergent charging, Ericsson**:** 1-22.

Euroforum (2007). Congres mobiele content. The Netherlands, Rotterdam, May 30.

Farley, P. and Capp, M. (2005). "Mobile Web Services." BT Technology Journal **23**(2): 202-213.

Fischer, C. A., Han, K. and Wang, Z. (2002). "Accounting solutions in the UMTS core network." Bell Labs Technical Journal **6**(2): 65-73.

Forrester (2006). European Mobile Forecast: 2005 To 2010, Forrester research.

Fransman, M. (2001). "Evolution of the Telecommunications industry into the Internet Age." Communications & Strategies **43**(3rd quarter 2001): 57.

Fransman, M. (2002). "Mapping the evolving telecoms industry: the uses and shortcomings of the layer model." telecommunications Policy **26**(2006): 473-483.

Garcia-Pont, C. and Nohria, N. (2002). "Local versus global mimitism: the dynamics of alliance formation in the automobile industry." strategic management journal **23**(2002): 307-321.

Garner, P., Mullins, I., Edwards, R. and Coulton, P. (2006). Mobile Terminated SMS Billing - Exploits and Security Analysis. Third Interational Conference on Information Technology: New Generations (ITNG'06), Las Vegas, Nevada.

Gordijn, J. (2002). E3value in a Nutshell. Technical report, *HEC University Lausanne*, 2002.

Gordijn, J. and Akkermans, J. M. (2003). "Value-based requirements engineering: exploring innovative e-commerce ideas." Requirements Engineering **8**(2003): 114-134.

Gordijn, J., Akkermans, J. M. and van Vliet, H. (2000). Business Modelling is Not Process Modelling. Conceptual modeling for e-business and the web (ECONOMO-2000), Salt Lake City, USA, Springer-Verlag Berlin Heidelberg.

Gordijn, J. and Tan, Y.-H. (2001). "A design methodology for modeling trustworthy value webs." international journal of electronic commerce **9**(3): 31-48.

Granbohm, H. and Wiklund, J. (1999). "GPRS - General packet radio service." Ericsson Review **2**(1999): 82-88.

Grant, D. (2004). "A Wider View of Business Process Reengineering." Communications of the ACM **45**(2): 85-90.

Grover, V. and Saeed, K. (2003). "The telecommunication industry revisited - the changing pattern of partnerships." Communications of the ACM **46**(7): 119-125.

Gulati, R. (1998). "Alliances and networks." strategic management journal **19**(1998): 293-317.

Gulati, R., Nohria, N. and Zaheer, A. (2000). "Strategic Networks." strategic management journal **21**(2000): 203-215.

Haglind, M. and Helander, J. (1998). Development of value networks - an empirical study of networking in Swedish mnufacturing industries. International conference on engineering and technology management, San Juan, Puerto Rico.

Hammer, M. (1990). "Reengineering Work: Don't automate, Obliterate." Harvard Business Review **68**(4): 104-112.

Harpaz, I. and Meshoulam, I. (1997). "Intraorganizational power in high technology organizations." journal of high technology management research **8**(1): 107-128.

Hart, C. (2005). Doing your Masters Dissertation. London, Sage publications.

Hazeu, C. A. (2000). Institutionele economie; een optiek op organisatie en sturingsvraagstukken. Bossum, Coutinho.

Holmberg, S. (2000). "A systems perspective on supply chain measurments." International journal of physical distribution & logistics management **30**(10): 847-868.

Hoskisson, R. E., Hitt, M. A., Wan, P. W. and Yiu, D. (1999). "Theory and research in strategic management: Swings of a pendulum." journal of management **25**(3): 417-456.

Hunter, J. and Thiebaud, M. (2003). Telecommunications Billing Systems Implementing and Upgrading for Profitability. New York, McGraw-Hill.

Inkpen, A. C. and Beamish, P. W. (1997). "Knowledge, bargaining power, and the instability of international joint ventures." academy of management review **22**(1): 177-202.

ITU (2004). M30.50.0 Enhanced Telecom Operations Map (eTOM) - Introduction, International Telecommunications Union, Telecom standardisation sector**:** 14.

Jansen, M. F. W. H. A. (2006). Lecture slides SPM 4340: Enterprise Frameworks introduction, Delft University of Technology, department of Technology Policy and Management.

Jonason, A. and Eliasson, G. (2001). "Mobile Internet revenues: an empirical study of the I-mode portal." Internet Research: Electronic Networking Applications and Policy **11**(4): 341-348.

Jonkers, H., Lankhorst, M., Van Buuren, R., Hoppenbrouwers, S., Bonsangue, M. and Van Der Torre, L. (2004). "Concepts for modeling enterprise architectures." International Journal of Cooperative Information Systems **13**(3): 257-287

Kallio, J., Tinnila, M. and Tseng, A. (2006). "An international comparison of operator-driven business models." Business Process Management Journal **12**(3, 2006): 281-298.

Kallio, P. (2004). Emergence of Wireless Services - Business Actors and their Roles in Networked Component-based Development. Faculty of Science. Oulu, University of Oulu. **Phd.**

Katz, M. L. and Shapiro, C. (1985). "Network Externalities, Competition, and Compatibility." The American Economic Review **75**(3): 424-440.

Kavakli, V. and Loucopoulos, P. (1998). "Goal-driven business process analysis application in electricity deregulation." Information Systems **24**(3): 187-207.

Kelly, M. B. (2003). "The TeleManagement Forum's Enhanced Telecom Operations Map (eTOM)." Journal of Network and Systems Management **11**(1): 109-119.

Kiiski, A. (2006). Impact of MVNOs on mobile data service market. 17th European Regional ITS Conference, Amsterdam, the Netherlands.

Kijl, B., Bouwman, H., Haaker, T. and Faber, E. (2005). Dynamic Business Models in Mobile Service Value Networks: a Theoretical and Conceptual Framework, FRUX Freeband**:** Deliverable 2.2-II: 1-87.

Kormentzas, G., Katsikas, S., Anerousis, N. and Venieris, I. (2007). "Special issue: Emerging middleware for next generation networks." Computer Communications **30**(2007): 497-498.

Kothandaraman, P. and Wilson, D. T. (2001). "The future of competition Value-Creating Networks." Industrial Marketing Management **30**(2001): 379-389.

Koutsopoulou, M., Kaloxylos, A. and Alonistioti, A. (2002). Charging, Accounting and Billing as a sophisticated and Reconfigurable Discrete Service for Next Generation Mobile Networks. 56yh IEEEVehicular Technology Conference, Vancouver, BC, Canada, IEEE.

Koutsopoulou, M., Kaloxylos, A., Alonistioti, A. and Merakos, L. (2004). "Charging, Accounting and Billing Management Schemes in Mobile Telecommunication Networks and the Internet." IEEE Communications Surveys **6**(1): 50-58.

Koutsopoulou, M., Kaloxylos, A., Alonistioti, A. and Merakos, L. (2007). "A platform for charging, billing and accounting in future mobile networks." Computer Communications **30** (2007): 516-526.

KPMG (2006a). White paper Revenue Assurance for digital content Adequate controls for optimal performance, KPMG**:** 28.

KPMG (2006b). white paper - Consumers and convergence challenges and opportunities in meeting next generation customer needs, KPMG.

Kranenburg, v. H., Koolwaaij, J., Mulder, I. and Eertink, H. (2006). Context Awareness Targeting User Needs, Telematica instituut.

Kumar, S. and Zahn, C. (2003). "Mobile communications: evolution and impact on business operations." technovation **23**(2003): 515-520.

Kuo, Y.-F. and Yu, C.-W. (2006). "3G telecommunication operators' challenges and roles: A perspective of mobile commerce value chain." technovation **26**(2006): 1347-1356.

Kurhonen, J. (2005). "WIMAX VERSUS 3G threat or opportunity?" IEEE Communications Engineer(December/January 2005/2006): 38-41.

Lam, W. (2005) "Investigating success factors in enterprise application integration: a case-driven analysis" European Journal of information systems **14** (2005): 175–187.

Lee, S.M., Olson, D.L., Trimi, S. and Rosacker, K.M. (2002). "An integrated method to evaluate business process alternatives" Business process management journal **11** (2): 198-212.

Lemstra, W. (2006). The internet bubble, the impact on the development path of the telecommunication sector. Delft University of Technology. **dr.** Enschede, Gildeprint Drukkerijen BV

Levenshteyn, R. and Fikouras, L. (2006). "Mobile Services Interworking for IMS and XML WebServices." IEE Communications Magazine(September 2006): 80-87.

Li, F. and Whalley, J. (2002). "Deconstruction of the telecommunications industry: from value chains to value networks." Telecommunications Policy **26**(2002): 451-472.

Malone, T. W., Crowston, K., Lee, J., Pentland, B., Dellarocas, C., Wyner, G., Quimby, J., Osborn, C. S., Bernstein, A., Herman, G., Klein, M. and O'Donnell, E. (1999). "Tools for Inventing Organizations: toward a handbook of organizational processes." management science **45**(3): 425-443.

Maier, M. , Rechtin, E., (2000). The Art of Systems Architecting, Second Edition, Boca Raton: CRC Press

Medcof, J. W. (2001). "Resource-based strategy and managerial power in networks of internationally dispersed technology units." strategic management journal **22**(2001): 999-1012.

Miller, D. and Shamsie, J. (1996). "The Resource-Based View of the Firm in Two Environments: The Hollywood Film Studios from 1936 to 1965." The academy of Management Journal **39**(3): 519-543.

Mobile People (2006). Mobile Search Trends 2006. Mobile People, Mobile people.

Mohamedjoesoef, S. (2007). Europoese telecommarkt verzadigd - "Brtise Vodafone slaat slag op Indiase markt voor mobiele telefonie". Dagblad de Pers. **May 1, 2007**.

Montalvo, U. W., van de Kar, E. and Maitland, C. (2004). Resource-based interdependencies in value networks for mobile Internet Services. Sixth International Conference on Electronic Commerce, Delft, The Netherlands.

National Institute of Standards and Technology (1993). Draft Federal Information Processing Standards Publication 183 - INTEGRATION DEFINITION FOR FUNCTION MODELING (IDEF0), National Institute of Standards and Technology.

Netsize (2007a). The netsize guide - Convergence: Everything's going mobile, Informa Telecoms & media**:** 318.

Netsize (2007b). Mpayment - a unique solution for billing mobile consumers globally, Netsize.

Nicopolitidis, P., Papadimitriou, G., Obaidat, M. S. and Pomportsis, A. S. (2004). "The economics of wireless networks - Assessing the rapidly changing economics of the wireless industry." Communications of the ACM **47**(4): 83-86.

Nightingale, D.J. and Rhodes, D.H., (2004) Enterprise Systems Architecting: Emerging Art and Science within Engineering Systems. MIT Engineering Systems Symposium. March 2004.

Nokia (2006a). White paper - Fixed-mobile convergence. Nokia corporation networks.

Nokia (2006b). White paper - convergent charging, Nokia corporation networks.

Odlyzko, A. (2000). "Should Flat-Rate Internet Pricing Continue?" IT Professional **2**(5): 48-51.

OMI (2006). Open Mobiel Internet Position Paper, Open Mobiel Internet Alliance.

Open Mobile Alliance (2002). WAP Billing framework version 1.0 Nov 2002, Open Mobile Alliance (OMA).

Osterwalder, A. and Pigneur, Y. (2003). Modeling value propositions in e-business. ICEC, Pittsburgh, PA.

Paper, D. and Chang, R.-D. (2005). "The State of Business Process Reengineering: A Search for Success Factors." Total Quality Management **16**(1): 121-133.

Pateli, A. G. and Giaglis, G. M. (2006). Governance Options for Strategic Technology Alliances in Value Webs. Hawaii Internatonial Conference on System Sciences, Hawaii.

Paypal (2007). Mobile checkout Developer Guide.

Peltoniemi, M. (2004). Cluster, Value Network and Business Ecosystem: Knowledge and Innovation Approach. Organisations, Innovation and Complexity: New Perspectives on the Knowledge Economy, Manchester.

Peppard, J. and Rylander, A. (2006). "From value chain to value network: insights for Mobile Operators." European Management Journal **24**(2): 128-141.

Pijpers, V. and Gordijn, J. (2007). Bridging Business Value Models and Process Models in Aviation Value Webs via Possession Rights. 40th Annual Hawaii International Conference on System Sciences (HICSS'07) Hawaii.

Pollet, T., Maas, G., Marien, J. and Wambecq, A. (2006). Telecom Services Delivery in a SOA. 20th International Conference on Advanced Information Networking and Applictations (AINA '06).

Porter, M. (1985). Competitive advantage: creating and sustaining superior Performance. New York, The Free Press.

Porter, M. (1990). The competitive advantage of nations. London, The Macmilan Press LTD.

Praveen Tanguturi, V. and Harmantzis, F. C. (2006). "Migration to 3G wireless broadband internet and real options: The case of an operator in India." telecommunications Policy **30**(2006): 400-419.

Ratcliffe, J. (1999) "Scenario building: a suitable method for strategic property planning?." Property Management **18** (2): 127 - 144.

Ray, G., J. Barney et al. (2004). "Capabilities, business processes, and competitive advantage: choosing the dependent variable in empirical tests of the resource-based view." Strategic Management Journal **25** (2004) 23-37.

Rechtin, E. (1992). "The art of systems architecting" IEEE Spectrum October 1992: 66-69.

Reijers, H. A. and Mansar, S. L. (2005). "Best practices in business process redesign: an overview and qualitative evaluation of successful redesign heuristics." Omega **33**(2004): 283-306.

Riemer, K., Gogolin, M. and Klein, S. (2002). Introduction to Organizational Networks, University of Munster.

Riemer, K., Klein, S. and Selz, D. (2001). Classification of dynamic organizational forms and coordination roles. e-work and e-business, venice, IOS Press.

Robbertson, P. (1997). "Implementing the new without comprising the old- Integrating Legacy Systems with Modern Corporate Applications" Communications of the ACM **40** (5): 39-46.

Ross, J. W. (2003). *Creating a strategic IT Architecture Competency: Learning in Stages - CSIR working paper 335* MIT Sloan School of Management

Rukanova, B.D., van Slooten, K. and Stegwee, R.A. (2006) " Business Process Requirements, Modeling Technique and Standard: how to Identify Interoperability Gaps on a Process Level" in: Konstantas, D., Bourrières, J-P., Léonard, M. and Boudjlida, N. (eds.) "Interoperability of Enterprise Software and Applications" London: Springer.

Ryan, C., Rousseau, B., O'Riordan, C. and Vejgaard-Nielsen (2004). Flexible Billing for a Personalised Mobile Services Environment, Waterford Institute of Technology.

Saarikoski, V. (2006). The Idyssey of the Mobile Internet. Faculty of science. Oulu, University of Oulo. **doctor:** 274.

Sabat, H. K. (2002). "The evolving mobile wireless value chain and market structure." telecommunications Policy **26**(2002): 505-535.

Sakaguchi, T., Nicovich, S. G. and Dibreel, C. C. (2004). "Empirical evaluation of an integrated supply chain model for small and medium sized firms." information resources management journal **17**(3): 1-19.

Sarker, S., Sarker, S. and Sidorova, A. (2006). "Understanding business process change failure: An actor-network perspective." Journal of Management Information Systems **23**(1): 51-86.

Scales, I. (2004). Business Process Management - Waiting for the wind to pick up. Total Telecom. **September 1, 2004:** 36-37.

Scourias, J. (1995). Overview of the GSM cellular system, University of Waterloo, Department of Computer Science.

Shapiro, C. and Varian, H. R. (1999). Information rules: A strategic guide to the network economy. Boston, Massachusetss, Harvard Business School Press.

Sharma, C. (2006). White paper- Worldwide wireless data trends, Chetan Sharma Consulting.

Sicker, D. C. (2002). Further defining a layered model for telecommunications policy, Center for Science and Technology Policy Research University of Colorado at Boulder**:** 1-26.

Soffer, P. (2005). "Scope Analysis: Identifying the Impact of Changes in Business Process Models." Software process improvement and practice **10**(2005): 393-402.

Soininen, M. (2005). Segments of the Mobile Internet Industry - Examples from Finland and Japan. International Conference on Mobile Business (ICMB'05), Sydney, Australia.

Stabell, C. B. and Fjeldstad, O. D. (1998). "Configuring Value for Competitive Advantage: On Chains, Shops, and Networks." strategic management journal **19**(5): 413-437.

Tan, W., Shen, W. and Zhao, J. (2007) "A methodology for dynamic enterprise process performance evaluation". Computers in Industry **58** (2007) 474–485.

Tapscott, D., Ticoll, D. and Lowy, A. (2000). Digital capital Harnessing the power of business webs. Boston, Harvard Business school press.

Tilson, D. and Lyytinen, K. (2006). "The 3G transition: changes in the US wireless industry." telecommunications Policy **30**(2006): 569-586.

Tsalgatidou, A. and Junginger, S. (1995). "Modelling in the Re-engineering Process." SIGOIS Bulletin **16**(1): 17-25.

Tsalgatidou, A. and Pitoura, E. (2001). "Business models and transactions in mobile electronic commerce: requirements and properties." Computer Networks **37**(2001): 221-236.

Ulrich, D. and Barney, J. B. (1984). "Perspectives in Organizations: resource dependence, efficiency, and population." academy of management review **9**(3): 471-481.

UMTS Forum (2002). Report 21 Charging, Billing and Payment Views on 3G Business Models, UMTS Forum**:** 36.

van Otterlo, A. (2007). IP Multimedia Subsystem (IMS) - Operator - Vendor perspective, Nokia Siemens Networks.

Van Veen, N. (2007). The evolution of Mobile Services - presentation at conference "Mobiele content". May 30, 2007 Rotterdam, Forrester Research.

Verschuren, P. and Doorewaard, H. (1999). Designing a research project. Dordrecht, Lemma.

Verschuren, P. and Hartog, R. (2005). "Evaluation in Design-Oriented Research" Quality & Quantity **39** (2005): 733–762.

Versteeg, G. and Bouwman, W. A. G. A. (2004). Business Architecture: A New Paradigm to Relate E-Business Strategy to ICT. 12th European Conference on Information Systems, Turku.

Voermans, K. (2007). Economic validation of a media levy for digital music. Case study in the Dutch download market. . Enschede, Twente Universty. **ir.**

Wang, S. (1997). "Modeling information architecture for the organization." Information & Management **32**(1997): 303-315.

WAP forum (2002). *Wireless Application Protocol - WAP 2.0 Technical white paper* WAP Forum

Wernerfelt, B. (1984). "A Resource-based View of the Firm." strategic management journal **5**(1984): 171-180.
Weske, M., van der Aalst, W. M. P. and Verbeek, H. M. W. (2004). "Advances in business process management." Data & Knowledge Engineering 50 **2004**: 1-8.
Yang, J. and Papazoglou, M.P. (2000) "Interoperation support for electronic business" Communications of the ACM **43** (6): 39-47.
Yin, R. (2003) Case Study Research, 3rd ed. Thousand Oaks, Sage Publications
Zhang, G. and Z. LIu (2005). Internet Pricing With Multiple Demands for Quality of Service Option. IEEE Conference on e-Business Engineering (ICEBE'05), Bejing, China.
Zimmerman, H. (1980). "OSI Reference Model - The ISO Model of Architecture for Open Systems Interconnection." IEEE Transactions on communications **COM-28**(4): 425-432.
Zlatev, Z. and Wombacher, A. (2005). Consistency between e3-value models and activity diagrams in a multi-perspective development method. OTM workshops 2005, Agia Napa, Cyprus, Springer-Verlag Berlin Heidelberg.
Zomerdijk, L. G. and de Vries, J. (2007). "Structuring front office and back office work in service delivery delivery systems. An empirical study of three design decisions. ." International journal of operations & production management **27**(1): 108-131.

Websites

3G Americas (2006). Statistics.Last accessed at May 12, 2007 http://www.3gamericas.org/English/Statistics/
Allen, K. (2007). Mobile phone firms seek their own search engine.Last accessed at June, 27 2007 http://technology.guardian.co.uk/news/story/0,,2006006,00.html
Besselink, T. (2007). Mobiele sites: banken en publishers lopen voorop.Last accessed at June 8, 2007 http://www.junglerating.nl/?nieuws/marketingnieuws/view/178#.
Boogert, E. (2007). Rabobank neemt premium sms op de korrel met Minitix.Last accessed at June 29, 2007 http://www.emerce.nl/nieuws.jsp?id=1985627
CBS (2007). Bevolkingsteller.Last accessed at May 17, 2007 http://www.cbs.nl/nl-NL/menu/themas/bevolking/cijfers/extra/bevolkingsteller.htm
CDrator (2006). Press release - CDRator helps Rabobank launch Mobile services.Last accessed at July 6, 2007 http://www.iir-billingsystems.com/document-downloader.cfm?filename=cdr%20Press%20Release-%20Mobiel.pdf&releaseID=16
Emerce (2005). Telfort verkocht aan KPN.Last accessed at May 17, 2007 http://www.emerce.nl/nieuws.jsp?id=690621.
Emerce (2007). Feiten en cijfers.Last accessed at June 16, 2007 http://mobile.emerce.nl/feiten_en_cijfers/index.html
Groen, G. (2007). Overname Orange Nederland door T-mobile bijna rond. .Last accessed at June 16, 2006 http://www.telecomwereld.nl/n0001972.htm
iPhoneclub (2007). iTunes-account nodig om iPhone te kunnen gebruiken.Last accessed at July 12, 2007 http://www.iphoneclub.nl/itunes-account-nodig-om-iphone-te-kunnen-gebruiken/
Lassalle, A. (2006). MVNOs - the best is still to come.Last accessed at June 27, 2007 http://globalbilling.org/microsite/2007_april/ib_article03.htm
Managers online (2007). Top-100 adverteerders niet vindbaar op internet.Last accessed at May 17, 2007 http://www.managersonline.nl/index.php?section=article&id=4916.
Media Onderzoek (2006). Philips grootste online adverteerder.Last accessed at May 17, 2007 http://www.mediaonderzoek.nl/709/philips-grootste-online-adverteerder/
Minitix (2007). Mobiel betalen.Last accessed at June 29, 2007 http://www.minitix.nl/mobiel_betalen.html
Mobile Europe (2006). mBlox chairman predicts mobile content ISPs will "vapourise.Last accessed at June 11, 2007 http://www.mobileeurope.co.uk/news/news_story.ehtml?o=2190
Mperical limited (2006). mperical courses.Last accessed at 3-5-2007 http://www.mpiricalcom/companion/mpiricical_companion.html
Nokia (2007) Press releases - Nokia acquires Twango to offer a comprehensive media sharing experience. July 24, 2007. http://www.nokia.com/A4136001?newsid=1141417 Last accessed at 1-8-2007.
Nu.nl (2007a). KPN voorziet sterke groei mobiel internet.Last accessed at June 4, 2007 http://www.nu.nl/news/1076202/50/KPN_voorziet_sterke_groei_mobiel_internet.html
Nu.nl (2007b). Google richt zich op mobiele markt. Last accessed at Juli 23, 2007. http://www.nu.nl/news/1164954/51/Google_richt_zich_op_mobiele_markt.html

Openwave (2002). Presentation - Overview of location technologies Openwave http://developer.openwave.com/omdtdocs/location_studio_sdk/pdf/Intro_to_Location Technologies.pdf

OSS news review (2006). Disney Mobile Selects Convergys and Visage Mobile to provide MVNO Billing and Professional Services.Last accessed at June, 27 2007 http://www.ossnewsreview.com/telecom-oss/disney-mobile-selects-convergys-and-visage-mobile-to-provide-mvno-billing-and-professional-services/#more-469

Planet Internet (2007). KPN: samenwerking met MSN zoeken.Last accessed at June 27, 2007 www.planet.nl/planet/show/id=118880/contentid=680577/sc=4ff4be

Research and Markets (2007). Mobile Messaging Futures 2007-2012.Last accessed at May 13, 2007 http://biz.yahoo.com/bw/070425/20070425005504.html?.v=1

UMTS Forum (2007). Happy new Year for global 3G mobile industry as UMTS/WCDMA subscriptions hit 100 million.Last accessed at http://www.umts-forum.org/content/view/1438/71

Vodafone (2007). Persberichten.Last accessed at June 27, 2007 http://www.perssupport.anp.nl/Home/Persberichten/Actueel?itemId=93481

Webwereld (2007). Rabobank introduceert mobiel betalen via Minitix.Last accessed at June 29, 2007 http://www.webwereld.nl/articles/46503/rabobank-introduceert-mobiel-betalen-via-minitix.html

Scientific paper

Billing for content services in an evolving mobile Internet industry
Is the central position of mobile network operators coming to an end?

Abstract
Internet on the mobile phone is starting to take shape and various actors in the industry are increasingly focussing on ways to exploit this new revenue driver. Despite of the fact that both worlds are converging, the mobile Internet differs significantly from the regular Internet in terms of entrepreneurial freedom. In the mobile domain the mobile operator at present controls the relation with the end-user and the related billing processes. This lack of freedom for actors other than the mobile operator could hamper the further development of the mobile Internet. The lack of competition enables the operator to determine its own billing fees. For several years other role divisions are discussed that place the operator less centric in the value network and other actors to assume end-user contact. These other role divisions would enable easier deployment of new services that, in an open market, are more competitive. However, it remains uncertain to which extent billing in the alternative role divisions is possible and can compete with the current solutions of the mobile network operators.

When dealing with the question how a specific role division will be shaped we essentially ask about the changes in the underlying business processes. Relating business processes to role divisions in a value network is a very challenging task. Hardly any literature on the subject exists and those approaches we identified are rather rigid. In this paper we propose a framework to demarcate our theoretical perspective on closing this theoretical gap. Through the perspective of this framework we analyze the current billing processes to identify which developments can enable the proliferation of other role divisions, given the current situation. Based on thirteen interviews with industry participants in the Netherlands we identified several potential developments related to actors' roles, technology and information access, and ownership relevant to billing of content services. These developments mitigate the resource barriers controlled by mobile network operators and their current billing methods, and enable other role divisions to emerge.

Keywords: Content service, Billing, Mobile Internet, Value network, Business process

Introduction
Stimulated by the growth in available bandwidth, the various actors in the mobile industry are increasingly focusing on mobile content services as a driver of revenue. Since the general view is that ARPU for voice is flat, or even decreasing due to competition (Tilson and Lyytinen, 2006; Kuo and Yu, 2006), especially mobile operators see the need to participate in this new market (Ary et al, 2005; Farley and Capp, 2005; Cushnie et al, 2000; Tilson and Lyytinen, 2006; Peppard and Rylander, 2006; Praveen Tanguturi and Harmantzis, 2006). However, this participation currently is constrained by the mobile operator who controls not only the radio network but also the end-user contact and the billing relation (Sabat, 2002; Peppard and Rylander, 2006). These barriers are considered inhibitors of innovations by several actors (OMI, 2006). Furthermore, the currently dominant billing method, that uses SMS messages to bill on the customer account at the operator (i.e. Premium Rate SMS billing) is fully controlled by the operator. There is little competition here and the fee that content aggregators and content providers receive from the operator is rather low compared to the total price customers pay for content services.

With the migration of the mobile Internet towards the regular Internet, the restrictions in the mobile Internet collide with the openness that actors are accustomed to. On the regular Internet the end-user and billing relation is not restricted to the Internet Service Provider (ISP). However, also on the mobile channel the situation is changing and it is likely that other models will proliferate (Koutsopoulou et al, 2007). Many actors are eager to become the focal point for billing (Farley and Capp, 2005; Gulati et al, 2000; Buellingen and Woerter, 2004; Shapiro and Varian, 1999). We identified primarily two reasons. First, when an actor holds the billing relations, he does not have to pay a fee to a third party. Especially in current PRSMS this fee is very high, up to 50 percent of total revenue of the content service (Garner et al, 2006). Second, the billing relation provides a customer relation and hence includes the end-user (demographic) details. Especially given the trend towards more personal, location and context aware services, knowing the end-user is of great importance.

Starting with the UMTS forum in 2002 (UMTS forum, 2002), several role divisions other than the current operator centric have been proposed and adopted into scientific literature (e.g. Butyka et al, 2004; Ary et al, 2005). Five role division archetypes can be identified, the differentiating factor being the role holding the customer contact. In the five archetypes this is respectively: the mobile operator, content aggregator, content provider (UMTS Forum, 2002), the independent billing aggregator (Li and Whalley, 2002; Farley and Capp, 2005) and the Internet Service Provider (Bhushan et al, 2002; Bhushan et al, 2005; Farley and Capp, 2005).

However, how billing actually will be performed in these models when they are applied in practice remains unclear. In literature many technological and information architectures are proposed to facilitate these billing processes (e.g. Koutsopoulou et al, 2007; Koutsopoulou et al, 2004; Bhushan et al, 2005; Butyka et al, 2004). However, it remains uncertain how the alternative role divisions will emerge in practice and in which directions the billing process will evolve.

In this paper we analyze the current billing processes and the feasibility and likelihood of the alternative role divisions from a billing process perspective. To this end we discuss the actual and anticipated developments in technology and information that may contribute to enabling billing with other role divisions. We provide a high level view on the billing for content services, also incorporating the charging of these services, and to a certain extent also the accounting. Hence, we look at the generation of usage data on chargeable events, the transforming of this data into a bill, or deduction from an account, and consequently settling the revenues among the different parties involved in the service provisioning (Koutsopoulou et al, 2004).

The relation between the value network layout, i.e. role divisions, and the business processes is hardly studied in literature. Although a few approaches can be identified to translate value network role divisions into business processes or relate the two views (e.g. Pijpers and Gordijn, 2007; Zlatev and Wombacher, 2005; Bergholz et al, 2003; Dijkman et al, 2003) these are rather rigid. We apply a framework as a means to demarcate our theoretical perspective on exploring the feasibility and likelihood of the emergence of various role divisions in billing related to a mobile value network. Mobile content services provide a suitable case to assess the usability of our framework as both the role divisions and the business processes in terms of the technology in use are highly dynamic.

This paper is structured as follows. First we show our framework and the methodology that we used to assess the various role divisions in the mobile content services domain on feasibility and likelihood. Subsequently we discuss how billing for content services is currently performed and identify both the strengths and weaknesses of the current situation. Then we discuss the results from our interviews and the feasibility of the billing processes in the various role divisions. Finally we provide our conclusions and further discuss the value of our framework in the mobile content services case.

Research perspective

In this paper we consider primarily three aspects; the value network, business processes and their relations.

Stabell and Fjeldstad (1998: 427) have a firm specific view on value networks as they are defined as “firms that can be modelled as value networks rely on a mediating technology to link clients or customers who are or wish to be interdependent”. Kijl et al (2005) emphasize the fact that value networks concern value creation by a group of companies, which can be various economic players, without considering all individual choices in terms of make or buy decisions. Each actor in a value network can have one or more roles in the creation of value (Kijl et al, 2005).

Davenport refers to a business process as “a structured set of activities designed to produce a specific output for a particular customer or market” (Davenport, 1993: 5). Tsalgatidou and Junginger (1995: 17) define a business process as “a set of logically interrelated activities within an organization the execution of which contributes in the achievement of the business objectives”. The ITU (2004: 4) defines a process as: “…a systematic, sequenced set of functional activities that deliver a specified result”. Bititci and Muir (1997: 366) identify the commonalities throughout several definitions and define a business process as “a collection of various tasks which produce an output”. There are primarily four aspects visible here; (1) a business process consists of several structured activities, (2) the activities provide output for a specific market or customer, (3) the activities are sequential, and (4)

the activities relate to the achievement of a specific goal of the firm participating in the process. From business process literature it can be concluded that business processes are supported by three aspects; information, technology and participants (Alter, 1999). In this paper we specifically regard the first two: information and technology. The current charging and billing processes are highly automated (Bhushan et al, 2002) which removes direct dependency on participants.

The relation between business processes and role divisions in the value network can be regarded as a refinement relation; the value network view defines on a high level what the value adding activity is for each element of the value network, whereas the process view further defines how this should be done (Dijkman et al, 2003). There are strong differences between on the one hand the value network level and on the other the process level, as they refer to completely different aspects of the organizations involved (Gordijn et al, 2000). This makes it difficult to determine their interdependencies.

Following Gordijn and Tan (2001) the relation between the concepts is best analyzed through focussing on value. On the value network level a model shows the transfers of value between actors but not their behaviour, nor the sequential order of the value transfers. Business process models show the order of the value activities and the flow of value objects, but do not show which processes create which value for which value transfers (Pijpers and Gordijn, 2007). The creation of value can best be regarded as the provision of a service to the business process by different actors (Jonkers et al, 2004). This value focus can be regarded a means to identity business processes, which is further developed in Pijpers and Gordijn (2007). Although this method identifies the business process activities, it does not deal with information or technological resources that contribute to the processes. The are regarded to be important determinants of business process feasibility. Fulfilling specific roles by certain actors requires specific resources, this is the basic premise of our framework, shown in Figure P 1.

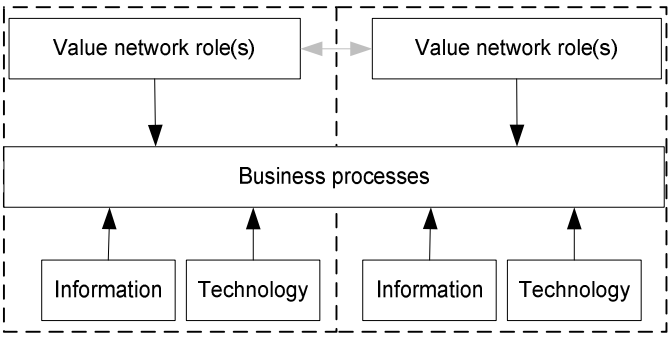


Figure P 1 Framework for studying business processes in a value network

This framework should not be confused with frameworks used in business process analysis or business process redesign. As Reijers and Mansar (2005: 284) state; “A framework is not a model of a business process. It is rather an explicit set of ideas that helps in thinking about the business process in the context of reengineering”. The dotted lines represent the boundaries of an actor, we only show the relations between two actors for the sake of clarity, whereas evidently a value network will consist of many more.

The framework shows that an actor has one or more roles in value network. The use of roles has at least two major advantages over directly identifying the actors that fulfil the roles. Roles are more stable than the actors fulfilling them and the complicating aspect that one actor can have multiple roles or one role can be performed by multiple actors, is mitigated (Jonkers et al, 2004). Actors fulfilling roles can be related several ways.

In our perspective the link between the value network (roles) and business processes is established through focussing on information and technology resources. The control of resources provides an interesting perspective to explain the heterogeneity of firms (Barney, 1991; Barney et al, 2001), and the roles these firms fulfil in the value network. Each role corresponds to specific activities in the value network’s business processes, i.e. a specific role lays down specific responsibilities in terms of business process activities. To be performed, these activities require information and technology. The control of this technology and information can be attributed to actors fulfilling specific roles and fall within the actor’s boundary. However, given the increasing extent to which business processes are inter-organizational, technology and information are shared among actors participating on the business

process level. Hence the interconnection of systems and the sharing of information enable business process activities to cross the boundaries of actors.

The grey marked arrow points to the interactions on a value level, i.e. the actual contributions of value by actors which concern (primarily monetary) exchanges (see e.g. the e3-methodology (Gordijn et al, 2000; Gordijn and Tan, 2001)). This value perspective could be further developed by analyzing the transactions between actors on a business process level, but this is not part of our perspective.

Methodology

We applied the framework demarcating our perspective in the previous section on mobile content services to gain insights into the relation between the role division in the mobile content service provisioning and the underlying business processes. We used the five potential role divisions identified earlier from literature, as archetypes to structure the potential different directions in role divisions. We speak of archetypes here as they depict extreme situations which enable us to study the industry through more isolated relations whereas it is expected that multiple models will proliferate and coexist in practice (Koutsopoulou et al, 2007). Nevertheless, these archetypes provide a good means of communication with industry participants to identify the potential billing processes that could exist in the archetypes.

To gather our data on the billing processes in future role divisions we used thirteen semi-structured, face to face interviews with representatives of actors currently fulfilling crucial roles in the content services in the mobile industry. Semi-structured interviews allowed a more open discussion of the subject under study while ensuring depth and providing structure in our exploration. To ensure we discussed all relevant aspects in our interviews, additional to the archetypes we used a list with the main topics. From a study into literature on the mobile internet value network we concluded that the following nine roles are relevant: (1) Content provider, (2) Content aggregator, (3) Portal provider, (4) Mobile Network Operator, (5) Mobile Virtual Network Operator, (6) Billing and collections provider, (7) SMS service provider, (8) Technology and platform provider, and (9) Internet Service Provider (fixed domain). Evidently this selection of roles results in knowledge from currently active actors in the industry and hence we extrapolate from the current situation. We return to the implications of this choice in the discussion section.

We selected companies in the Netherlands that currently fulfil these roles in such a way that we incorporated each role at least once in our interviews and included the crucial roles in billing (i.e. content provider, content aggregator, mobile network operator, SMS service provider, and billing and collections provider) twice. This provided a research design covering thirteen companies. Most companies were approached directly on the basis of existing contacts, others were either found through identifying the primary players in specific roles on the Internet or through snow-balling, i.e. asking interviewees who else can provide valuable information.

Billing for content services on the mobile Internet

The mobile Internet is a broad concept. We follow the general definition provided by Saarikoski (2006: 12): "the mobile Internet is a direct connection from a mobile phone (handset) or a portable device to the Internet". Content is delivered on this connection to the user for which the billing consists of two parts: (1) billing for network resource usage, and (2) billing for the premium content provided.

Network resource usage

Currently in the Netherlands the billing for network resource usage is predominantly based on packet metering (Orange, T-mobile, KPN mobile, Telfort, Rabobank, Tele2, Telfort) and time metering (Vodafone)[18]. New data subscriptions at three of the four major operators in the Netherlands are based on flat fee (possibly with some form of fair use policy). However, opening up current subscriptions to introduce flat fee is not practiced by operators as it would result in large revenue losses on the voice part of the subscription and the sponsored handset should be renegotiated. The charging for network resource usage is based on Charging Data Records (CDRs) that are generated in the mobile operator's network. These are aggregated, rated and placed on the end-user's monthly bill or deduced from his pre-paid credit.

The charging of premium content

[18] Based on tariff schemes at http://kostenmobielInternet.nl/index.php?id=prive (last accessed at June 4, 2007)

The charging and billing for the monetary value of content services involves multiple roles. We shortly discuss these roles, before turning to the specification of interactions between these roles in the billing of premium content.

Mobile network operator*:* The UMTS Forum (2002) defines the key function of the network operator as the provision of access and transport services, typically as a 3G license holder. Kuo and Yu (2006) therefore use the term "3G mobile network operators" as providers of mobile communication networks that are the vital channel for mobile services.

Content provider: Essentially content providers "deliver the intrinsic forms of value – goods, services, or information – that satisfy customer needs" (Tapscott et al, 2000: 19). In a rather generic definition Grover and Saeed (2003) define content providers as companies that provide and distribute copyright material (through either the Internet or other channels). Although content providers can create their own content (Tilson and Lyytinen, 2006), they usually provide content obtained elsewhere.

Content aggregator and enabler: This role basically refers to bringing together the traffic of several content providers on a single interface. Li and Whalley (2002) distinguish passive and active aggregation. When an actor actively aggregates, the number of service combinations will be limited but more targeted to the end-user. If an actor passively aggregates, there is less segmentation and classification and the end-user is responsible for finding the desired content. In the latter case the aggregator only needs access to a broad range of content providers and does little filtering. The passive aggregator is also called content integrator (Kallio, 2004).

Portal provider: Portals are basically the line of contact of the end-user to the mobile Internet (Kuo and Yu, 2006). It can be defined as "a network site that aggregates, presents, navigates, and delivers a wide range of Internet communication, commerce, and content services to a large number of visitors." (Sabat, 2002: 522). Barnes (2002) places the portal under "market making" as the portal primarily targets marketing and selling content, including programme development, service delivery and customer care.

Billing and collections provider*:* According to the UMTS Forum the actor fulfilling the BCP's role "issues bills (or the equivalent) and arranges for collection of payments from customers." (UMTS Forum, 2002: 3).

Authentication, Authorisation, Credit Reservation*:* The AAC role is usually part of the BCP role. This is especially the case in prepaid scenarios where the AAC will be performed in real time (UMTS Forum, 2002). Authentication basically refers to the proof that the customer is the rightful customer and authorization is the verification that the customer is allowed to use the particular service (UMTS Forum, 2002).

There are currently two types of billing constellations in place in the Netherlands; on the operator portal and outside of the operator domain, i.e. off-portal. In *on-portal* provisioning the operator controls the content obtained from content providers, aggregates and enables this content and provides and bills this under its own brand. Hence, the operator assumes five roles here. This is shown in Figure P 2. In this figure we have denoted actors on the basis of their primary role that possibly extends various other roles they fulfil.

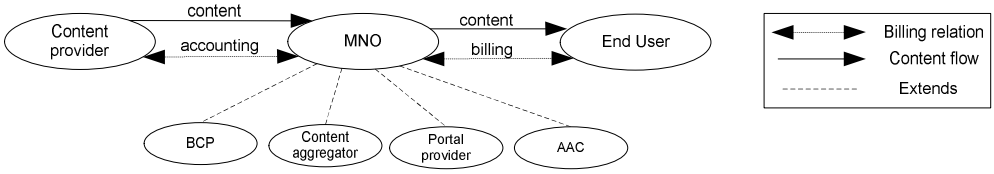


Figure P 2 On-portal billing for the price of content

Content providers have to adapt to the operator's requirements and therefore frequently host several different sites as each operator demands a different format. The dominant on-portal billing method is what is termed WAP billing or content billing. This billing method directly charges the consumption of content services on the customer bill through a direct interface to the billing system. *Off-portal* the traffic aggregation of the content services and possibly the hosting is performed by an independent aggregator. This aggregator usually also performs an additional role termed SMS billing provider. This role entails the provision of premium rate SMS services to retailers (Garner et al, 2006).

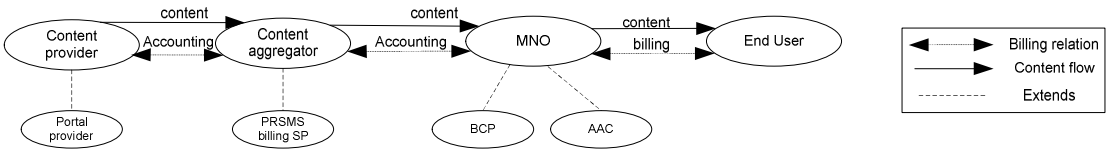


Figure P 3 Off-portal billing for the price of content

The dominant off-portal billing method in the Netherlands is Premium Rate SMS (PRSMS) billing. This billing process is shown in the Role Interaction Diagram in Figure P 4. In the scenario the content aggregator also hosts the content and the MNO assumes the BCP role. Furthermore, we have shown the content aggregator and SMS service provider as separate roles to clarify their interactions whereas in practice these roles are frequently assumed by one actor.

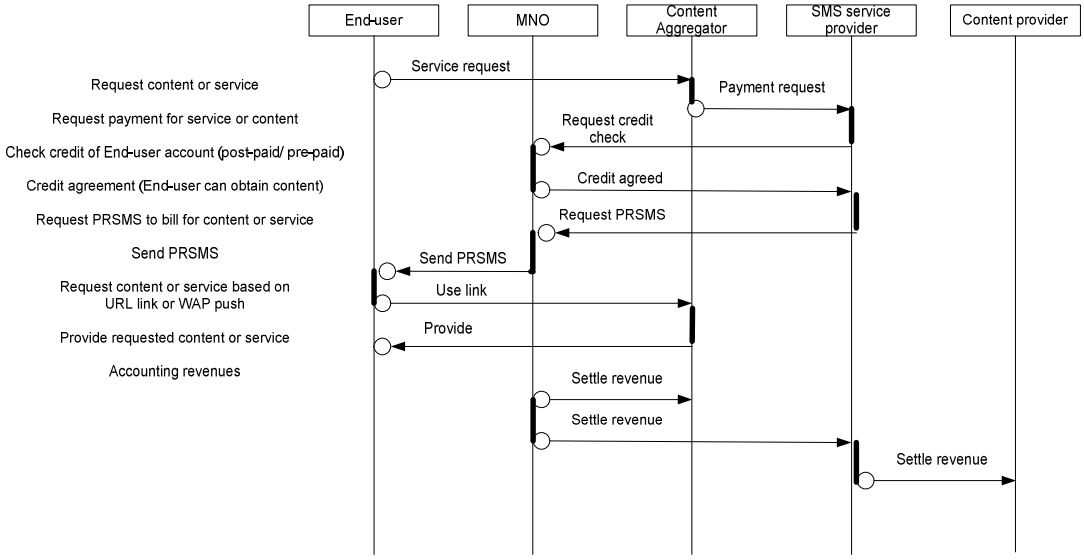


Figure P 4 PRSMS billing for content services

As the name implies this method uses SMS to charge users on their account or monthly bill. These messages are send through the component termed SMS Centre (SMSC) at the operator. To enable off-portal billing the operator provides a separate gateway to the SMSC where the SMS service provider can request the sending of a message to a specific number. These messages can be Mobile Terminating (MT) which means that the receiver of the message pays. These Mobile Terminating messages can be used for billing premium content services and can charge up to 1.5 euro of value. The SMSC in this case uses the already existing relation to the billing system and generates so-called CDRs that are placed on the customer bill.

SMS billing has several advantages to end-users, which predominantly relate to the flexibility of the model. Both post-paid and pre-paid are supported by the system, that is easy to integrate in the systems of the content and application providers. Furthermore, the support of the service by the operator is rather straightforward and strong, as they can remain the central point for billing through their existing relation. As users can consume services from any operator that supports PRSMS, the penetration is very high (Garner et al, 2006). Furthermore, through to the reselling of SMS short-codes, smaller parties can also provide services to mobile user without requiring contact with the operator.

Disadvantages of the PRSMS relate to the fact that SMS was not originally developed to support billing. Therefore it lacks sufficient guarantees of quality of service and fraud protection. For example a frequently occurring incident is the usage of SIM pre-paid cards with insufficient credit to download content after which billing does not succeed (Mobile Europe, 2006). Furthermore, PRSMS does not support real-time billing (OMA, 2002), chargeback is difficult (Garner et al, 2006), redundant SMS costs are made by the end-user (BT Agilemedia, 2006) and user interaction can not be monitored in terms of the data tracking and hence it remains uncertain to the content provider who exactly bought what (Mobile Europe, 2006). Nor is the tracking of recurrent users supported by PRSMS (BT Agilemedia, 2006). Finally, the method facilitates the use of spam messages by parties once the mobile

number is known. This is an always-open channel to the customer that, despite of regulations in most countries, is frequently applied to lure customers into more purchases through soliciting a response that triggers a PRSMS. This type of customer spam is usually attributed to the operator since its close relationship with the end user makes the operator the first point of contact (Garner et al, 2006).

The advantage of strong operator support for SMS billing also has a drawback. The operator has a great deal of power through the dependency of other parties on the SMS resources and hence can ask high fees for content provision, possibly up to 50 percent of the revenue compared to other (more traditional) methods that range from 3 to 10 percent (e.g. NTT DoCoMo charges a 9 percent fee for using its billing services). This high charging for PRSMS services, despite of low handling costs, is rather consistently done throughout Europe (Garner et al, 2006). The low kick-back[19] in PRSMS billing was identified in our interviews as one of the primary shortcomings of the methods. From our interviews another disadvantage of PRSMS was identified; the redundancy in SMS messages that need to be sent. Especially subscription based models are hard to accomplish as a user must be sent premium mobile terminating messages summing up to the total price of the subscription every time the subscription is billed (e.g. once a week). Frequently this adds up to three or four messages a week.

Currently visible changes

Interviewing the industry participants specifically focussing on potential changes in role divisions through our framework provided many insights in the feasibility and likelihood of changing role divisions. From our framework we first discuss the primary developments we perceived in the roles in the industry impacting the billing processes. Then we target the developments in technology impacting the billing processes and finally we discuss information aspects impacting billing for content services.

Developments in roles

Traffic will increasingly divert to off-portal content consumption and content providers will increasingly provide content on their own portals, decreasing the usage of the operator portals. As discussed earlier, currently two types of content provisioning are in use; on-portal and off-portal, both having their own billing methods and specific processes. From our interviews we observed that this portal role is subject to change. The common view of interviewees was that the portals at operators will decrease in their usage and eventually vaporize or reduce to solely a first point of contact to the open Internet. Several interviewees pointed to the increasing importance of mobile searching. This is supported by data that suggests that the amount of searches on mobile phones in Europe in 2006 has been ten times the amount of searches in 2005 (Mobile people, 2006). Essentially the role of portal provider on the mobile Internet will change to search engine provider and content providers will acquire the portal role to provide access to their own content.

Given the trend towards accessing the open Internet, on the mobile channel, the operator will no longer have the aggregation and portal provision role. Given the growth of the mobile Internet, operators no longer have direct relations with the content providers. In the off-portal scenario the actors that provide SMS billing services (i.e. the SMS service providers) frequently also assume the content aggregation role. This is already evident and expected to further increase. The actors fulfilling these roles see no direct need to obtain the customer relation. Their business aims at remaining business to business, or in some cases business to business to consumer. In the aggregation role we also see the entry of new actors formerly active on the regular Internet, now increasingly focussing on the mobile channel.

As already indicated by Ballon (2004), the role divisions identified by the UMTS Forum (2002), fail to reflect the increasing role of technology providers in the content service market. Several of these parties increasingly target the media sector and the mobile channel. Examples are Nokia (acquired OD2) and Apple (Itunes, Iphone connection). These technological actors play an increasingly important role and are rapidly building on their customer relations. This also holds for actors strongly represented on the regular Internet such as Yahoo!, Microsoft and Google. Barnett (2000) already stated that these actors will be the strongest competitors to mobile operators on the mobile Internet. This was also the view of several of our interviewees.

Many interviewees recognized the entry of specialized billing and collections providers in the market. These parties are not interested in content services or customer contact but specifically target the fee

[19] In this paper we frequently refer to the term kick-back to denote the ratio of the revenue that the operators share with PRSMS service providers and the latter with content providers. This is based on current usage of this term in the industry and should not be confused with another usage of the term in literature to denote transactions based on referrals.

that can be obtained in providing billing and collections services. Interviewees noted that especially actors such as financial institutions and specialized payment providers will become part of the mobile content industry.

MVNOs are growing in number and diversity. In the Netherlands only a few MVNOs offer data access to their users and they limit their services to voice and SMS. However, end-users increasingly demand also data access of these virtual operators. This increasingly demands mobile network operators to offer wholesale services to MVNOs. As their organization is currently not targeting the wholesale market, this leaves a gap. This is where the Mobile Virtual Network Enablers (MVNEs) join the market and offer wholesale capacity and enabling services to a large diversity of actors wishing to start an MVNO. This facilitates the easy entry of MVNOs.

Developments in the technological dimension
Payment methods already available on the regular Internet are expected to become available on the mobile channel. As already mentioned above new actors enter the industry particularly interested in the BCP role. These actors bring new technological resources and capabilities to the mobile value network. For example Paypal has launched its mobile checkout payment method and for example Rabobank in the Netherlands has introduced a mobile version of its Minitix payment system. Especially the latter is placed in the market to compete with current PRSMS billing solutions. The method is similar to SMS billing as it also uses SMS to bill for online content services.

In the consideration of future role divisions, many interviewees pointed to the fact that the increasing intelligence of mobile devices will become an important enabler of billing. First it facilitates the convergence of several access technologies on mobile devices. Not only the mobile technologies such as GPRS, UMTS, EDGE and HSPDA provide mobile data access but also Wifi and Wimax are increasingly offered on mobile devices. This is the second trend: the increasing capabilities and intelligence of mobile devices. Additional to having larger screen sizes and better batteries, these terminals are increasingly able to use XML and HTML, and the Session Initiation Protocol. Most interviewees expected the intelligence and capabilities to enable identification of the user and its location (e.g. GPS, NFC) in future mobile devices. Hence this technological development may challenge the position of the mobile operator. This trend is strongly related to the entry of technology providers in the mobile content market, including Nokia, Apple and Google, who are benefiting from the capabilities of these devices.

In discussing developments in billing methods, interviewees not only pointed to the entry of alternatives emerging from the Internet world, also the current operator centric methods will change. As discussed earlier, in the Netherlands the dominant on-portal billing method is WAP billing. Primarily driven by greater ease of use, higher kick-backs and lower overhead compared to PRSMS billing, it is expected to gradually replace the latter type, also in the off-portal billing scenario. This is a view broadly supported by the interviewees. The current large SMS service providers will most likely be the partners to provide WAP billing services in off-portal scenarios. The off-portal provisioning of WAP billing does not impose any additional requirements on operators other than providing a separate API to their billing system for WAP billing service providers. The use of specialized billing service providers makes sense to manage the relations with the great diversity of premium content providers. Although operators do not like the provisioning of direct access to their billing systems, they are forced by the market. For example Vodafone in the Netherlands has already accomplished this task and in Germany WAP billing has become the absolute standard. Nevertheless, PRSMS is not dead yet. This type of billing may become extinct on the online content services market, its position in charging for non-mobile services (e.g. voting) does not appear to be compromised in any way.

A technology that should be considered in the development of future billing processes is the IP Multimedia Subsystem (IMS). Additionally to enabling the provision of multiple services in parallel, the IMS will provide the operator with new means of billing complex services in real time, based on Quality of Service (QoS) characteristics and enabling parallel services. The dominant methods in the Netherlands for charging network (data) resource usage are Metered and Packet pricing. Operators are increasingly offering flat fee data subscriptions. However, currently offered flat fee subscriptions are not “entirely flat” as operators tend to restrict it to certain services. Moreover, the implementation of the IMS, which enables differentiation of pricing depending on QoS characteristics may stimulate non-flat fee subscriptions. The flat fee price is also not a ceiling price; differentiation in QoS may provide

operators with additional ARPU. Nevertheless, based in the experience from the Internet world the general view is that flat fee will further proliferate and eventually replace metered and packet charging.

Developments in the informational dimension
Information ownership evidently is one of the primary drivers of changes in the division of roles in the value network. As discussed earlier many parties are eager to become the focal point for billing to capture the related fees and acquire information on customer demographics. The latter is directly related to the user ID which currently resides in the Subscriber Identity Module (SIM) or Universal Subscriber Identity Module (USIM). To bill end-users through other channels, actors require access to this ID. From our interviews we identified four ways to obtain this ID.

First, it can be provided by the operator, possibly on a premium basis through a wholesale relation. This requires a relation to be established with the mobile network operator, a fee and progresses the current dependence on the mobile operator. It does provide high ease of use, as no additional steps are needed. Second, the ID can be obtained through an SMS construction; for example using a specific short-code which is essentially similar to the current PRSMS methods. Although this is a rather straightforward method there is considerable overhead involved and goes against the current trend of replacing PRSMS by faster and easier methods. Third, the ID can be requested from the user through the online channel; for example using an ID and password. Fourth, the ID can be obtained from the device which is increasingly capable of providing a unique ID separately from the SIM or USIM. The latter would provide great ease of use and freedom to any actor wishing to bill the end-user. However, it poses significant challenges on the functionality of the device and will be subject to regulation. On the short term legacy handsets will remain dependent on SMS constructions.

A second informational aspect we identified from our interviews was the fact that the monetary value of content on the regular Internet is different from the value attributed to the same content in the mobile world. Content on the Internet should provide a strong differentiated value, will users be willing to pay for it (Shapiro and Varian, 1999). Many types of content, especially information that is currently being paid for through subscriptions on the mobile Internet, will become free of charge; requiring other ways to generate revenue. All interviewees directly involved in the marketing of content were investigating advertisement based models as an alternative means to generate income. The content that has sufficient added value will increasingly be provided on the basis of subscription models. Our interviewees widely supported the view that the model in which content is sold piecewise and the billing is event based, is not very viable.

Likelihood of new role divisions to emerge
Given the developments identified and the insights from discussions on the role divisions in our interviews, we can now reflect on the feasibility and likelihood of role divisions in which the mobile operator has a less centric role. Although we do not believe the five archetypes of role division models we identified earlier are exclusive, they provide a proper means to structure our findings.

First we discuss the operator centric model. Currently two constellations in this model exist; on-portal and off-portal. We found that the first will eventually disappear. The portal role of the operator will reduce to providing access to the open Internet, most likely by means of a search engine. Based on the trends towards mobile advertising, this will remain a revenue driver. However, off-portal the operator remains in a very strong position to bill the end-user for content services. With content billing becoming available, the kick-back will become more interesting to actors fulfilling the content provision and content aggregation roles, and the end-user will gain greatly in terms of usability. The future deployment of the IMS will provide the operator with new resources and stimulate interoperability, especially in the provision of more advanced, bundled and simultaneous services. Given the ability of this platform to differentiate in quality of service, the billing for network resource usage may remain a strong revenue driver.

The second role division model where the content aggregator is centric will not be based on current mobile content aggregators. These actors are focussing purely on business to business and specialize in interfacing with many different content providers and mobile network operators. Although from a purely information and technology and role perspective on the billing processes these actors would have a strong position, they lack a strong name and are not interested in business to consumer services. We return to the implications of these findings to our framework in the following section. Interviewees believed that actors currently dominant in the regular Internet as well as technology providers would

play an increasingly important role as content aggregators, since they have the critical resources such as strong brand names, technological know-how and experience on the Internet channel.

Concerning the second role division, the content provider centric archetype, we already identified the differences in the monetary value of content services provided over the regular Internet and the mobile channel. This will inevitably lead to a proliferation of advertisement based models in which the BCP role seizes to exist and actors other than the MNO are entirely dependent on alternative means to obtain end-user demographics and usage data. With the decreasing use of the operator portals, we see an increasing divergence in actors providing content. Those formerly depending on the operator portals will have to find new means to acquire traffic, those currently operating predominantly off-portal are expected to be affected positively, as end-users will further exploit the open Internet. Where content services will be provided on a premium basis, it is not very likely that the actors fulfilling the content provision role will attain the BCP role. Current content providers lack the critical information and technology resources to bill end-users.

However, we identified several options to overcome these resource barriers. First, these actors can exploit any existing billing relation. For example a newspaper can add access to their mobile channel on a premium basis to their subscription. A second option would be to start an MVNO, which is facilitated by the entry of MVNEs in the market. Although this would remain a rather local initiative, and most likely serving a niche market, it would provide full control of the end-user, reducing the role of the MNO to a bit pipe. The last option we identified would be to acquire these resources through an actor who specializes in the BCP role. This would leave the content provider dependent on this actor instead of assuming the billing relation itself and hence, it can not be considered content provider centric but points to another role division.

This fourth role division is what we termed payment provider centric. We found that the amount of information that this specialized billing and collections provider has, differs significantly depending on the billing method deployed. Pure pre-paid methods provide no user information at all, whereas the payment methods that relate to a bank account or to credit cards provide a full customer profile. The billing processes in this model are similar to the regular Internet with this difference that, if allowed by the operator or enabled by the handset, the customer can directly be identified removing several steps from the billing process. Currently the kick-backs that are provided by these payment providers on event-based billing may be rather low compared to the content billing methods provided by the mobile operator. The latter also provides more ease of use.

We found that the fourth role division, the Internet Service Provider centric archetype, can be divided into two subtypes: (1) the model in which a fixed operator further exploits his existing billing relation, and (2) the model in which an ISP, not owning physical infrastructure in the fixed domain further exploits his billing relation. The second model is not further developed as it would very much resemble the content aggregator model. The billing for network resource usage would typically remain with the mobile operator. The first model is of particular interest, since these actors have systems in place that resemble the systems mobile operators have to bill their customers. This leverage of legacy removes the resource barrier and fixed operators could potentially offer similar billing capabilities. However, fixed operators are not used to establishing relations with content providers and do usually not own their own content. Therefore cooperation with current mobile aggregators makes more sense, these have infrastructure in place to deal with micro payments. The customer identity in this case must be obtained from the operator on a fee basis or be provided by the device.

Conclusions

We found that content services on the mobile Internet are billed in two different ways; on-portal and off-portal. The first refers to users acquiring content through the mobile operator's portal. This method uses a direct interface with the operator's billing system and reduces the need for SMS messages. The latter are required in the dominant off-portal billing method, i.e. Premium Rate SMS billing. Off-portal users acquire content usually at actors aggregating content and traffic, but can also acquire it directly at actors providing the content. Here the aggregation role is not performed by the operator but by a third party that usually also provides the SMS billing services. In both scenarios the end-user pays for the content services on the basis of his subscription at the mobile network operator who has full control of the process and accessibility of customer demographics. This control enables the MNO to charge high billing fees. With the migration of the mobile channel model to the regular Internet model, this control

may be about to change. This migration provided the starting point for the exploration of potential changes in the role of actors fulfilling billing and potential changes in the underlying billing processes.

Several different role divisions can be identified from literature, in which the differentiating factor is the ownership of the customer contact. Exploring the role of business processes in different role divisions is a challenging task and only a very small amount of literature is available on this subject. The available literature focuses mainly on value exchanges and reciprocity among actors. Furthermore, these approaches can be considered rather rigid. In our study we aimed for a more pragmatic approach that incorporates aspects directly relevant to the business processes. We created a framework to study alternative role divisions that is based on three primary observations:

- Information and technology are the primary inputs to increasingly automated business processes.
- To assess the likelihood of change in the role division among actors, the availability of the appropriate resources plays a crucial role. It is insufficient to regard only value exchanges and reciprocity.
- Specific roles assumed by actors require specific resources to accomplish the functions related to these roles.

The framework that we used together with a set of theoretical role divisions in thirteen semi-structured interviews with industry participants was found to be highly useful. From this approach we identified developments in actors fulfilling roles, technology and information relevant in billing. We found that mobile network operators are increasingly focusing on providing access and billing services, leaving content provisioning to the open market. Actors currently active on the regular Internet and technology and platform providers are actively stepping into this open market. These actors are expected to assume the content aggregation role and further build on their customer relation. Actors that at present provide SMS billing service and aggregate content are expected remain in an important position in the market, but are not expected to establish direct customer contact other than the service relation.

Actors currently providing content are looking at means to deal with the difference in the value of content provided through the mobile channel and the regular Internet. Subscription (flat fee), and advertisement models are expected to proliferate at the expense of event-based billing. However, advertisement based models are not further developed in this paper. Also billing for network resource usage is subject to changes, as mobile operators increasingly use flat fee subscriptions for online surfing and downloads. The deployment of the IMS by mobile operators could equally likely point to other directions. As the IMS enables differentiation in QoS, it also enables differentiation in tariffs. Concerning technological developments we identified three other expected developments. First, the current PRSMS billing solutions will disappear as content billing becomes available off-portal at all operators. Second, the actors entering from the regular Internet and from the financial domain bring in new resources, experience and new payment methods, related to bank accounts, credit cards. These payment methods, although currently mostly not suited for micro payment, will increasingly target this market. Third, interviewees expect mobile devices to become increasingly intelligent and become capable of identifying the end-user separately from the SIM or USIM which is being controlled by the mobile operator.

Based on the developments identified and the input of interviewees we conclude that several options exist for actors fulfilling other roles than the mobile operator to establish the customer contact and bill for the provision of content services on the mobile Internet. These directions emerging from the on-portal operator-centric model at present are shown in Figure P 5. We show the different directions in the archetypes, their billing method and the market segments anticipated to be served by these methods. From this figure it is evident that the operator role is expected to remain central in the billing of many content services. However, alternatives are expected to become available and increasingly obtain market share.

Obtaining the customer relation may in several scenarios require only moderate investments in infrastructure; however, it does require investments in other fields such as marketing. Only the very large players, usually emerging from the regular Internet, having a technological background or an existing billing relation in place are likely to assume a billing relation with end-users. Therefore, although many models will proliferate and coexist, the operator centric models are expected to remain the dominant billing model especially on the short term.

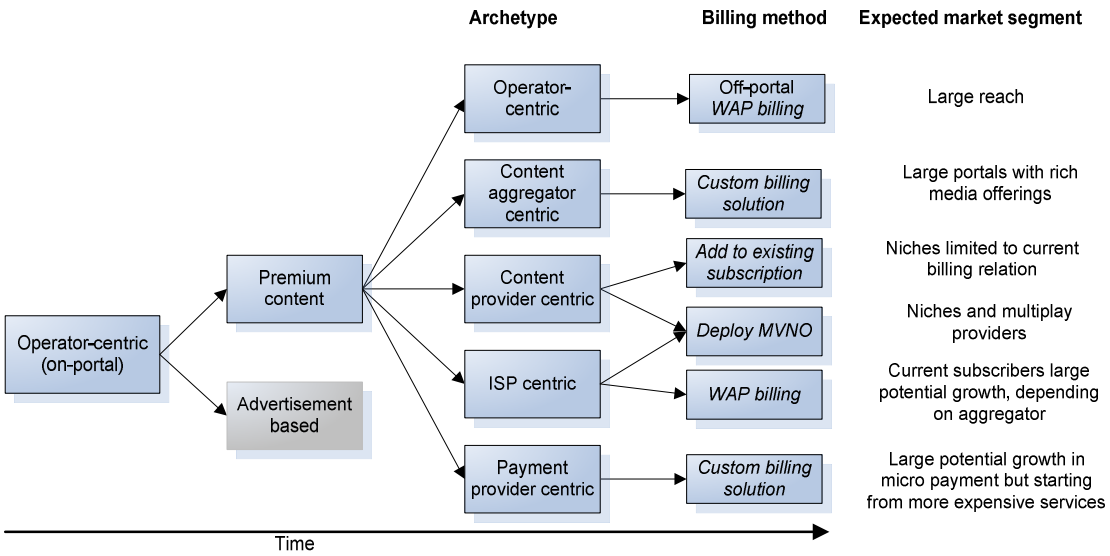


Figure P 5 Expected directions in billing role divisions

On the longer term it is expected that several of the models will coexist. We found that most of the models are expected to be used only by a small customer base compared to the total amount of content service consumptions. Especially the content provider centric models are expected to be used to bill for specific types of premium content, requiring end-users to start several subscriptions. It is expected that the models that will become strongest competitors to the current mobile operators are those supported by the technology providers assuming the content aggregation role, and the financial institutions or specialised payment providers assuming the BCP role.

Discussion

Our framework provided a useful means to look at the developments in billing in the mobile content industry and capture the feasibility of specific role divisions in terms of information and technological resources. Although we believe the focus on resources to be of great value, a focus on information and technology also limits the perspective. Especially when the framework is used in an explanatory setting, resources of more intangible nature are important. Examples are the importance of an established user base and brand name. Hence, the resources attributed to specific roles in our framework could be expanded to provide a broader perspective. Our framework could be enhanced to capture a broader resource perspective (Montalvo et al, 2004; Miller and Shamsie, 1996; Das and Teng, 2000) and/ or be expanded to include capabilities (see e.g. Amit and Schoemaker, 1993; Andreu and Ciborra, 1996).

In the application of our framework we discovered that the link between actors, roles and resources provides good insights and greatly structures our approach to business processes in role divisions. However, the link between the actual deployment of resources in business process activities and the role itself remains rather rigorous in our framework. Assuming a specific role in the value requires performing specific functions. These can be performed several ways using different informational and technological resources. Multiple options can arise here and the selection of either options is a rather strategic choice. This choice is frequently not only made on the basis of available (informational and technological) resources but can also be the result of weighing many more factors and actor relations. Therefore a layer could be added to our framework that incorporates strategic choices and thereby sharpen the perspective of our framework. Further research should expand on this aspect.

In the domain under study we assessed the feasibility and likelihood of emergence of alternative role divisions based on information and technology resources. Results of this research should be interpreted according to this perspective. The exploration was primarily based on the ideas of actors currently active in the mobile industry which emphasizes the fact that we focussed on an extrapolation of the situation at present, given currently visible developments. This makes the results of our research strongly part of the telecommunications domain and further research could aim to use a more obtrusive method including more actors emerging from the Internet domain such as Amazon, Google and Yahoo! to further broaden the perspective and potentially reveal additional relevant potential developments.

We regarded functional feasibility on a process and role level, specifically aimed at the billing processes and did not regard the financial viability. Further research into the domain should focus on assessing the financial viability. An approach highly complementary to the approach taken here is for example the e^3-value method (see e.g. Gordijn, 2002; Gordijn and Tan, 2001).

References

Alter, S. (1999). Information Systems: A Management Perspective. Amsterdam, Addison-Wesley.

Amit, R. and Schoemaker, P. J. H. (1993). "Strategic Assets and Organizational Rent." Strategic management journal **14**(1): 33-46.

Andreu, R. and Ciborra, C. (1996). "Organisational learning and core capabilities development: the role of IT." Journal of Strategic Information Systems **5**(1996): 111-127.

Ary, B. D., Debrei, G. and Imre, S. (2005). Real-Time Charging in Third-Generation Mobile Networks. 8th international Conference on Telecommunications - ConTEL 2005. Zagreb, Croatia.

Barnett, N., Hodges, S. and Wilshire, M.J. (2000). "M-commerce: An operator's manual." The McKinsey Quarterly **2000**(3): 162-173.

Barney, J. (1991). "Firm Resources and Sustained Competitive Advantage." Journal of management **17**(1): 99-120.

Barney, J. (2001). "The resource-based view of the firm: Ten years after 1991." Journal of management **27**(2001): 625-641.

Bergholz, M., Jayaweera, P., Johannesson, P. and Wohed, P. (2003). Process Models and Business Models - A Unified Framework Advanced Conceptual Modeling Techniques. Heidelberg, Springer Berlin.

Bhushan, B., Gringel, T., Ryan, C., Leray, E., de Leastar, E. and Cloney, J. (2002). "Federated Accounting Management System Architecture for Multimedia Service Usage Management." MMNS **2002**: 12-24.

Bhushan, B., Hall, J., Kurtansky, P. and Stiller, B. (2005). "OSS Functions for Flexible Charging and Billing of Mobile Services in a Federated Environment." Integrated Network Management **2005**: 717-730.

Bititci, U. S. and Muir, D. (1997). "Business process definition: a bottom-up approach." International journal of operations & production management **17**(4): 365-374.

BT Agilemedia (2006). Whitepaper - WAP billing for Premium-rate Services, BT Agilemedia.

Buellingen, F. and Woerter, M. (2004). "Development perspectives, firm strategies and applications in mobile commerce." Journal of Business Research **57**(2004): 1402-1408.

Butyka, Z., Jursonovics, T. and Imre, S. (2004). A Real-Time Charging Model for UMTS Mobile Network, Budapest University of Technology and Economics, Department of Telecommunications.

Cushnie, J., Hutchison, D. and Oliver, H. (2000). Evolution of Charging and Billing Models for GSM and Future Mobile Internet Services, Multimedia Research Group, Lancaster University.

Das, T. K. and Teng, B.-S. (2000). "A Resource-Based Theory of Strategic Alliances." Journal of management **26**(1): 31-61.

Davenport, T. H. (1993). Process innovation. Boston, MA, Harvard Business School Press.

Dijkman, R. M., Quartel, D. A. C., Pires, L. F. and van Sinderen, M. J. (2003). An Approach to Relate Viewpoints and Modeling Languages. Seventh IEEE international enterprise distributed object computing conference (EDOC' 03), Brisbane, IEEE computer society.

Farley, P. and Capp, M. (2005). "Mobile Web Services." BT Technology Journal **23**(2): 202-213.

Garner, P., Mullins, I., Edwards, R. and Coulton, P. (2006). Mobile Terminated SMS Billing - Exploits and Security Analysis. Third Interational Conference on Information Technology: New Generations (ITNG'06), Las Vegas, Nevada.

Gordijn, J., Akkermans, J. M. and van Vliet, H. (2000). Business Modelling is Not Process Modelling. Conceptual modeling for e-business and the web (ECONOMO-2000), Salt Lake City, USA, Springer-Verlag Berlin Heidelberg.

Gordijn, J. and Tan, Y.-H. (2001). "A design methodology for modeling trustworthy value webs." international journal of electronic commerce **9**(3): 31-48.

Grover, V. and Saeed, K. (2003). "The telecommunication industry revisited - the changing pattern of partnerships." Communications of the ACM **46**(7): 119-125.

Gulati, R., Nohria, N. and Zaheer, A. (2000). "Strategic Networks." strategic management journal **21**(2000): 203-215.

ITU (2004). M30.50.0 Enhanced Telecom Operations Map (eTOM) - Introduction, International Telecommunications Union, Telecom standardisation sector**:** 14.

Jonkers, H., Lankhorst, M., Van Buuren, R., Hoppenbrouwers, S., Bonsangue, M. and Van Der Torre, L. (2004). "Concepts for modeling enterprise architectures." International Journal of Cooperative Information Systems **13**(3): 257-287

Kallio, J., Tinnila, M. and Tseng, A. (2006). "An international comparison of operator-driven business models." Business Process Management Journal **12**(3, 2006): 281-298.

Kijl, B., Bouwman, H., Haaker, T. and Faber, E. (2005). Dynamic Business Models in Mobile Service Value Networks: a Theoretical and Conceptual Framework, FRUX Freeband**:** Deliverable 2.2-II: 1-87.

Koutsopoulou, M., Kaloxylos, A., Alonistioti, A. and Merakos, L. (2004). "Charging, Accounting and Billing Management Schemes in Mobile Telecommunication Networks and the Internet." IEEE Communications Surveys **6**(1): 50-58.

Koutsopoulou, M., Kaloxylos, A., Alonistioti, A. and Merakos, L. (2007). "A platform for charging, billing and accounting in future mobile networks." Computer Communications **30** (2007): 516-526.

Kuo, Y.-F. and Yu, C.-W. (2006). "3G telecommunication operators' challenges and roles: A perspective of mobile commerce value chain." technovation **26**(2006): 1347-1356.

Li, F. and Whalley, J. (2002). "Deconstruction of the telecommunications industry: from value chains to value networks." Telecommunications Policy **26**(2002): 451-472.

Miller, D. and Shamsie, J. (1996). "The Resource-Based View of the Firm in Two Environments: The Hollywood Film Studios from 1936 to 1965." The academy of Management Journal **39**(3): 519-543.

Mobile Europe (2006). mBlox chairman predicts mobile content ISPs will "vapourise.Last accessed at June 11, 2007 http://www.mobileeurope.co.uk/news/news_story.ehtml?o=2190

Montalvo, U. W., van de Kar, E. and Maitland, C. (2004). Resource-based interdependencies in value networks for mobile Internet Services. Sixth International Conference on Electronic Commerce, Delft, The Netherlands.

OMI (2006). Open Mobiel Internet Position Paper, Open Mobiel Internet Alliance.

Open Mobile Alliance (2002). WAP Billing framework version 1.0 Nov 2002, Open Mobile Alliance (OMA).

Peppard, J. and Rylander, A. (2006). "From value chain to value network: insights for Mobile Operators." European Management Journal **24**(2): 128-141.

Pijpers, V. and Gordijn, J. (2007). Bridging Business Value Models and Process Models in Aviation Value Webs via Possession Rights. 40th Annual Hawaii International Conference on System Sciences (HICSS'07) Hawaii.

Praveen Tanguturi, V. and Harmantzis, F. C. (2006). "Migration to 3G wireless broadband internet and real options: The case of an operator in India." telecommunications Policy **30**(2006): 400-419.

Reijers, H. A. and Mansar, S. L. (2005). "Best practices in business process redesign: an overview and qualitative evaluation of successful redesign heuristics." Omega **33**(2004): 283-306.

Ross, J. W. (2003). *Creating a strategic IT Architecture Competency: Learning in Stages - CSIR working paper 335* MIT Sloan School of Management

Saarikoski, V. (2006). The Idyssey of the Mobile Internet. Faculty of science. Oulu, University of Oulo. **doctor:** 274.

Sabat, H. K. (2002). "The evolving mobile wireless value chain and market structure." telecommunications Policy **26**(2002): 505-535.

Shapiro, C. and Varian, H. R. (1999). Information rules: A strategic guide to the network economy. Boston, Massachusetss, Harvard Business School Press.

Stabell, C. B. and Fjeldstad, O. D. (1998). "Configuring Value for Competitive Advantage: On Chains, Shops, and Networks." strategic management journal **19**(5): 413-437.

Tapscott, D., Ticoll, D. and Lowy, A. (2000). Digital capital Harnessing the power of business webs. Boston, Harvard Business school press.

Tilson, D. and Lyytinen, K. (2006). "The 3G transition: changes in the US wireless industry." telecommunications Policy **30**(2006): 569-586.

Tsalgatidou, A. and Junginger, S. (1995). "Modelling in the Re-engineering Process." SIGOIS Bulletin **16**(1): 17-25.

UMTS Forum (2002). Report 21 Charging, Billing and Payment Views on 3G Business Models, UMTS Forum**:** 36.

Yin, R. (2003) Case Study Research, 3rd ed. Thousand Oaks, Sage Publications

Zlatev, Z. and Wombacher, A. (2005). Consistency between e3-value models and activity diagrams in a multi-perspective development method. OTM workshops 2005, Agia Napa, Cyprus, Springer-Verlag Berlin Heidelberg.

Appendix 1 The WCA framework

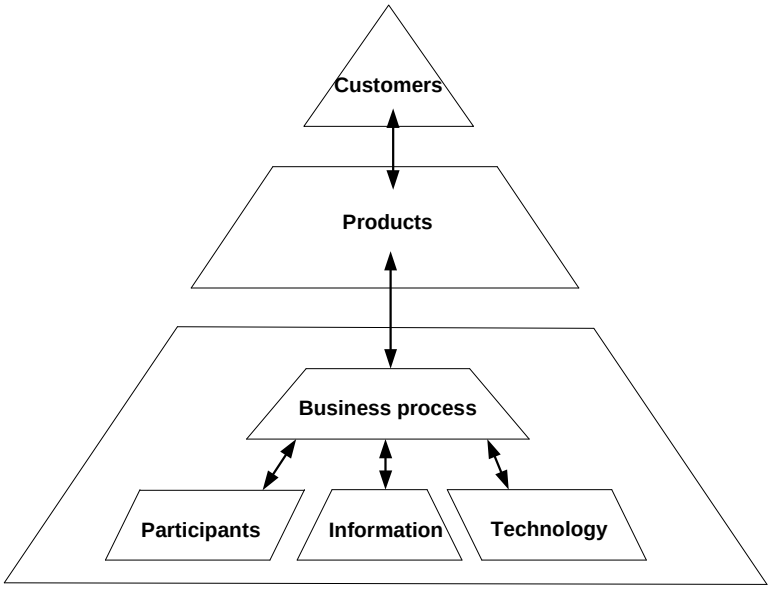


Figure A 1 WCA framework (Adapted from Alter, 1999)

In this framework, Alter defines customers as the external or internal people who receive and use its outputs. These can both be people that actually consume the goods, but also stakeholders like for example company officials that introduce a specific tool (Alter, 1999: chapter 2). The product is understood as the output of the work system. Although it is termed product, it usually contains a mix of physical and service components comprising the value for the customer. Business processes are defined by Alter as "a related group of steps or activities that uses people, information, and other resources to create value for internal or external customers."(Alter, 1999: 47).

This definition is well aligned with the four components of a business process identified in chapter 3. Participants in the work system are basically the people that do the work. Although many tasks are automated, people remain to play a crucial role as they essentially use the information that is processed through the systems and maintain and update the systems. Information can take many forms such as numbers, text and media and may be created, modified and received throughout information systems. Alter clearly distinguishes information from knowledge and data by defining the concepts as follows (Alter, 1999: 49):

- *Data* "are the facts, images, or sounds that may or may not be pertinent or useful for a particular task."
- *Information* "is data whose form and content are appropriate for a particular use."
- *Knowledge* "is a combination of instincts, ideas, rules, and procedures that guide actions and decisions."

Alter raises five perspectives in using the framework; (1) the architecture perspective specifies the system components and how they operate together, (2) the performance perspective defines how well the system operates, (3) the infrastructure perspective deals with the essential resources that are shared with other systems, (4) the context perspective refers to the organizational, competitive, and regulatory environment surrounding the system, and (5) the risk perspective focuses on foreseeable things that can go wrong (Alter, 1999: chapter 2).

Based on a review of other analysis frameworks and several enterprise modelling methodologies Reijers and Mansar (2005) come up with two additional separations and one additional factor in the WCA framework, see Figure A 2. They separate the business process in an operational view and a behavioural view and the participants in structure and population. The operational view relates to the manner in which the operations are implemented; the number of tasks in a job, the relative size of tasks, nature of tasks, degree of customization. The behavioural view relates to the timeliness of

activities; e.g. sequencing of tasks, task consolidation, scheduling of jobs. In the division of the organisation the structure refers to elements such as roles, users, groups, departments whereas the population refers to "agents who can have tasks assigned for execution and relationships between them" (Reijers and Mansar, 2005: 294). The additional dimension that they add is the external environment referring to anything in the firm's environment other than the customer.

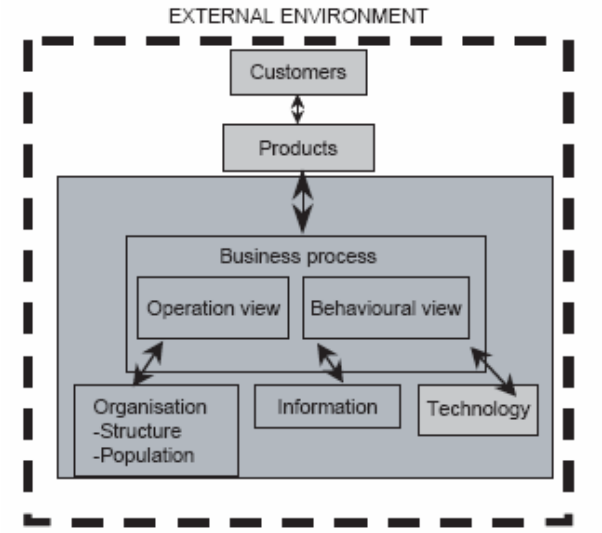


Figure A 2 Adaptations to the WCA framework (Reijers and Mansar, 2005: 293)

In this framework as well as in the original framework the business process level consists of the analysis of the steps taken in the process and their sequencing and relations to the other components. The modelling of these steps is not part of the framework that has a more high level character. To illustrate the process steps a modelling technique is required. Alter proposes the use of Data Flow Diagrams or Flowcharts. These are only few of the wide range of options available for modelling a business process. We discuss business process modelling more extensively in section 2.3.2.1.

Appendix 2 relations among business process theory

Business processes are studied from a variety of fields that strongly interrelate and depend on cross-fertilizations among these fields. The impact of ICT in the study and optimization of business processes has been tremendous, and is clearly visible in many business process analysis and design approaches, most prominently being business process reengineering.

The application of information and technology in business processes has fuelled automation. This trend has resulted in what is called Workflow management, which is defined as: "The automation of a business process, in whole or part, during which documents, information or tasks are passed from one participant to another for action, according to a set of procedural rules." (Weske et al, 2004: 2). The trend towards workflow management is followed by "Business Process Management" which is widely considered the next step after the workflow trend. It is defined by Weske et al (2004: 2) as: "Supporting business processes using methods, techniques, and software to design, enact, control, and analyze operational processes involving humans, organizations, applications, documents and other sources of information." Thus, basically the application of IT in combination with BPA (BPR) has resulted in the Workflow management approaches which are now being replaced by more integral business process management approaches.

Although it is not our intention to be exhaustive, in the following figure we relate the different concepts in the study of business processes.

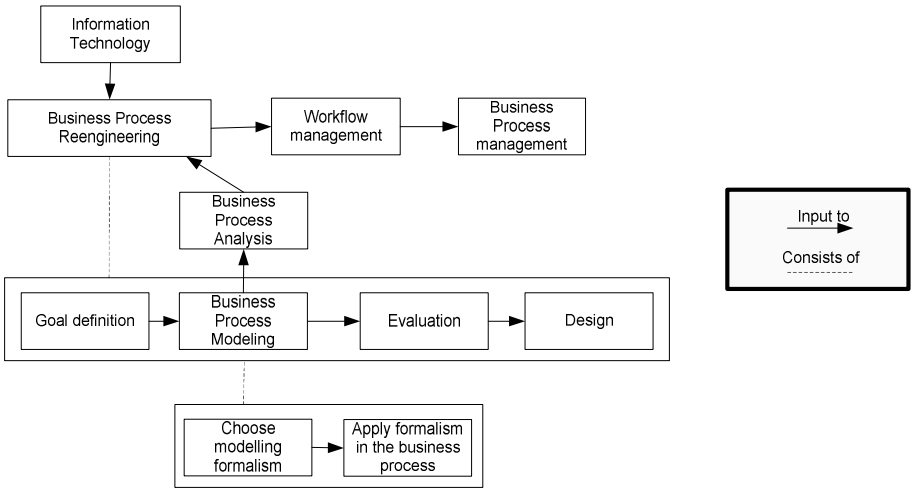


Figure A 3 Business process theories related

From the discussions in earlier paragraphs and emphasized in this figure is that at the core of any study of business processes lays its analysis. This analysis is supported by a modelling methodology, providing an overview of the actual process activities. This modelling methodology can be of any formalism, each with its own specific purpose, strengths and weaknesses.

Appendix 3 Relating value networks to business processes

In chapter 2 we discuss the two levels separately. This appendix contains the result of our literature study into theory on the relations among views and levels of analysis. Additional to showing some approaches we discuss these in the light of our research goal and the original purpose of the approaches. Four different approaches can be distinguished:

1. Directly relating two levels based on ad-hoc identified characteristics specific for the purpose at hand.
2. Working downwards from the value network through a stepwise inclusion of additional aspects until operational processes can be distilled.
3. Working upwards from the process through stepwise aggregating the view and including new high-level concepts until the value network can be distilled.
4. Using a predefined (general) relation or a common level of analysis between two levels and apply this to the problem at hand.

The different relations are shown in Figure A 4.

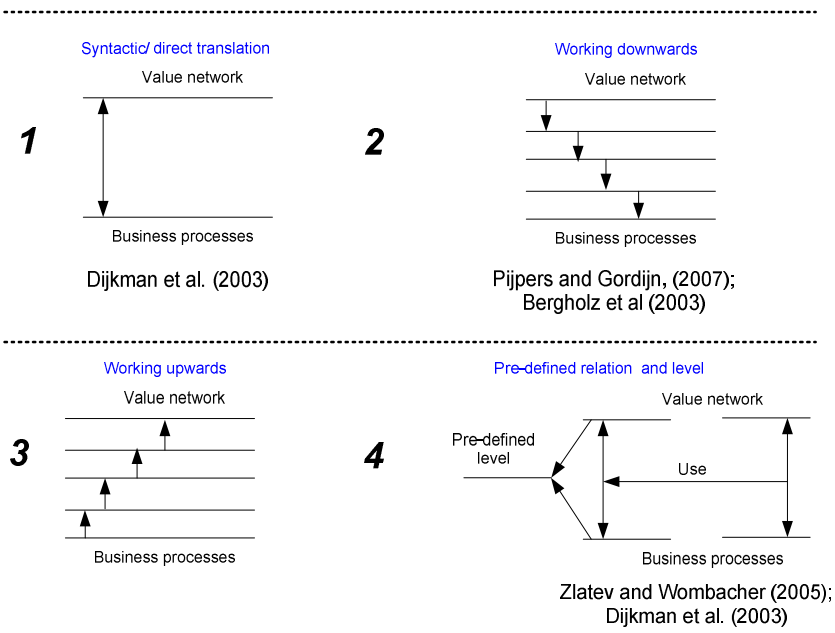


Figure A 4 Relations between value network and business processes

The first is termed “syntactic” or direct translations; the terms on both levels (and hence specific notations) are directly related here (Zlatev and Wombacher, 2005). Directly relating two levels through their notations and modelling approaches is rather static and descriptive. This descriptive character suits our research goal as we also analyze rather than prescribe. Directly relating the two levels when the value network and business processes are concerned is a challenging task. As Gordijn and Tan (2001) note, this would easily result a myriad of relations between concepts and terms. This would harm the communicative value of the resulting work. As this is one of the core aspects of this thesis we do not apply a direct translation.

Some examples can be found in literature adopting the second approach, for example Pijpers and Gordijn (2007), Bergholz et al (2003).These approaches identify a viable model on the value network level as the basis for further specification. Pijpers and Gordijn (2007) create two levels of analysis between deep processes and the value network level; one level downwards from the value network level is called transition model and one step further is called high-level process model. From the high-level process model they create the low level process model which is the basis for the creation of information systems. However, these approaches are very prescriptive in nature as they use the value network role division to lay down the processes. Thus the goal of this method is not aligned with our research goal as we do not prescribe but rather describe and analyze.

Due to the prescriptive nature this approach lacks the ability to incorporate the current situation (e.g. technology in use) and dynamics at the process level as the aim is to design the processes top-down; given a specific value network constellation the business processes are laid down. When considering business processes as a separate level of analysis there can also be dynamics in the sense that new technologies, integration of existing technologies etc. can all pose constraints and requirements or a technology push on the process level. Therefore given our research goal it makes sense to independently create both models and capture the dynamics at both levels before relating the two levels.

Given the limitations of the second (top-down) approach, it makes sense to look at a more bottom-up approach. It could for example entail the analysis of processes to identify the roles and relations in the network required to provide the business processes as analyzed. Several concepts might be usable for this approach. For example Malone provides tools for "inventing organizations" in which the focus lies on redesigning and inventing new processes and communicating ideas about organizational practices. This approach works on several levels ranging from specific process details to the "deep structure" of their similarities (Malone et al, 1999). These several levels of process analysis and the focus on generic processes and blueprints could be further aggregated and extracted to create actor interactions. However such an approach is too detailed to be applicable in the conceptual modelling of the value network. As Gordijn and Tan (2001) mention, the tremendous amount of constructs in this model, i.e. 3400 activities, 20 levels of specialization and 10 levels of decomposition, is hardly suitable for exploring concepts. Furthermore, the focus of these approaches is nearly entirely inward looking making the connections of inter-firm processes hard to distinguish and analyze.

The fourth can be found in Dijkman et al (2003) who discuss the relations among different (modelling) views and stress the importance of consistency between these views. The "pre-defined viewpoint relation" concerns the use of an existing relation between the two views. Dijkman et al (2003) provide the example of the relation between a structure view and a behaviour view of a system. If interactions between behaviours in a behaviour view are to take place, in the structure view the components creating these behaviours must be interconnected. The fact that the behaviour of a component is known is considered a pre-defined relation. The "pre-defined basic viewpoint relation" uses a basic viewpoint on which both viewpoints are mapped. To use this approach Dijkman et al (2003) stress that "a viewpoint must be found that matches the concepts used in the viewpoints one wants to relate" (Dijkman et al, 2003: 5). Concerning the analysis of the relation between a value network view and a business process view, we have not found such an intermediate level of analysis in literature. Therefore this approach is hardly applicable to suit our research goal.

Zlatev and Wombacher (2005) adopt an approach close to the fourth approach. They identify three perspectives which are comparable to the levels of analysis of Pijpers and Gordijn (2007); the value perspective is close to the value network level, the business process perspective is close to the high level process model, and the application communication perspective resembles the low level process model. They only deal with the relations between the value network level and the process level and leave the application communication perspective open for further research (Zlatev and Wombacher, 2005). They model both levels separately and aggregate these to capture only the essence of these levels at an equal granularity and consequently check on the consistency among the two aggregated levels.
This approach assumes specific scenarios and specifications at both levels of analysis rather than prescribing them. Therefore it suits the descriptive character of our research goal. However, with this approach the authors are specifically concerned with consistency in the usage of terms, relations and concepts, to ensure proper translations among views. This makes it rather rigid as relations and terms and concepts must be specific on a deep level of granularity in order to be able to use the approach. This rigidity does not suit the exploratory character of this research which requires flexibility to deal with uncertainties caused by dynamics.

Hence we conclude that although none of the approaches identified and discussed here are aligned with our research goal some valuable insights can be obtained here. First, it is not feasible to directly relate aspects from both views but linking similar concepts and terms suits the descriptive, explorative character of our research. Furthermore the second and third approaches stress the need for aggregating both levels into usable concepts and the fourth approach stresses the need for identifying common concepts in both views.

Appendix 4 Telecommunications' infrastructure unravelled

In the current mobile value network billing is primarily performed by the MNO. The operator usually bills users both for the usage of the network resources and the content services consumed on the operator's portal and off-portal. Hence, for an understanding of the current billing processes and their consequent analysis it is necessary to understand the basic architecture of the telecommunications network (shown in Figure A 5). As the focus of this research is on the Dutch situation and on billing processes we use the dominant architecture as used in the Netherlands, and only denote crucial components relevant in the billing for content services, and the related network resource usage. The same holds for the connections between components. These are only shown insofar relevant for billing. Therefore this architecture is not a general representation but delineated to suit our analysis.

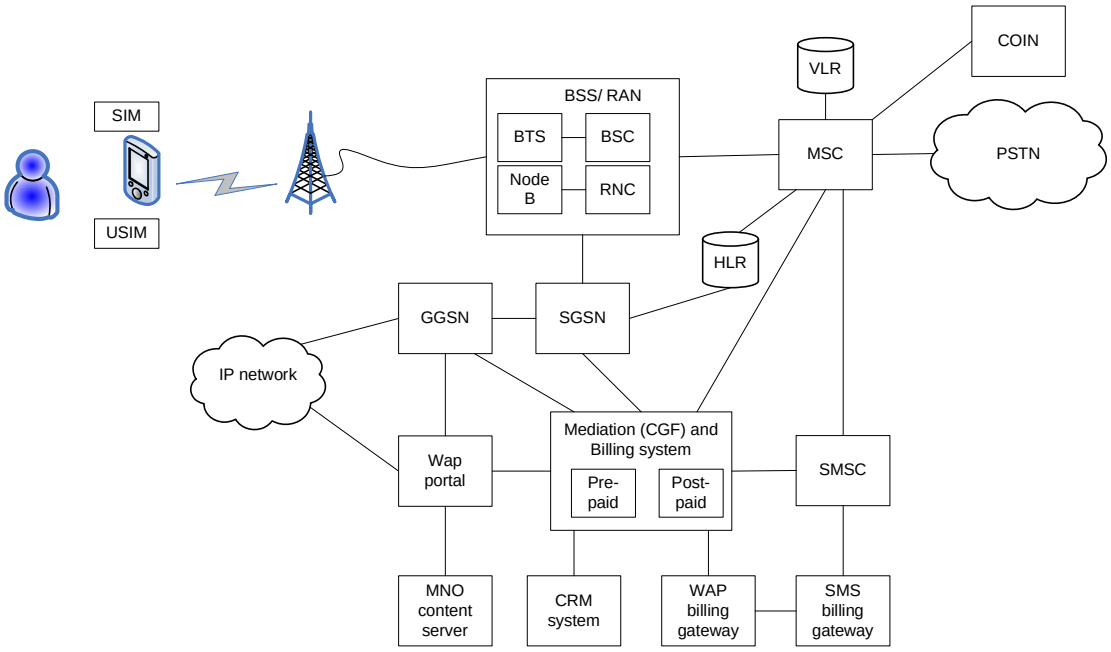


Figure A 5 Current dominant GSM, GPRS and UMTS network architecture in Europe

Below we describe this architecture and the relations among the components.

The user domain
The *end-user* has a mobile device (the mobile station) that contains a Subscriber Identity Module (2G, *SIM*) or Universal Subscriber Identity Module (3G, *USIM*) and has an International Mobile Equipment Identity (IMEI) to identify the device.

The GSM part of the architecture
The GSM architecture consists of primarily three parts; (1) the mobile station, described above, (2) the Base Station Subsystem (BSS) and the network subsystem. We describe these parts below (Scourias, 1995).

On the regular GSM network the mobile device connects to the BSS, which is composed of two parts: (1) the Base Transceiver Station (BTS) which houses the radio receivers that define a cell and handles the radio link protocols with the Mobile station and (2) the Base Station Controller (BSC) which manages the radio resources for one or more BTSs, it is the connection between the mobile station and the Mobile services Switching Center (MSC) (Scourias, 1995).

The network subsystem holds the MSC as central component. The MSC acts as a normal switching node of the PSTN or ISDN and additionally provides all the functionality needed to handle a mobile subscriber. Furthermore, the MSC generates CDRs (Charging Data Records, also termed Call Detail Records). A CDR holds the information on chargeable events. The Home Location Register (HLR) and Visitor Location Register (VLR), together with the MSC, provide the call-routing and roaming

capabilities of GSM (Scourias, 1995). Therefore the MSC is connected to the COIN database that holds the numbers of users and their home provider.

Finally the Short Messaging Service Centre (SMSC) enables the sending and receiving of Short Message Entities (SMEs), frequently termed "short messages", between users and systems. To facilitate the billing through SMS, the SMSC is connected to the mediation platform or CGF to which it also sends CDRs. The latter components are for the sake of clarity aggregated in the billing system. The content aggregators that the operator uses are connected to the WAP (Wireless Application Protocol) portal that provides their connection to different user devices and hence enables these actors to provide their services on the telecom domain. We discuss WAP further in section 3.5.3.

GPRS additions
GPRS introduces two new nodes to the GSM network (Granbohm and Wiklund, 1999); the SGSN and the GGSN. The serving GPRS support node (SGSN) is connected to the BSS and keeps track of the location of the GPRS user, performs security functions and handles access control. The gateway GPRS support node (GGSN) is the interconnection point for packet data networks and is connected to the SGSN via an IP network. The aggregators of content services are connected to the IP network to deliver the required data and services through IP (the open API) or to the WAP gateway to have direct access to the different devices. These actors are furthermore connected to the MNOs billing system to settle content charges.

The SGSN and GGSN are important in the billing process as they both generate CDRs. Two are generated here: one by the GGSN (the G-CDR) concerning the Internet part of the chargeable event and one by the SGSN (the S-CDR) concerning the radio part of the chargeable event (Cushnie et al, 2000). The G-CDR is primarily used in the billing process; the S-CDR serves primarily for fraud detection purposes. The GGSN distinguishes between different tariffs depending on usage. For example on-portal traffic can have a different tariff from off-portal traffic. Hence the GGSN can be regarded as the technical enabler of the walled gardens in telecommunications. Depending on the source of the traffic these tariffs can be attributed. However, although the GGSN can distil the type of traffic based on the source, it is not capable of directly detecting what is transported (e.g. ring-tones, HTML sites, etc.) in the measured packets.

UMTS additions
The UMTS architecture is directly hooked up to the GPRS architecture, to the SGSN and to the GSM network on the MSC. To provide the physical UMTS link two new nodes were introduced; (1) Node B which is similar in role to the BTS in the GSM network; it provides the physical link between the user's device and the network, and (2) the Radio Network Subsystem (RNC) which controls the use and reliability of the radio resources.

Billing components
Several additional components are included for billing. The first is the Charging Gateway Function (CGF). This component consolidates, filters and optimizes CDRs before they are forwarded to the billing mediation system[20]. Additional to filtering and optimizing it also functions as a buffer by storing and forwarding CDRs (Fischer et al, 2002). This component can be either centralized or distributed within the SGSN and GGSN; the decision here lies at the operator (www 32: Mperical limited, 2006).

The billing mediation system is connected to the WAP portal or directly to content providers and aggregators as well as to the CGF, SMSC and WAP billing gateway to receive CDRs and charging information. This information is aggregated and sent to the billing system. The WAP billing gateway and the SMS billing gateway are respectively used for online or WAP billing, and SMS billing. A separate API is provided to billing partners (Mobile Europe, 2006).

The MNO has large systems in place to deal with the billing for chargeable events based on CDRs. These so-called billing systems generate bills from a broad range of information; "..billing systems process large quantitative of time- and location specific usage data into customer-specific usage information. They figure out how much to charge for the usage, as well as for other non-usage based

[20] The aggregation of CDRs is usually performed separately before they are sent to the CGF. This aggregation component is termed GTP collector. Due to its simple and evident task, for the sake of clarity it is not further discussed here.

products and services [i.e. the rating]. They apply relevant federal, state, and local taxes to the billed services. They generate a readable bill format and print or electronically distribute the bill [i.e. billing]." (Hunter and Thiebaud, 2003: 2). Although the pre-paid and post-paid billing systems are shown in the same block here, they are separated systems each holding its own subscribers and their data (Interviews: Bergkamp, 2007; Wennekers and Theunissen, 2007). The billing and mediation system is connected to the CRM system that holds the actual customer demographics. This architecture greatly simplifies the complexity and redundancy evident in operator's billing systems. This redundancy is primarily due to take-overs of actors already having billing systems and the introduction of new services that were designed with their own specific billing functionality.

To obtain the required customer information in the billing system, it is connected to the CRM (Customer Resource Management) systems (not shown here). The billing system also plays a primary role in the billing of roaming users. From the CDRs the billing system creates Transferred Account Procedure (TAP) files. These files contain aggregated information on chargeable events such as type of service, amount of data and minutes and tariffs, related to the customer that generated the events. A TAP-out file is send to the clearing house and a TAP-in is received from the clearing house. The differences in costs and revenues between providers are settled at the clearinghouse. Differences in interconnection costs and revenues of users are usually not settled through a clearinghouse but through separate reports communicated among the involved operators.

Appendix 5 Bearer charging methods

In this appendix we discuss several charging methods in use for charging for the usage of resources in the provision of services to end-users.

Metered charging

This is a widely applied method that involves charging the user with a fixed fee on a monthly basis for his connection combined with a potential additional fee for metered usage. This metering is mainly done on the basis of units of time (Cushnie et al, 2000), but can also be on the basis of duration, distance or time of the day.

Packet Charging

The packet charging method is similar to metered charging but not based on time but on the amount of data packets. It requires the implementation of packet counting systems and a billing system that can deal with packets. The major disadvantage is that the costs of measuring packets is very high and may be greater than their actual value (Cushnie et al, 2000).

Expected Capacity Charging

In this model the user is charged for his expected capacity and not the peak rate of the network. The expected capacity is determined on the basis of congested conditions. Excess traffic (traffic exceeding the expected capacity) is rejected in case of congestion and is not charged for. The advantage of this model is its transparency; the user knows what he will pay, the provider knows the required capacity. Major disadvantage is that this method requires the policing of actual capacity used by subscribers possibly charging additional fees through metered or packaged charging (Cushnie et al, 2000).

Edge Pricing

Edge pricing is based on charging the user for using capacity at the edges of the network, i.e. local charging information. Once this information is captured, any other method can be applied. The idea on edged pricing is based on the fact that much of the congestion on the Internet is formed at the edges of individual networks. Charging based on the usage of these parts can be effective in mitigating this congestion. Another advantage is that only local data on usage needs to be captured and not the more complex interconnections and roaming usages. Clearly the lack of transparency on the usage here is also a disadvantage. Furthermore, again the costs of collecting edge usage data may excess the value of usage (Cushnie et al, 2000).

Paris-Metro Charging

As the name implies this method is based on public transport systems; differentiated services can be provided based on user pricing. Users pay for their preferred quality of service that can be fixed and limited to two types like the Metro in Paris on which the method is based, or more dynamic. Dynamic refers to the capability of users to change quality in case of congestion which essentially aids in congestion managements through self-regulation. The flexibility of the method can be considered a major advantage whereas the need for complex mathematics, network segmentation and hence lack of multiplexing possibilities are the primary disadvantages (Cushnie et al, 2000).

Market Based Reservation Charging

This method is based on an auction; users place monetary bids for quality of their services. Equally to the Paris Metro charging method users have the advantage that they can influence the quality of their services. The disadvantages are the uncertainty on actual received quality and the unfair advantage gained by users through outbidding others. It is generally regarded inapplicable on the Internet, possibly also in mobile networks (Cushnie et al, 2000).

Appendix 6 Charging parameters

(Based on UMTS Forum, 2002: 27)

Some parameters potentially relevant in the charging for a service and content in a packet-switched environment are mentioned here. The pricing of a service can be based on either one or a combination of these parameters.

- Service: The value of the service delivered. Examples: content type and content ID, gaming units (e.g. lives, bullets, points scored, high scorer);
- Subscription: e.g. a bundled offer including access, fixed charges and a certain usage;
- Duration: the time spent using a service;
- Destination: from where or where to;
- Location: e.g. inside a VPN or at a specific place;
- A person's role ("persona"), for example at home or at work;
- Volume: e.g. downloaded volume in megabytes;
- Network: your own network or visiting another network;
- Device capabilities: viewing a picture or video with a low-resolution terminal may invoke a lower price;
- Quality of Service (QoS): offered or guaranteed service quality;
- Service Termination Indicator: charges may depend on why, when or where a service was abnormally terminated;
- Event: there may be fixed prices for certain events, similar to today's pricing for sending SMSs;
- Transaction type: receiving a certain type of message may have a specific price;
- Transaction value: e.g. a service provider may always get 10% of the full transaction value, while the full transaction value is determined by the content provider;
- Content provider, content aggregator or network operator identity.
- Discounting, loyalty bonus schemes.

Appendix 7 Value based pricing

Value based pricing; what is information worth?
Thinking in value is a challenging task. It is against the regular economical paradigm as the economic paradigm primarily considers costs; human assets for example are placed as costs on the trade balance and general ledger. However, this cost-based paradigm does not fit information as will become evident in this appendix.

Value on the mobile Internet can best be captured through the discussion of information when defining this concept broadly. According to Shapiro and Varian (1999: 3) information is "essentially, anything that can be digitized – encoded as streams of bits" and information goods can range from baseball scores and databases to web pages. Customers differ in their value attribution to information goods ranging from entertainment to business value, but a common aspect is that people are willing to pay money for it. Furthermore, information is costly to produce and assemble but very cheap to reproduce; it has high fixed costs but negligible marginal costs. Hence, cost-based pricing of information goods doesn't work. Information goods must be priced according to customer value and not production costs and since people value information goods differently, value based pricing leads to differential pricing. The most extreme form of differential pricing is what economists term "perfect price discrimination"; charging each customer just what he is willing to pay (Shapiro and Varian, 1999).

A proper manner to gather information on the willingness of customers to pay is holding a survey. This shows insight into the price elasticity of the market and can emphasize individual differences. An example of the results of such a survey is shown in Figure A 6.

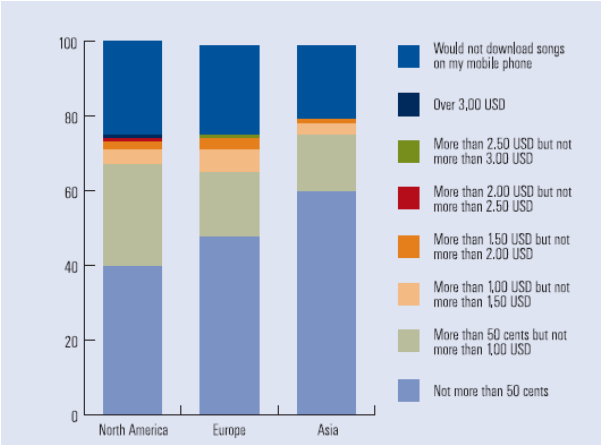


Figure A 6 Consumer willingness to pay for online music (KPMG, 2006b)

There are primarily three ways to differentiate pricing;

1. Personalized pricing; sell to each customer at a different price
2. Versioning; sell different versions of the product at different prices. This strategy is for example evident from the prices of hardcover or paperback books.
3. Group pricing; use for example student discounts

In either of these strategies the most important question remains which prices to use. Although several strategies are in use to obtain insights into this question the core message remains; know your customer. Primarily two ways exist to get to know your customer and provide personalized services and prices; the billing relation and observation. From the work of Shapiro and Varian (1999) we discuss some relevant aspects of pricing information goods.

Experience goods
According to economists a good is an experience good if "customers must experience it to value it" (Shapiro and Varian, 1999: 5). Information is an experience good every time you consume it and the major question is how you know what information is worth before you have consumed it. Some common strategies to overcome this issue are use of branding and reputation; you know for example

that a certain newspaper will provide a certain value of information. A core aspect here is the image of a company, represented by its logo; "image is everything in the information business" (Shapiro and Varian, 1999: 7). This makes it difficult for new actors in the roles of content providers or aggregators as these actors rely on the brand of the current operator. Therefore, established brands such as newspapers (e.g. De Telegraaf), but also news agencies (e.g. Reuters) in content provision and MVNOs (e.g. Disney Mobile, Scarlet) in service provisioning will become more important.

The economics of attention

Today's "wealth of information creates a poverty of attention" (Simon u.q. by Shapiro and Varian, 1999: 6) perfectly shows the fact that today not information access is the problem but information overload. Hence, real value is provided by locating, filtering, and communicating what is useful to the customer. The one-to-one "privatisation" of information by commercial parties is important here as both sides benefit; the customer only receives information potentially relevant and the advertiser only reaches customer that may be interested. This aspect is primary relevant to the content aggregator and the content provider roles that heavily rely upon their ability to provide only the desired content services to the end-user.

Technology

The value of the web lies not in the creation of information or the amount of information but in its distributing ability. The fact that customers have immediate access is the essential value provided by the infrastructure. This characteristic further creates interdependence between content providers and infrastructure providers; "The information economy is about both information *and* the associated technology." (Shapiro and Varian, 1999: 9). Therefore, although there will be more emphasis on names, brands, user base and other rather intangible assets, technology will remain important as an asset in the provisioning and billing of services.

Lessons from the Internet in pricing strategies

Despite of many evident differences such as screen sizes, the mobile Internet can be considered an extension to the regular Internet. Hence much can be learned from the pricing here as online content services are already rather widely available. Personalized pricing is made available through the one-to-one communication on the Internet. A core aspect here is to know the customer, for which the Internet provides several possibilities such as registrations, click streams and search behaviour. The Internet enables the use of personalized promotions and offers to estimate price sensitivity and identify market segments (Shapiro and Varian, 1999). Various techniques exist, ranging from "cookies" to track recurrent users to complex collaborative filters that predict preferences of customers (Barnett et al, 2000).

Intellectual property rights

Since producers of information can easily reproduce it, others can easily copy it which is further enabled through the digitalization of the Internet which is often viewed by content providers as a mere giant copying machine. Although several protection mechanisms are in place to "privatise" the information, such as property rights, enforcement is a problem. A core lesson here is that owners of information should choose the terms and conditions that maximize the value of the information goods and not their protection (Shapiro and Varian, 1999).

Appendix 8 Interview analysis

In this appendix we provide a high level overview of the major developments in the industry and, where applicable, high levels views on the five role division archetypes, from our interviews.

Interview	Anticipated developments
Bergkamp, L. InfoSpace.	Content aggregators will further aggregate. Mobile searching will become more important and is more personal than regular searching on the Internet. Infospace will further specialize in its role, as content provisioning services are sold. "eye balls" will become important, this is where advertisement revenue goes Given the fact that end-users expect the value of content to be similar to the Internet, a central question should be whether premium content will remain in use or only advertisment models will proliferate. Actors currently prominently represented on the regular Internet will become the strongest competitors to mobile operators in their customer relation.
De Buck, M. Vodafone	More focus on mobile searching Data subscriptions will become flat fee but premium prices can still be asked based on Qos characteristics Vodafone will stimulate the usage of the open Internet NFC, related to SIM or USIM will potentially become an important asset for operators.
Egberts, P. and Vlasblom, A. Netsize	Content providers are increasingly smart in obtaining customer details seperate from the billing relation, however, validity can not be ensured here. The aggregation role is a direct answer to the market that requires aggregation through economies of scale Netsize is not interested in a customer (billing) relation but focuses on B2B (and B2B2C services, i.e. the service relation). Web Services as an interface to content providers have the future. As an interface to the mobile device it will grow but first some problems must be overcome.
Haanstra, R. Wallie	Devices will become more intelligent, removing the dependence on the SIM/ USIM Operator dominance in the mobile payment domain will eventually vaporize. Payment methods that are currently big on the regular Internet, will become available on the mobile device without significant alterations; devices will be more intelligent.
Hania, S. XS4All	Internet on the mobile phone will become a personal Internet connection in contrast to e.g. ADSL that is shard in the living room Developments on the mobile device (e.g. supporting windows mobile) enable new services and models Flas fee is the future, the right to use should be paid for MVNO data activities are crucial to offer multiplay services The IMS will not without questions become the standard as it is an open technology that stimulates closed business models "walled gardens" Subscription based/ flat fee/ bundled services have the future; they remove complexity and ensure fixed income Usage of the mobile Internet is currently bound by habit, the fear of network collapse in case of an entirely flat fee based subscription is ungrounded. Given the current projections flat fee will be possible. Assisting the user in the usage of the open mobile Internet can generate revenue

Interview	Anticipated developments
Hermans, F. Ericsson	The current mobile Internet is not as open as it may seem; e.g. streaming is not yet flat fee. However, developments in this direction are visible (e.g. 3 in the UK). The world market is an important driver of openess on the mobile Internet. The bandwith of mobile data networks is rapidly growing, soon matching for example the speed of ADSL. Large actors increasingly deploy their own (facilitating) platforms to support innovative business models. There is a clear trend towards parallel communication Actors must focus on their core capabilities and gradually expand these; content providers will try the maximum amount of channels to deliver their content whereas operators should focus on faciliation. The variety in payment models will increase, economies of scale are important here. The location of the user will become a commodity. Eventually all network operators will implement the IMS The operator will offer several building blocks on wholesale basis (e.g. location, billing, identity etc.) A model that can become important is a model in which an actor specifically targets market and customer knowledge and sells this to other actors. MVNOs will grow in number and heterogeneity
Meijering, H. Scarlet	Data services on the mobile channel will be similar to current Internet offerings; flat fee, and added to the subscription. Reliance on the data of the operators will remain.
Pauala, A. and Copius Peereboom, P. Hyperleap	With the increasing intelligence of mobile devices, the legacy systems tailored to content enabling will become less important. The operator portals will eventually vaporize. Trust is a critical asset in deploying alternative billing models. Mobile searching is important. Advertisment models will become important revenue drivers. LBS will be carried by GPS, triangulation at the operator is insufficient. Portals will become personal e.g. through RSS feeds that enable users to create their own portals.
SMS Service provider	Services will become more advanced but the billing will not change.
Staal, M. Sportsplaza (Infostrada).	Sportsplaza expects that advertisement models will become important. Subscription based models are frequently used. PRSMS billing is not preferred and this method must change.
T-Mobile	T-mobile will specifically target the billing relation with the client and the faciliation of access and network traffic. Especially the collections is what T-mobile is good at and the expectation is that other parties will not be able to handle this. T-mobile will stop offering content on-portal.
Van den Bulk, R. 2WayTraffic	Subscription based models for content services have the future as event based selling of content, especially due to marketing costs is hardly viable. For mass-marketing only off-portal is interesting as on-portal would introduce too much complexity.
Wennerkers, N. and Theunissen, R. Orange	Content (WAP) billing will be introduced off-portal The billing relation will remain at Orange, the operator simply has too much control Advertisement models will become more important on the mobile channel Free services will be most succesfull The diversity in MVNOs will grow and MVNEs will enter the market

Interview	*MNO centric*	*Content aggregator centric*	*Content provider centric*	*BCP centric*	*ISP centric*
Bergkamp, L. InfoSpace.	WAP billing will eventually replace PRSMS billing. On-portal content provisioning will disappear.	Current mobile content aggregators will not obtain a customer relation; this is not their role and is not what they are good at. They will remain B2B.	Content providers can only become centric if they have an existing billing relation.	Banks and current payment methods will have in increasingly important role but the penetration remains rather low. This is a CSF. Especially the large Internet actors will deploy micropayment (e.g. Google, Microsoft, Yahoo!)	ISPs have legacy in place that would enable them to charge the end-user with micro-payments. However, wholesale services of billing capabilities at ISPs are currently not visible.
De Buck, M. Vodafone	Vodafone already offers WAP billing off-portal in which it is unique. WAP billing will eventually dominate operator billing methods. WAP billing will be offered by current SMS serivce providers.	The current kick-back of mobile service provisioning is not satisfying which may be a reason to deploy billing functionalities by other actors.	Content providers could exploit their current relation (add additional value) and hence surpass the operator's billing functionality.	Actors who currently specialize in financial transactions will be interested in the BCP role.	N/A
	Other payment methods can always proliferate (e.g. credit card, Ideal) but usability will remain low compared to the WAP billing solution. Furthermore, a secure means to establish the identity will be difficult to attain in alternative models.				
Egberts, P. and Vlasblom, A. Netsize	Will be an entirley off-portal model where the operator portal will remain first point of contact with e.g. a search engine.	A content aggregator centric model based on current mobile aggregators is highly unlikely.	N/A	Also when using specialized payment providers content providers must obtain their own customer data.	A mechanisms such as mPayment (WAP billing) could apply in this model when it is linked to a billing system of fixed ISPs.
Haanstra, R. Wallie	Operators will eventually loose the billing relation. This is similar to what happened on the regular Internet.	N/A	Content providers can use a service such as Wallie to build a relation, but there always remains ambiguity in the data as this data is not related to a payment relation	Actors such as Paypal could become competitors in micro payment but are currently focussed on payment of larger sums. The fact that they require credit cards decreases their kick-back.	In France an ISP centric model is currently in use. However, similar to the regular Internet channel, this will vaporize.
Hania, S. XS4All	Eventuall flat fee will become the future and services will be billed on the basis of subscriptions additional to subscriptions for flat fee data usage.				Offering of personal services on many access channels; multiplay services. Use of an MVNE to enable billing is currently practiced

Interview	*MNO centric*	*Content aggregator centric*	*Content provider centric*	*BCP centric*	*ISP centric*
Hermans, F. Ericsson	The IMS will enable real-time billing and further enable qos differentiation.	Many different models will coexist. Accounts could also be linked to a bank account for which the MVNO or operator requires a banking license.			
Meijering, H. Scarlet	N/A				
Pauala, A. and Copius Peereboom, P. Hyperleap	The operator portals will vaporize	The content aggregator model is considered most likely, aided by an independent payment provider such as a bank	Content provider centricity will be based on advertisement.	The content aggregator model is considered most likely, aided by an independent payment provider such as a bank	N/A
SMS Service provider	The content market will not change drastically in terms of billing in the years to come. PRSMS will remain in usage. Although more advanced services will be deployed, the				
Staal, M. Sportsplaza (Infostrada).	On-portal content provisioning will vaporize.	N/A	Sportsplaza will not implement its own billing functionalities but rather cooperate with other actors.	It is not unlikely that Sportsplaza will on the longer term cooperate with for example Minitix (Rabobank).	N/A
T-Mobile	T-mobile will specifically target the billing relation. Although content provisioning will not be one of their assets, billing will remain at T-mobile.				
Van den Bulk, R. 2WayTraffic	Subscription based models for content have the future. The operator centric model suffices.				
Wennerkers, N. and Theunissen, R. Orange	The operator will remain central in the value network. The control is simply too high. Models other than the operator-centric model will predominantly be based on advertisement as it are especially the free services that proliferate here.				

Appendix 9 IDEF-0 analysis of billing processes

In this appendix the process analyses in the interpretation of the role division archetypes by means of IDEF-0 diagrams are provided. Below the different models and their explanations are shown.

Content aggregator centric model

We illustrate the billing process in this scenario in Figure A 7. The first step (see A1) in the process is the processing of a service or content request of the user on the aggregator platform by the user. This step is nearly identical in every model. Based on the intelligence in the platform of the aggregator, the device and operating platform of the user are identified, which can also include context and location information (e.g. through GPS, triangulation or NFC) to which the content service is adapted. Hence this does not require any further optimization of the MNO.

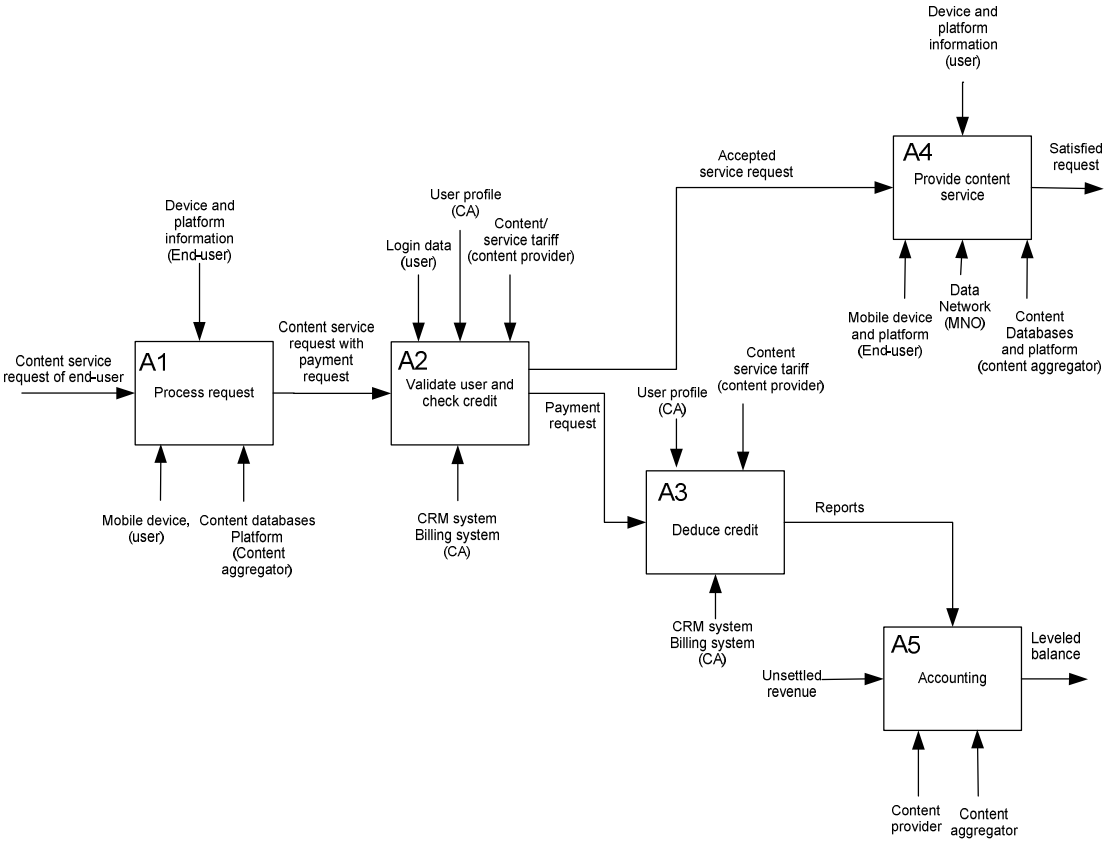


Figure A 7 IDEF-0 decomposition of Content aggregator centric model

Subsequently at A2 the user is forwarded to the payment platform which is also located at the aggregator. Here the user is validated on his identity through his account at the aggregator. Based on the information received from the operator, this can be through several mechanisms. First, when the operator is paid to provide the identity, it can immediately be established and no additional mechanisms need to be in place. Second, the identity can be established based on the intelligence in the device. Especially actors such as Nokia but also Apple control the device and can enable authentication here (Interviews: Haanstra, 2007; Bergkamp, 2007). In the case of Apple the online identity is directly related to the device. Third, the identity can be requested or confirmed (in case for example stronger security mechanisms are required) through a login which can be strong or short, depending on the information available. After the identity is established the credits are checked.

When accepted the credit required for the service or content is deduced from the user account at A3 and the service can be provided at A4. All these activities remain at the same platform making it rather easy to link these activities. Finally, after this deduction it is reported in the systems of the aggregator. At A5 the content provider(s) relevant in the provision of this service are compensated based on the tariffs they pre-communicated. Evidently a similar problem to the currently used PRSMS and WAP billing models is the fact that this reporting is entirely based on self-reporting.

Content provider – MVNO centric model

Due to the fact that the differences primarily reside in the control of technology and information and not the activities or their sequence, we only provide the IDEF-0 model which is shown in Figure A 8. We describe it below.

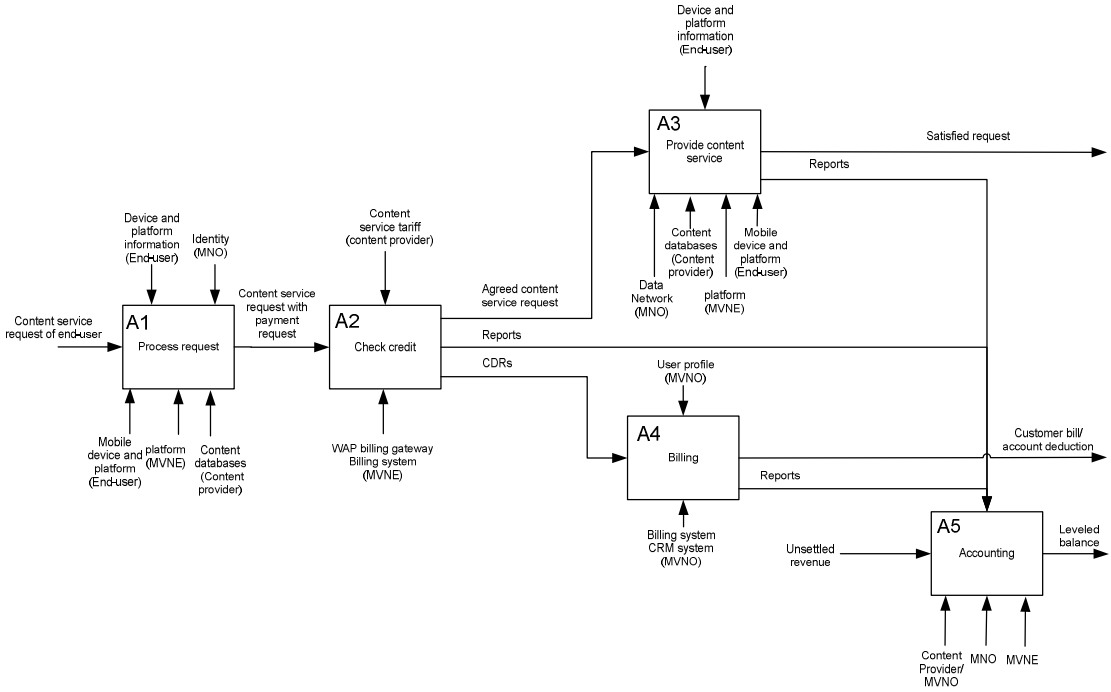


Figure A 8 IDEF-0 decomposition of Content provider/ MVNO centric model

This process starts with the selection of content on the content provider's databases, supported or hosted by the MVNE's platform. Based on the information of the user device the platform enables content consumption. The identity (phone number) of the user is received here from the operator. When the user has accepted payment of the content a payment request is made to the WAP billing gateway and billing system of the MVNE.

Based on the ID of the user received earlier and the tariff of the content service set by the content provider, the payment is accepted by the MVNE. Subsequently the port is opened and the user can obtain the content. The CDRs generated by the MVNE on the basis of the phone number are sent to the MVNO that places these on the bill of the customer. Finally the reports generated throughout the several process activities are accounted by the content provider/ MVNO. Here the MNO is paid for the capacity usage, and providing the user ID and the MVNE for the platform and charging and possible hosting services.

Payment provider centric model

In our discussion of the billing processes in this model we select the model as shown in Figure A 9 in which aggregation of the payments methods is based on a payment aggregator but the customer relation strictly lies at the specific payment provider.

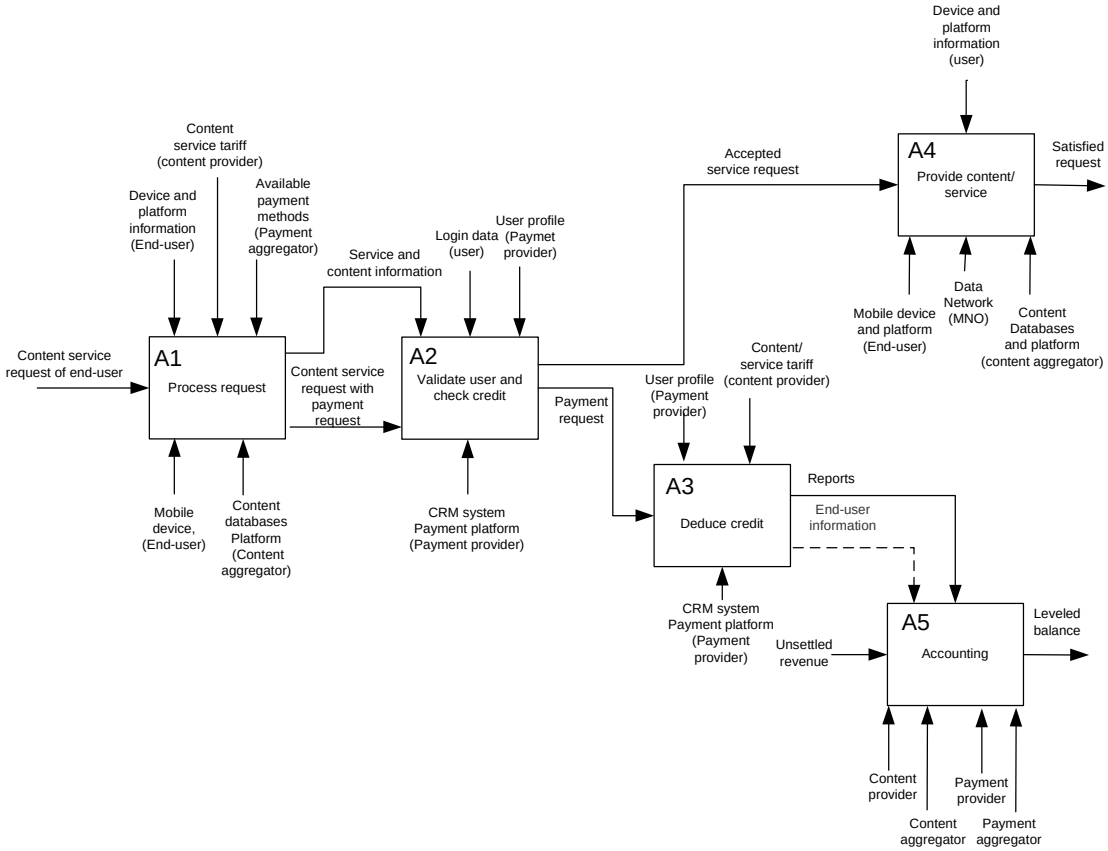


Figure A 9 IDEF-0 decomposition of billing processes in billing aggregator centric model

Clearly this model closely resembles the content aggregator centric model. However, important differences can be noted. First, the CRM system and Billing system are not part of the aggregator that strictly hosts content. When the user requests for premium content services he is provided with several payment methods. Based on the selected method he is either diverted to another platform. Subsequently this is where the validity of the end-user identity is checked.

Second, due to the fact that the payment and hosting is not handled by the same actor, information must be communicated on the service between the payment provider and the content aggregator. The payment provider must know what to charge.

Third, although the payment provider handles the user account, also information can be communicated to the content provider. Whereas this is evidently not the case with pure pre-paid methods where the payment provider does not have this data, it is common for credit card related methods to provide customer information to the content provider (see for example Paypal mobile checkout in chapter 5). However, this provision of information in entirely controlled by the payment provider and it remains to be seen what information on the end-user is actually provided (Interview: Egberts and Vlasblom, 2007). Hence, this type of model enables content providers to build their own customer relation without having direct billing contact. The data received from the payment provider is related to the billing relation ensuring it validity.

ISP centric archetype

In this paragraph we illustrate our interpretation of the billing processes in the ISP centric model, shown in Figure A 10.

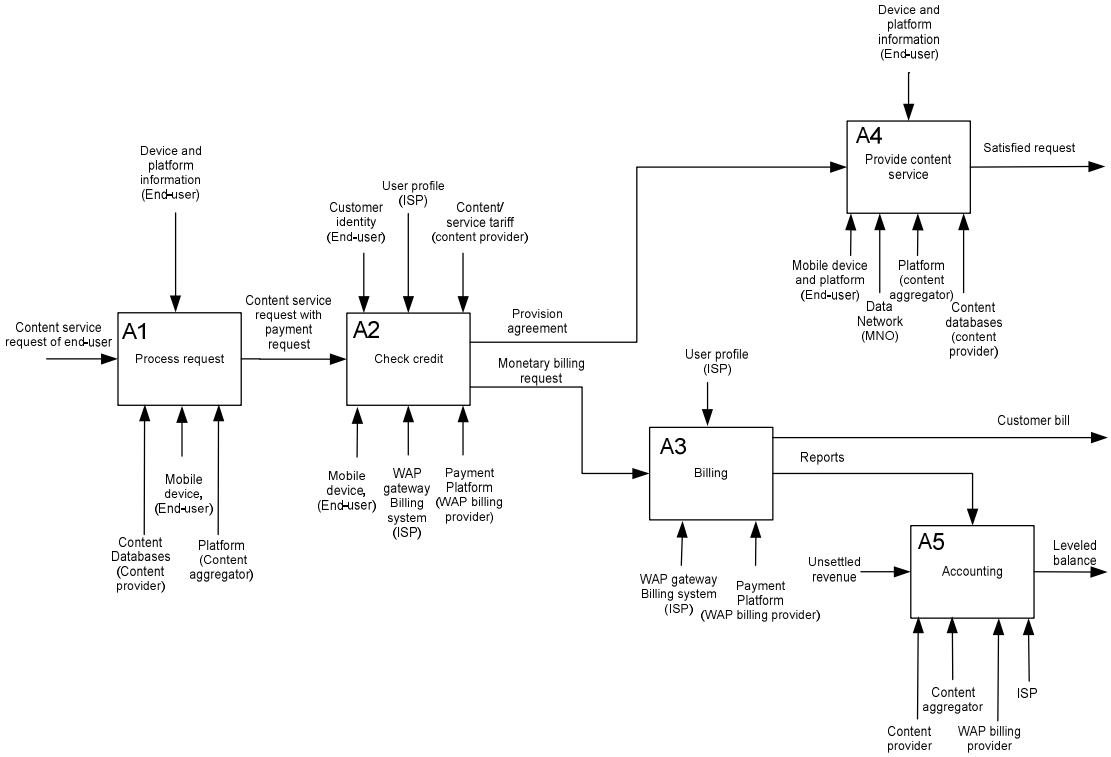


Figure A 10 IDEF-0 decomposition of the billing processes in the ISP centric model

The first step in this process is the selection of content by the end user which is subsequently processed at the platform of the content aggregator. Based on the capabilities of the device and the type of content selected, the request is made for payment using the ISP subscription of the user at A1. Subsequently the credit of the account at the ISP account is checked through the WAP billing gateway in the ISP billing system. The required identity of the user is established based on his device and the price of the content is based on the tariff scheme provided by the content provider, present at the aggregator. If the user can use his ISP account to bill for the content, two requests are made. The first is the request to the billing system to place the content purchase on the customer's monthly bill which is performed at A3. The second is the agreement that the service can be provided. This is received at A4 at the platform of the content aggregator where the port to the content provider's services or content is opened and the end-user can obtain the content service. Finally at A5 the accounting takes place. Here the ISP settles the revenue of the end-user with the content aggregator who compensates the content provider and (if not part of his own portfolio) the WAP billing provider.

Abbreviations

3GPP	3 Generation Partnership Project
AAC	Authentication, Authorisation, Credit Reservation
API	Application Program Interface
ARPU	Average Revenu Per User
ASP	Application and Service Provider
AUC	Authentication Centre
BCP	Billing and Collections Provider
BPA	Business Process Analysis
BPM	Business Process Modelling/ Management
BPR	Business Process Redesign/ Reengineering
BSC	Base Station Controller
BSG clearing	Billing Services Group Clearing
BSS	Base Station Subsystem
BTS	Base Transceiver Station
CBS	Centraal Bureau voor de Statistiek
CCF	Charging Collection Functionality
CDR	Charging Data Record
CEO	Chief Executive Officer
CGF	Charging Gateway Function
CID	Charging Identifier
COIN	COmmunications INfrastructure
CPM	Cost Per Mile
CRM	Customer Resource Management
DSL	Digital Subscriber Line
eTom	enhanced Telecom Operations Map
FTD	Full Track Downloads
GDR	Group Decision Room
GGSN	gateway GPRS support node
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile communication
HLR	Home Location Register
HTML	Hypertext Markup Language
IBM	International Business Machines Corporation
IDEF-0	Integration DEFinition language 0
IETF	Internet Engineering Task Force
IM	Instant Messaging
IMEI	International Mobile Equipment Identity
IMS	IP Multimedia Subsystem
IP	Internet Protocol
ISDN	Integrated Service Digital Network
ISP	Internet Service Provider
IT	Information Technology
ITU	International Telecommunications Union
KPMG	Klynveld Peat Marwick Goerdeler
KPN	Koninklijke PTT Nederland NV
MNO	Mobile Network Operator
MO	Mobile Originated
MSC	Mobile services Switching Center
MT	Mobile Terminated
MVNE	Mobile Virtual Network Enabler
MVNO	Mobile Virtual Network Operator
MWS	Mobile Web Service
NFC	Near Field Communication
OMA	Open Mobile Alliance
OMI	Open Mobiel Internet initiatief
PC	Personal Computer
P-CSCF	Proxy Call Session Control Function
PDA	Personal Digital Assistant
PIN	Personal Identification Number
PRSMS	Premium Rate Short Message Service
PSTN	Public Switched Telephony Network
Qos	Quality of Service
RAN	Radio Access Network
RBV	Resource Based View
RDT	Resource Dependency Theory
RID	Role Interaction Diagram
RNC	Radio Network Subsystem
S-CSCF	Serving Call Session Control Function
SGSN	serving GPRS support node
SIM	Subscriber Identity Module
SIP	Session Initiation Protocol
SME	Short message Entity
SMS	Short Message Service
SMSC	Short Message Service Centre
SSL	Secure Socket Layer
TAP	Transferred Account Procedure
TCE	Transaction Cost Economics
TPM	Technology Policy and Management
UMA	Unlicensed Mobile Access
UML	Unified Modelling Language
UMTS	Universal Mobile Telecommunications System
UPC	United Philips Communications
USIM	Universal Subscriber Identity Module
VAS	Value Addes Service
VASP	Value Addes Service Provider
VLR	Visitor Locatoin Register
VOIP	Voice Over IP
WAP	Wireless Application Protocol
WCA	Work Centred Analysis
W-CDMA	Wideband Code Division Multiple Access
Wifi	Wireless Fidelity
Wimax	Worldwide Interoperability for Microwave Access
WLAN	Wireless Local Area Network
WWW	WorldWide Web
XML	eXtensible Markup Language
xVNO	Virtual Network Operator (on any access network)