SNF REPORT NO. 02/07

Structural conditions, business models and customer value in heterogeneous network services – A pre-study of five service areas

by

Per E. Pedersen, Leif B. Methlie, Herbjørn Nysveen, Irena Gjerde, Helge Godø, Anders Henten, Rich Ling, Vladimir Oleshchuk and Frank Reichert

SNF Project No. 6255: "Debussy – Designing Business Models for Customer Value in Heterogeneous Network Services"

The project is funded by the Research Council of Norway

INSTITUTE FOR RESEARCH IN ECONOMICS AND BUSINESS ADMINISTRATION
BERGEN, APRIL 2007

ISBN 978-82-491-0502-1 Print version
ISBN 978-82-491-0503-8 Online version
ISSN 0803-4036

PREFACE

This report presents the results of a pre-study of five service areas characterized by heterogeneous network services. The purpose of the report is to provide a basis for deeper analysis of three selected service areas. The report is written as a deliverable of the SNF-project 6255, Debussy – "Designing Business Models for Customer Value in Heterogeneous Network Services". The report is a joint effort of the authors and valuable inputs have been provided by the project industry partners being Telenor ASA, Teleca, Agder Energi and the Norwegian Post and Telecommunications Authority.

Bergen, Grimstad, København, Oslo, April 2007

Per E. Pedersen, Leif B. Methlie, Herbjørn Nysveen, Irena Gjerde, Helge Godø, Anders Henten, Rich Ling, Vladimir Oleshchuk and Frank Reichert

CONTENTS

ABSTRACT

Next generation networks are expected to utilize a wide range of current and future heterogeneous networks and provide end-users with seamless services across these networks. Technological developments to realize this scenario is under way, but unresolved technological issues still exist. In addition, it is likely that non-technological structural conditions, such as market positions and regulatory policy, as well as established business strategic and customer behaviour will represent obstacles on the way to convergence of previously heterogeneous network services in an "All-IP dream-world" scenario. On our way to this scenario, business models must and will be designed that adapt to and influence the future development trajectory of heterogeneous network services.

This report presents a structure-conduct-performance (SCP) framework that may be used to study what influences business model innovation in heterogeneous network services. The framework is used as a basis for investigating five heterogeneous network services: Corporate VoIP, mobile VoIP, mobile broadband, multi play services and M2M communication services. The report takes the form of a pre-study that partly discusses modifications to the proposed SCP framework and partly identifies sources of heterogeneity problems and opportunities in the five service areas. The report concludes that all five service areas are interest in further studies of heterogeneous network services, but mobile VoIP, multi play and specific M2M communication services are most interesting. These three service areas accentuate different problems of heterogeneity located partly in technology, market positions, regulatory policy, business strategic behaviour and customer behaviour, and the report recommends conducting empirical studies of specific research problems for each service area.

LIST OF ABBREVIATIONS

3G	-	Third-generation Technology
3GPP	-	3rd Generation Partnership Project
4G	-	Fourth-generation Technology
ALG	-	Application Layer Gateway
ARPU	-	Average Revenue Per User
AMR	-	Automated Meter Reading
B3G	-	Beyond Third-generation Technology
CIP	-	Common Industrial Protocol
CPA	-	Content Provider Access
CRM	-	Customer Relationship Management
DECT	-	Digital Enhanced Cordless Telecommunications
DSL	-	Digital Subscriber Line
DSRC	-	Dedicated Short Range Communications
DVB-H	-	Digital Video Broadcasting - Handheld
EAP	-	Extensible Authentication Protocol
EDGE	-	Enhanced Data rates for Global Evolution
EIB	-	European Installation Bus
EPG	-	Electronic Program Guide
ETSI	-	European Telecommunications Standards Institute
FCC	-	Federal Communications Commission
FMC	-	Fixed-Mobile Convergence
FTTH	-	Fiber To The Home
GPRS	-	General Packet Radio Service
GAN	-	Generic Access Network
GPS	-	Global Positioning System
GSM	-	Global System for Mobile Communications
HSDPA	-	High Speed Downlink Packet Access
HTML	-	HyperText Markup Language
HTTP	-	Hypertext Transfer Protocol
IAX	-	Inter-Asterisk eXchange
ICT	-	Information and Communication Technology
IETF	-	Internet Engineering Task Force
IMS	-	IP Multimedia Subsystem
IP	-	Internet Protocol
IPTV	-	Internet Protocol Television
IRAP	-	International Roaming Access Protocols
J2EE	-	Java 2 Platform, Enterprise Edition
KNX	-	Konnex.org standard for Home/Building Connectivity

LAN	-	Local Area Network
LON	-	An Echelon Automation Systems Architecture
LTE	-	Long Term Evolution
M2M	-	Machine to Machine
M2MXML	-	XML based protocol for Machine-To-Machine communications
MMS	-	Multimedia Messaging Service
MVNO	-	Mobile Virtual Network Operator
NAT	-	Network Address Translation
NES	-	Networked Energy Services
NGN	-	Next Generation Networks/Networking
NPT	-	Norwegian Post and Telecommunications Authority
NTV	-	Norges Televisjon
ODVA	-	Open DeviceNet Vendor Association
OPC	-	OLE for Process Control
OTA	-	Over-The-Air
PBX	-	Private Branch eXchange
PDA	-	Personal Digital Assistant
PSTN	-	Public Switched Telephone Network
QoS	-	Quality of Service
RAN	-	Radio Access Network
RFC	-	Request for Comments
RFID	-	Radio Frequency Identification
SCP	-	Structure Conduct Performance
SER	-	SIP Express Router
SIA	-	Securities Industry Association
SIM	-	Subscriber Identity Module
SIP	-	Session Initiation Protocol
SMS	-	Short Message Service
SONA	-	Service Oriented Network Architecture
STUN	-	Simple Traversal of UDP through NATs
TISPAN	-	Telecoms & Internet Converged Services & Protocols for Advanced Networks
UDP	-	User Datagram Protocol
UMA	-	Unlicensed Mobile Access
UMTS	-	Universal Mobile Telecommunications System
URL	-	Uniform Resource Locator
VCC	-	Voice Call Continuity
VoIP	-	Voice over IP
VPN	-	Virtual Private Network
WAN	-	Wide area network

WLAN	-	Wireless LAN
WiFi	-	WLAN Technology based on IEEE 802.11
WiMAX	-	Worldwide Interoperability for Microwave Access
WPA	-	Wi-Fi Protected Access
WSN	-	Wireless Sensor Network
XMPP	-	Extensible Messaging and Presence Protocol
XML	-	Extensible Markup Language

1 INTRODUCTION

Third generation mobile networks (3G) are expected to represent the last generation of homogeneous networks for providing services based on wireless network access (Ballon, 2004). Next generation networks (often termed NGN, 4G or B3G – beyond 3G) are expected to utilize a wide range of current and future heterogeneous access networks and provide end-users with seamless services across these networks (e.g. Tachikawa, 2003, Hui and Young, 2003). Technological research conducted to fulfil this vision has been intense, and it is expected to continue growing for the next years (Houssos, Gazis and Alonistioti, 2004, see also Lu, Walke and Shen, 2004).

1.1 Background

Heterogeneity generally means something is composed of different components instead of similar components. Thus, a heterogeneous network connects different components and allows interoperability of these components. Interoperability, however, may be obtained by bridging differences or by creating homogeneity of components. By using the term heterogeneous network we mean to imply that components remain different, while interoperability is obtained by diverse forms of bridging. Interoperability is also a more general term used to describe connections among people, data and diverse systems, whereas heterogeneity is used to describe retain the focus on technological differences as the source of heterogeneity. The most traditional source of heterogeneity is heterogeneous access networks. For mobile VoIP, for example, the situation is characterized by an existing infrastructure of cellular access networks being challenged by service provisioning over a new access network, typically WiFi-networks. This situation creates uncertainty among traditional providers of cellular based services and new opportunities for greenfield providers utilizing the alternative access network.

When seen from the end-user perspective, seamless integration across access networks is preferred. The example also illustrates two other important issues of heterogeneity. First, it illustrates how networks providing become capable of providing the same services, a situation typically described as network convergence. While convergence describes a development, heterogeneity is used to describe a state on the way to convergence. Second, it illustrates how the state of heterogeneity creates uncertainty in the structural conditions of established providers and creates opportunities for new players and providers. Heterogeneous networks are, however, not limited to access networks only. Sources of heterogeneity may be found in core, backbone, service and application networks. Heterogeneity in service and application networks often reflects differences in business strategic components of the network. While seamlessness and complete interoperability are often believed to be preferred by end-users, well established end-user habits associated with services distributed over specific access and service networks represent behavioural inertia on the way to convergence of the same kind as those of heterogeneity described above.

Business model research on heterogeneous access networks is scarce and focuses seamless services across *existing network infrastructures*, such as GPRS, UMTS and WiFi (Koutsopoulou et al., 2004, Eskedal et al., 2003). As the number of access networks are expected to increase with new wireless networks (e.g. WiMAX, DVB-H) and convergence of fixed and wireless access networks (FMC) will continue, the business models required to develop, provide and collect revenue from services provided by these networks will become more complex. Furthermore, an increase is expected in the number of ad-hoc networks (e.g. short range wireless P2P-networks, DSRC-networks) and sensor networks (e.g. environmental monitoring networks). These technological developments increase

the complexity of service innovations, and business models of the service providers must accommodate for this complexity. Thus, the business models must support not only revenue decisions, but also the organization of resources and capabilities for effective service *innovations* in heterogeneous network environments.

The term *business model* has gained considerable popularity recent years. Osterwalder et al. (2005b) show how the number of publications using the term correlates with NASDAQ fluctuations. This indicates that it has developed as a term used to describe how business is conducted in technology intensive sectors like ICT and telecommunications, and in particular in Internet-based firms of this sector. The term is relevant at three different levels – at the ontological level, at the typology level and at the instance level (Osterwalder et al., 2005b). At the ontological level, the business model concept is defined and its components and dimensions described. These dimensions are not randomly combined to form myriads of business models but are believed to be combined to form specific types of business models. Typologies categorizing these types are developed at the theory level. Finally, typologies are not only theoretically derived but are expected to reflect empirically observable instances of business models. In the popular literature, these examples are what are most often associated with the term business model – such as the Amazon model or the eBay model.

While business model components are defined at the ontological level, typologies are created at the theory level and examples of successful and less successful business models may be observed at the empirical level, surprisingly little empirical research has been conducted on what determines the design of business models of particular types and what effects business model decisions have. Thus, the business model literature is mainly descriptive in its attempts to categorize

business models and is practicing a form of normative "design science" suggesting how business models should be designed without actually having any empirical basis for these normative recommendations. Business model decisions will always have to be made by provider management. Research, however, may provide theoretical and empirically supported knowledge for these decisions by considering: a) the relationships between structural conditions and business model options, b) the dimensions and relationships between dimensions of business model types, and c) the effects of business model decisions on outcome related measures, such as customer value and innovation intensity. In this report, these business model issues are discussed for five different service areas believed to be characterized by the heterogeneity of the networks used to develop, distribute and consume these services.

1.2 Debussy - A Research Project

On this background a research project has been established. The objective of this project is to develop, validate and disseminate business models that will capture the potential business values of technological innovations in dynamic, wireless environments characterized by heterogeneous network infrastructures. From this main objective a set of operational goals has been developed where we aim to:

1. Develop a framework for collecting, analyzing and validating empirical knowledge of business model dimensions relevant to value creation in heterogeneous network infrastructures.
2. Increase the knowledge of all market players influencing or participating in future value chains of heterogeneous fixed and wireless services about the conditions and business model options for achieving customer value, and thus, attain successful adoption of these services.

3. Produce applicable and publishable results for dissemination by scientific publications, seminars, workshops and industry presentations covering theoretical, empirical and methodological results.

The results from this research may be used by operators, service providers and regulatory authorities to understand the market requirements for successful adoption of future services provided over heterogeneous networks. It will be of particular relevance to service providers offering cross media services or service providers attempting to offer their services internationally, under different regulatory regimes and market situations.

Network operators may have several motives for providing open interfaces to their networks. One is to increase traffic and thus revenues by allowing service providers to enrich their services with communication services. Another is to utilize the traffic and content charging mechanisms that are well established in telecommunications networks. It is, however, not obvious that service developers, service providers and access providers traditionally offering their services through a homogeneous network, will adopt these development and distribution platforms. Business strategic and behavioural problems may represent limitations to the value potential of providing seamless services across heterogeneous networks.

A four years research project has been organized consisting of a research consortium with researchers from the Norwegian School of Economics and Business Administration (NHH), Agder University College (AUC), NIFUSTEP, Telenor R&I and the Technical University of Denmark (DTU) and industry partners from Telenor, Teleca, Agder Energi and Norwegian Post and Telecommunication Authority.

1.3 A pre-study of service areas

The first activity undertaken in this project is a pre-study. The aim of the pre-study is to make a grounded selection of service areas for subsequent in depth empirical service analyses. The pre-study service areas are chosen on the basis of responses from the research consortium and the industry partners. The criteria for this selection are that they are relevant to partners, are sufficiently commercialized in the form that they are open to empirical investigation, and also show some variation in relevant determinants of optimal structural conditions, business models and in relevant service attributes.

At a workshop in September 2006, the pre-study work plan was presented to research and industry partners. All partners were invited to suggest relevant service areas for treatment in the pre-study. By the deadline of October 20, suggestions had been submitted for eight service areas including corporate VoIP, mobile VoIP, mobile broadband, multi play services, M2M communication services, mobile broadcast, personal area network services and mobile payment services. Discussions were held with industry partner representatives and researchers to reduce the number of service areas to five. Personal area network services, mobile payment services and mobile broadcast were of less relevance to industry partners and were excluded.

A pre-study requirement specification enclosed in Appendix A was written by the project management and sent out to all partners by October 31 with a deadline for deliverables set to December, 15. By December 22, all deliverables were received by the project management integrated in a pre-study report. A preliminary version

of the pre-study report was discussed and revised in a workshop on February 22, 2007 resulting in the published pre-study report presented here.

1.4 Report organization

The remaining report is organized in seven main sections. Section 2 presents the research framework applied and the method used to apply this framework to the five service areas being studied. The five areas are discussed with a brief presentation of the service area and a discussion of structure related, business model related and customer behaviour related issues of particular interest to each of the service areas. In the final section, differences between the service areas are discussed along with conclusions of relevance to modifications in our research framework as well as general conclusions on the relevance of each service area as an empirical context for investigating heterogeneity problems.

2 RESEARCH FRAMEWORK AND METHODOLOGY

To study business model related issues, a multidisciplinary approach unifying methods drawn from engineering disciplines and social science disciplines needs to be developed and applied. The level of analysis will be the service, service category or service platform. Relevant services or service categories must, however, first be identified. Existing services likely to be extended into a heterogeneous access network infrastructure must be identified using industry expertise and secondary data sources. New and innovative future services must be identified applying foresight methods. Once identified, two of the most important structural conditions of the service, market related and technology related conditions, may be investigated empirically using secondary data sources. The relationships between business model options and value drivers, and between business model options and resource and cost drivers may be investigated using primary data at the firm or value network level. Furthermore, the relationship between value drivers and customer value may be investigated using primary data at the customer level. These investigations collectively comprise a "*service analysis*", which is our main methodological research approach. The service areas included in these service analyses must, however, first be identified. The main purpose of this pre-study report is to discuss the potential of five service areas as candidates for service analysis and to discuss how an SCP-based research framework may be applied to these service analyses.

An SCP-based research framework has previously been applied in a series of studies of mobile services by researchers involved in the work reported here (e.g. Nysveen, Pedersen and Thorbjørnsen, 2005, Methlie and Gressgård, 2006). This framework is theoretically anchored in the field of industrial organization and the well-tested "structure-conduct-performance paradigm" (Bain 1951, Kadiyali,

Sudhir and Rao, 2001). By applying this framework to the context of heterogeneous networks, models of the relationships between structural market conditions, business models (business conduct) and customer value that are theoretically well founded and supported by *empirical* research can be developed. In the following section, a brief presentation of the framework is given.

2.1 Research framework

In a SCP- framework, business model decisions are made under the considerations of current structural conditions and the creation of customer value. Thus, business model decisions are the operationalization of the "conduct" part of the SCP-framework, and as such they are similar to, and aligned with, strategic decisions. The term business model, however, is used to focus other issues than those traditionally focused in strategy and it also extends beyond considerations typically made during strategy processes. Only business model dimensions under the influence of management are, however, included as relevant. While terms like demand models and industry models are important to business modeling, they are not components of a business model when seen from a SCP-perspective. Considerations of demand fluctuations and assumptions made of demand curves or current industry regulations must be included when designing business models, but such issues are not dimensions of a business model per se.

The SCP framework may be further split into operational models to be used as research models, analytical frameworks and empirically testable models. The conceptual SCP framework is illustrated in figure 2.1.

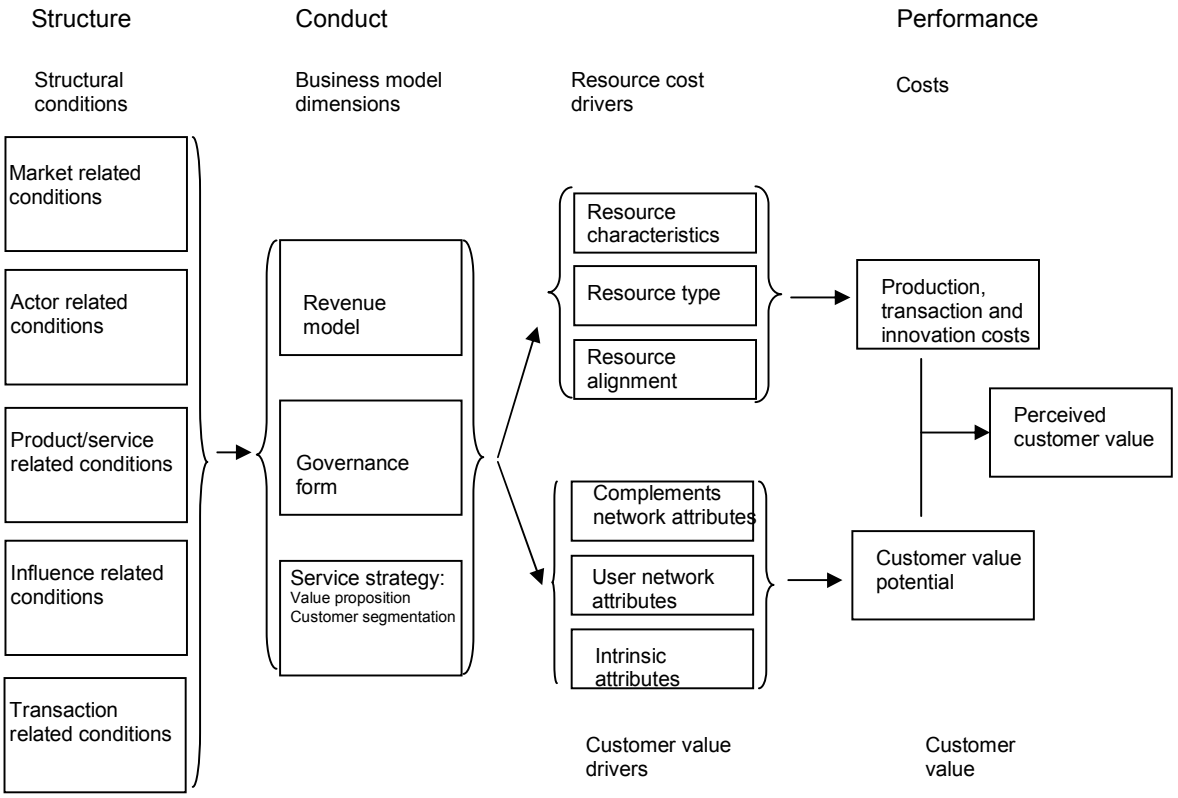


Figure 2.1 General SCP framework in a business model context

2.1.1 The SCP components

This SCP framework has three main components: structure – conduct - performance. Authors have discussed how structural conditions influence and limit the behavioural conduct of service providers in mobile services markets. For example, Henten et al. (2004) suggested technology, economy, market development and structure, marketing, socio-cultural, policy intervention and regulation as being among these structural factors. Others have looked at the long term dynamics of industry ecosystems in the network service market (Vesa, 2003). Furthermore, others have focused mainly on different forms of regimes facilitating or inhibiting specific behaviour by service developers and providers. For example, Godø (2000) suggested the innovation regime of a nation or sector is a structural determinant of the behaviour that is likely to be exercised by service developers

and providers. Hommen (2003, p. 153) suggested that in the future, regulatory structure and technological development will favour equipment suppliers and service providers to the detriment of "conventional" telecom operators. Another example is Funk (2004), who suggested that regimes in the form of "technological trajectories" of a sector or nation may facilitate or inhibit particular business models. Finally, regulatory regimes, such as licensing policy (Ure, 2003) or interworking requirements (Hagen and Nafstad, 2003; Northstream, 2002) have been suggested as important conditions for stimulating or inhibiting particular business models.

In our framework, *structural conditions* include market related, actor related, product/service related, influence related and transaction related structural conditions. This categorization was first developed by Methlie and Pedersen (2002, and later applied to a study of mobile services by Methlie and Gressgård (2006). These structural conditions are assumed to restrict business model options. *Business model options* are illustrated in figure 2.1 by three dimensions. The choice of specific business model options made by providers may be considered a strategic choice to obtain competitive advantage. Competitive advantage can be obtained by cost leadership or by creating service attributes that differentiate a provider from other providers. Thus, it is likely that the choice of business model options are reflected in the intrinsic and extrinsic service attributes of the services offered. As shown by Brousseau and Quelin (1996), communication services benefit from network size, and it is well known that the roaming and interconnect agreements among providers are made to increase network size and take advantage of the direct network effects valued by end-users of these services. For services characterized by indirect network effects, vertical forms of governance may be of more interest than horizontal forms like roaming agreements.

The revenue model options cover the financial dimension and the governance form options cover the infrastructural dimension of the business model. Service strategy options cover the value proposition and customer relationship dimension of the business model. The choices of particular business model options represent the "conduct" component of the SCP-paradigm.

Business model choices are believed to have *performance effects*. In the SCP framework of figure 2.1, we focus cost efficiency and customer value as the relevant performance components. To model the causal relationship between business model decisions and performance, two types of theories have been applied. The causal relationship between business model decisions and customer value is modelled combining theory of the economics of network goods and consumer behaviour theory. As discussed above, the main drivers of value are believed to be of either intrinsic or extrinsic kind. Intrinsic value drivers stem from the inherent attributes of the mobile data service itself whereas extrinsic value drivers stem from attributes of the network of users and complementary services offered. As shown above, network based value drivers, represented by user and complements network attributes are of great importance for mobile services.

In a SCP-framework, structure may affect conduct of different kinds and conduct may affect performance of different kinds. Examples of performance types are financial results and customer value. Each SCP-model defines its particular performance dimensions.

2.1.2 The SCP relationships

Each SCP-model includes one or more causal relationships between structure and conduct, and between conduct and performance. Structure – conduct relationships may be based on theories such as diffusion of innovations theory, path dependency theory or resource dependency theory, just to mention a few relevant theories. Conduct – performance model relationships may be based on theories such as transaction cost theory, resource based theory or strategic marketing theory, or a combination of several theories. Thus, SCP models represent a conceptual framework for applying more specific operational models to particular markets.

How business model options affects service attributes

Popular uses of the business model concept involves "how you get paid" or "how you make money" (Chesbrough and Rosenbloom, 2002). The idea is that the business model concept is required because the way "business is done" is different from before, and concepts like "strategy" do not sufficiently capture these new forms of business. This change is believed to be particularly profound for networked services. More scholarly writers have applied definitions, such as "*how the firm plans to make money long-term using the Internet*" (Afuah and Tucci, 2000), stressing that the "new economy" or "the Internet" is what requires "new forms of doing business". More academic approaches stress the difficulty in defining the business models concept without referring to a number of underlying dimensions (Chesbrough and Rosenbloom, 2002). One of the early attempts at defining the concept was Timmer's (1998) suggestion that a "*business model is defined as the organization (or architecture) of product, service and information flows, and the sources of revenues and benefits for suppliers and customers*" (p. 31). Similarly, Weill and Vitale suggest that a business model is the "*description of the roles and relationships among a firm's consumers, customers, allies and*

suppliers that identifies the major flows of products, information and money, and the major benefits to participants" (Weill & Vitale, 2001, p. 34). In a recent review of the business model literature, Osterwalder et al. (2005a, p. 17-18) suggest a business model "*is a conceptual tool that contains a set of elements and their relationships and allows expressing the business logic of a specific firm. It is a definition of the value a company offers to one or several segments of customers and of the architecture of the firm and its network of partners for creating, marketing, and delivering this value and relationship capital, to generate profitable and sustainable revenue streams*". As Osterwalder et al. (2005b) we find the business model concept as a tool or framework most interesting.

Recently, several authors have applied the business model concept to telecommunication services (Campanovo and Pigneur, 2003; Bouwman, 2003; Osterwalder et al., 2005b). With some variations in propositions, these authors mainly suggest four dimensions of business models; the product innovation, the customer relationship, the infrastructure and the financial dimensions, covering the product related value proposition, the customer related value proposition, the structural dimension and the revenue dimension, respectively (e.g. Campanovo and Pigneur, 2003). The business model dimensions discussed in this report correspond to the dimensions suggested in these studies. We are, however, more interested in the relationship between business model dimensions and between business model dimensions and performance. Using a three dimensional framework for business models, some examples of interdependencies may be given. For example, revenue models and governance forms are highly interdependent. To stimulate collaborative governance forms, agreements must be made on the distribution of generated revenue. Thus, open governance forms require revenue models with easily observable revenue objects and revenue sharing agreements that let partners predict

and survey the developments in revenue generation. Another example is the relationship between value proposition and market segmentation. Complex services with deep and specialized value propositions require that end-users understand and feel they control the services to generate customer value. Behavioural control of this kind may require end-user experience and some times even expertise. Thus, deep and specialized value propositions require careful segmentation of end-users. This may be particularly relevant for heterogeneous network services where obtaining compatibility across network requires experience or expertise by service users. A final example that crosses resource considerations and customer value considerations may be when platform services are introduced. Again, only experienced end-users may be able to generate customer value from platform services with great service variety. In fact, Pedersen et al. (2005) found a negative relationship between service variety and customer value for mobile platform services for customers with low behavioural control, whereas this relationship was positive for customers with high behavioural control.

The examples presented above also illustrate the second type of business model relationships suggested - the relationship between specific options along business model dimensions and the performance effects of choosing specific options under different structural conditions. These relationships have been given less attention in the literature on the business model concept. Instead, performance effects of the choice of options for product-, customer-, financial- and infrastructural business model dimensions are treated separately in individual research areas such as product innovation, industrial organization and strategic marketing research. In the industrial organization field, however, one acknowledges the causal relationships between structural market conditions and business model options, and between these strategic choices and performance in the “structure-conduct-performance

paradigm" (Bain, 1951). In this framework, performance is measured by a firm's business values such as profitability. Heterogeneous network services, however, are found in an emerging market of network services where performance may better be measured by perceived and anticipated customer values and profitability may be a long term goal. Thus, integration between business model options and perceived customer values is necessary in these network services industries. It is well documented that the choice of specific business model options affects the intrinsic and extrinsic attributes of the product or service developed and produced (Nicholls-Nixon and Woo, 2003; Zahra and Nielsen, 2002; Sengupta, 1998; Stuart, 2000).

How service attributes create customer value

Heterogeneous networks are mainly an innovation allowing end-users to access services through various networks, developers to design new services, and service providers to distribute and charge for new services. It stimulates a reorganization of the value chain of wireless, Internet and media services. These innovations may lead to cost efficiency or better quality, but eventually, such innovations must lead to service innovations for new customer values to be captured. As mentioned in section 1, customer value emerges from two different value drivers of networked services. *Intrinsic attributes* refer to the inherent attributes of the service itself, whereas *extrinsic attributes* emerge from the networks that provide and use network services.

One of the most obvious intrinsic attributes driving the value of mobile services is the lack of constraints related to time and space (Balasubramanian, Peterson and Jarvenpaa, 2002, Watson, et al., 2002). Others suggest that "being personal" is an additional intrinsic value driver (Doyle, 2001, Kannan, Mei Chang and Whinston, 2001). Services traditionally distributed over other networks than mobile

communication networks may be valued for other unique attributes. Broadcast service value is often driven by the unique attributes of community and sociability. These services are often used in family- and social contexts or are discussed in communities after an event (see e.g. the collection in Lin and Atkin, 2002). Many of the most successful Internet services, such as online banking and travel services are characterized by effectiveness, while others, such as P2P networks, are valued for their "cost efficiency". These examples suggest instrumentality is a unique characteristic of many Internet services (Papacharissi and Rubin, 2000). Thus, the value of services traditionally accessed using a particular access network may be driven by unique intrinsic attributes not expected from or easily obtained using another access network.

Extrinsic attributes in network services are different from traditional products and services where extrinsic attributes often originate from supplier services and consumer investments (Mathwick, Malhotra and Rigdon, 2001; Lee and O'Connor, 2003). The two most often mentioned extrinsic attributes of network services are direct and indirect network effects. Direct network effects are the effects related to increasing value of a service as the size of the network increases (Liebowitz and Margolis, 1999). Indirect network effects originate from direct network effects when the networked good is a platform for complementary services and products (Gupta, Jain and Sawhney, 1999). While direct network effects are important value drivers of communication services, indirect network effects are more often the value driver of information, transaction or machine-interactive services. Many network services (e.g. SMS) offer platforms for other, complementary services. Thus, the variety and quality of complementary services as well as the frequency of innovation (speed of development) in such services are attributes driving the value of such services. To appreciate these attributes, however, end-users must perceive

themselves in control of the service. Perceived control results from skills and experiences and is the result of behavioural usage patterns established over time (e.g. genres). Conducting user oriented service development is of less value for networked services because it is practically impossible for end-users to perceive the value of network size and complementarity until a network of considerable size or a large variety of complementary services may be offered. Thus, alternative service development methodologies must be applied. Studies in economics, marketing and information systems have concluded that the availability of complementary goods affects the prices that can be obtained for network goods (Gandal, Kende and Rob, 2000; Basu. Mazumdar and Raj, 2003; Brynjolfsson and Kemerer, 1996), whereas other studies indicate difficulties for end-users to perceive the values of extrinsic attributes (Schilling, 2003; Frels, Shirvane and Srivastave, 2003). Thus, differences across end-users' value drivers must be understood and taken into consideration in all network service innovation.

2.1.3 Business conduct and strategic opportunism

In this report, the main focus is on the business model (conduct) part of the SCP-framework. A rational approach to conduct is applied were we assume that providers will develop their business models to create values to customers while controlling the costs of input resources. In this situation, managers responsible for business model decisions face situations of asymmetric and lacking information and their rationality is bounded by these and other cognitive and affective limitations (Todd and Gigerenzer, 2000) as well as the constraints represented by structural conditions and customer behaviour. Thus, external constraints are taken into consideration as they are perceived by business model decision makers. This suggest that for taking external constraints into consideration in their business models, decision makers would require structural conditions and customer

behaviour to be predictable. This does not mean they should be stable, but that dynamic and uncertain elements are predictable and open to managerial comprehension. For structural conditions, this may for example imply:

- Known market conditions
- Well defined actor roles and relationships
- Entry barriers may be overcome
- Transparent cost objects
- Well defined service barriers
- Well defined technologies
- Well defined standards and interfaces
- Predictable regulation

Strategic opportunism may, however, also suggest some providers develop business models that are robust to lacking predictability of structural conditions. Thus, providers may seek to influence the development of structural conditions, for example by participating actively in standardization. Still, these providers participate in standardization particularly to make standards predictable from their point of view. Thus, predictability is sought by providers regardless of their power to influence structural conditions.

The situation is parallel for customer behaviour and customer values. All providers seek to be able to comprehend and predict customer behaviour in the form of the attributes that are likely to generate customer value and to understand and act on to provide these valuable attributes to customers. This may, for example, imply:

- Actionable intrinsic and extrinsic service attributes
- Predictable relationships between attributes and customer value

- Clear and understandable customer segments

Again, providers may seek to influence these elements, but this is also to make them more predictable and adapt them to their own service offerings.

As may be seen from the collection of potential sub-problems treated in this project, the main propositions made here are that heterogeneity:

- changes the structural conditions and customer values of relevance to providers' business models
- reduces the predictability of structural conditions and customer behaviour
- creates strategic opportunities for providers seeking to influence and adapt to changes in structural conditions and customer behaviour

Thus, heterogeneity is at the same time a source of uncertainty and lack of predictability while at the same time a basis for strategic opportunism. In our study we seek to balance these considerations to analyze how and why convergence at one level does not necessarily lead to convergence at another. For example, overcoming technological heterogeneity through technological convergence does not necessarily make market or regulatory sources of heterogeneity disappear. Providers may sometimes benefit from maintaining heterogeneity at one level while adopting converged solutions at another. To deepen our understanding of these issues, this report investigates heterogeneity as a complex concept routed in heterogeneity of technology, market and regulatory conditions, established business practices and established patterns of customer behaviour. In sections 3-7, these forms of heterogeneity are discussed for five service areas.

2.1.4 Business conduct and business modeling

In their review of the business model literature Osterwalder et al. (2005a) show that the 14 most cited papers on conceptual dimensions of business models covers nine

business model "building blocks" that relate to four different dimensions of business models. The dimensions are "product/service", "customer interface", "infrastructure management" and "financial aspects". The building blocks are the "value proposition" (13), "target customer" (8), "distribution channel" (6), "customer relationship" (4) , "value configuration" (11), "capability" (5), "partnership" (10), "cost structure" (4), and finally, "revenue model" (11) (Osterwalder et al., 2005b, p. 18). The figures refer to the number of papers that includes the corresponding "building block" among their conceptual business model dimensions. From these figures we find that the most commonly used dimensions include "value proposition", "value configuration" and "partnership", which are all parts of the term governance in the strategy literature, "revenue model", and "target customer", often termed segmentation in the strategy literature. Consequently, the dimensions "revenue model", "governance model", "value propositions" and "market segmentation" included in the SCP-framework applied in this report seem to be central to most of the published papers on the dimensions of the business model concept.

In telecommunication service design studies, the term business models has come to include a somewhat broader set of dimensions, of which some are under the managerial influence of the provider designing the business model whereas other dimensions would be included as part of the structural conditions or service and resources characteristics of the SCP-framework applied in this report. For example, the ePerSpace project has published a report on business models for personalised services that includes a business modelling framework including six dimensions (Solem et al., 2006). These include value proposition, customers and market segments, cost structure and profit potential, internal value chains, position in the value network and strategy for positioning and competition (adapted from

Chesbrough and Rosenbloom, 2002). As these are described in Solem et al. (2006), the value proposition, customers and market segments and parts of the value chain and value network dimensions correspond to that of the general business model literature. The strategy dimension is not found among the building blocks of the general business model literature and there is a mix of dimensions that should be modelled as constraints or conditions on managerial business model decisions and consequences of managerial business model decisions. For example, in Solem et al. (2006) it is proposed that "in order to describe a business model we need to thoroughly describe the [following] elements". Here, "following elements" refers to the six dimensions presented above. In this report, we suggest that instead of *describing* these elements, the elements should be organized in a conceptual framework where some of the elements described may be considered as structural conditions of the providers' business model decisions, some of the elements are included in managerial business model decisions, and some elements are the results of these decisions. The SCP-model presented above represents such a structuring framework, and it also suggests that business model elements under managerial decision making are the most important dimensions of business model design. For example, existing roles in a value network greatly influences the freedom of providers in designing their governance form. That said, governance form is a broad concept covering issues of both internal value chain organization and positioning in the total value network. Another example is where the results of business model dimensions influence characteristics of resources or service attributes. For example, managerial decision on value propositions will result in the use of resources that determine the costs of providing a service. The costs are not under full managerial control, but result from business model design decisions. It is important to describe these elements, but this should rather be described by the

relationship between managerial business model decisions and the effects it has on the costs of providing the service.

Other telecommunication studies designing services and service infrastructures have found the general dimensions of the business model literature too broad, and have suggested detailed sub-dimensions for many of the original dimensions. For example, in the Ambient Networks project, detailed business model dimensions have been specified for the revenue model dimension and parts of the governance form dimension (Huitema, 2006; Rietkerk, 2006). For each of the service areas analyzed in the Debussy project, we assume that the SCP-framework will have to be adapted and extended, including the re-specification of important business model dimensions and the inclusion of service specific sub-dimensions. Taking these considerations of telecommunication design studies into consideration, a mapping of terms and considerations of these issues into the SCP-framework is suggested in table 2.1.

Table 2.1 Mapping telecommunications business modelling elements to SCP-framework business model dimensions

Business modelling elements	Structural conditions	Business model dimensions	Resource characteristics and service attributes
Value proposition		Value proposition	
Customers and market segments		Market strategy	
Cost structure and profit potential	Technology	Profit potential covered by revenue model	Costs resulting from resource requirements
Internal value chains	Market, actor	Governance form	
Position in the value network	Market, actor	Governance form	
Strategy for positioning and competition	Market, actor	Market strategy and governance form	

To sum up, the SCP-framework covers most of the relevant building blocks of the business model literature as well as the elements described in telecommunication studies of business modelling. The framework, however, organizes the elements of the business modelling studies into elements constraining business model decisions, the managerial business model decision dimensions and the effects of these decisions on the costs of providing the services and their resulting attributes.

2.2 Method of the pre-study

Being a pre-study, an exploratory research design has been applied here. The project termed “Debussy – Designing Business Models for Customer Value in Heterogeneous Network Services” constitutes of a research consortium and an industry partner consortium. Researchers of the consortium contribute to the project

with their qualifications representing engineering science, technology management, business strategy, marketing, economics, sociology and consumer psychology. Thus, the research consortium is multidisciplinary, something that is required to cover the wide scope suggested by our research framework. Also, the pre-study was designed to reflect the interests of these research partners. In addition, the pre-study was designed to reflect the interests of the industry partners presented in section 1.

General procedure

During a workshop in September 2006, the planned procedure of the pre-study was presented to research and industry partners. All partners were invited to suggest relevant service areas for treatment in the pre-study. By the deadline of October 20, suggestions had been submitted for eight service areas including corporate VoIP, mobile VoIP, mobile broadband, multi play services, M2M communication services, mobile broadcast, personal area network services and mobile payment services. Discussions were held with industry partner representatives and researchers to reduce the number of service areas to five. Personal area network services, mobile payment services and mobile broadcast were of less relevance to industry partners and were excluded.

The pre-study requirement specification found in Appendix A was written by the project management and sent out to all partners by October 31 with a deadline for deliverables set to December, 15. Between December 15 and January 29, reviews where synthesized and integrated into a common pre-study document. This document was submitted to all partners and researchers as a basis for a service area workshop held on February 22, 2007. The results from the workshop were

synthesized with the researcher reviews into this report. The methods of the review deliverable and the workshop are briefly described below.

Researcher review deliverables

The deliverables were organized as follows:

Deliverable 1. Structure – conduct investigation of regulatory and market conditions:

Helge Godø (NIFU STEP) (D) and Anders Henten (CICT/DTU)

Deliverable 2. Structure – conduct investigation of technological development, security and standardization: Frank Reichert (AUC) (Responsible) and Vladimir Oleshchuk (AUC)

Deliverable 3. Investigation of current business model practices and challenges:

Leif B. Methlie (Responsible) (NHH) and Irena Gjerde (Telenor)

Deliverable 4. Investigations of customer behaviour and customer value drivers:

Rich S. Ling (Telenor) (Responsible) and Herbjørn Nysveen (NHH)

Deliverable 5. General literature review

Herbjørn Nysveen (NHH) (Responsible), Leif B. Methlie and Per E. Pedersen (AUC)

Except for the specifications shown in Appendix A, the researcher responsible for each deliverable was free to organize the assignment and to identify and use data sources of their own choice. The deliverable was limited to 15 pages and for each group, the following issues were asked to be discussed:

Deliverable 1. Structure – conduct investigation of regulatory and market conditions:

- Status of relevant regulation
- Status of market situation, such as market power and fragmentation
- Important characteristics of value chain configurations
- Characteristics of innovation processes
- Inputs from innovation research of particular relevance to service areas

Deliverable 2. Structure – conduct investigation of technological development, security and standardization:

- Status of standardization efforts in order to overcome heterogeneity problems
- Technological disruptiveness
- Technological barriers and challenges of relevance to commercialization, including security and privacy issues
- Recent technological industry efforts besides standardization to overcome heterogeneity problems, including industry investments

Deliverable 3. Investigation of current business model practices and challenges:

- Status of industry business model practices including:
- Revenue model alternatives
- Cooperative arrangements and governance forms
- Value proposition details and differences
- Market strategy details and differences
- Inputs from business model research of particular relevance to service areas

Deliverable 4. Investigations of customer behaviour and customer value drivers:

- Description of inherent service characteristics, including two-sidedness
- Categorization of customers
- Categorization of service attributes of relevance to customer value
- Inputs from domestication, adoption, acceptance and gratification research of particular relevance to service areas

Deliverable 5. General literature review:

- Status of customer behaviour research in service areas
- Status of business model research of relevance to SCP-framework
- Inputs from innovation and technology management research of relevance to SCP-framework
- Discussion of SCP-framework adjustments due to recently published research results

All literature used by the groups submitting pre-study deliverables are shown in appendix A. This list is organized by subject area and represents the literature used indirectly in this study in addition to the literature explicitly referenced throughout the report.

Workshop procedure and results

All researchers and industry partners reviewed the draft pre-study report to suggest modification in a workshop held on February 22, 2007. The workshop was organized by discussing issues along the SCP-framework for all reviewed service areas. The main objectives of the workshop were to identify service areas for focused study and modifications to the draft pre-study report.

Modifications on the following issues were decided:

- Explanation of heterogeneity
- Mapping of business modeling frameworks with the SCP-framework applied in this study

These modifications are integrated in the current version of the pre-study report.

With respect to service areas focused for further analysis, mobile VoIP, multi play and specific areas of M2M communication services were chosen. Full service analyses were decided on the first two service areas, whereas a limited service analysis was decided on the M2M communication services area. Results from these service analyses will be published in future SNF-reports.

3 SERVICE AREA – CORPORATE VoIP

Communication services in enterprises have traditionally been separated into voice and data. The heart of voice communication is the local switching system,
PBX, that connects the local voice system with PSTN. The heart of data communication was traditionally the data centre, now substituted by servers connected by a LAN. With VoIP these communication systems converge. This convergence at the enterprise level has led to many successful implementations. At the service level, we refer to corporate VoIP as solutions for implementing VoIP and corresponding non-voice services by corporate customers in general. Typically, current implementations will be found in enterprises and larger public sector organizations. One of the issues that makes this service area interesting is how the functionality of these services extends into operator provided VoIP implementations and infrastructures. Correspondingly, it is also interesting to consider how providers of public VoIP services might also adapt to the service functionalities offered in corporate VoIP implementations that have already been adopted. As such it represents an interesting case of what happens when a successfully converged service challenges the public network infrastructure. Many corporate VoIP implementations are valued for their non-voice functionality rather than their voice functionality. These functions include presence, integration with email clients and calendars etc. Thus, in this service area we would have the opportunity to discuss how public service operator based VoIP solutions take voice *and* non-voice functionality into consideration. In addition, we would discuss the customer value considerations of corporate rather than consumer customers.

3.1 Market and regulatory structural conditions

VoIP is basically a service that substitutes for traditional PSTN telephony. However, especially in the case of corporate VoIP, it can be integrated with data services enhancing its benefit to corporate customers. Corporate VoIP must, therefore, be seen as a cheaper substitution for PSTN telephony as well as a service which is more easily integrated into the computer systems of business users – therefore, an enhanced service.

Market

In contrast to the first computer-to-computer VoIP applications, VoIP services are presently interconnected with the PSTN telephone system and there are, consequently, no direct network effects constituting barriers to entry in the VoIP telephony market emanating from the telephony market as such. Furthermore, the quality of the telephone service as such of most corporate VoIP services is high and competes well with PSTN telephony. Most corporate VoIP solutions are based on managed IP solutions and not on the Internet as such.

Corporate VoIP is a market success and is witnessing a growing take-up among business companies. Until last year, VoIP was not widely adopted by residential customers, but the managed IP solutions offered to business customers have, indeed, been successful. The reason for the lack of success in the residential market has been the quality of some of the VoIP solutions offered in this market segment. But equally important has been the lack of incentive for the PSTN incumbents to offer VoIP, which clearly cannibalises on the PSTN telephony market. The reason that VoIP has reached larger market shares in the business market is partly that business customers have more power in relation to the telecom providers than residential customers.

VoIP is potentially a service that disrupts the market. It opens the market to new telephone service providers, both small companies in the residential market and larger IT companies in the corporate market. The barriers to entry in this market are relatively low; however, business customers tend to rely on larger providers in order to secure reliability in maintenance, upgrading, etc. This is also one of the reasons why the PSTN telephone providers are large providers of VoIP in the business market.

In spite of this, the corporate VoIP market is less concentrated than the telephony market in general. Whether it is less concentrated than the corporate PSTN market is a question which needs to be examined. With respect to the level of knowledge necessary to enter the corporate VoIP market, the technical requirements are relatively easily met. However, the requirements on the knowledge concerning the market are relatively high. Scale economies are not of great importance. However, a qualification needs to be made. We are here speaking of the VoIP service market, while the market for VoIP equipment, to a higher degree, is affected by scale economies. There are, indeed, economies of scope in this market, as one of the 'virtues' of this service is its potential integration with data service running on the same IP platform. With respect to revenues and costs, the corporate VoIP market is lucrative. Corporate VoIP may be provided at considerably lower costs than PSTN telephony but is not necessarily substantially lower priced. Finally, the important power relations in this market are that incumbent telephone companies have the customer contacts, but corporate customers have a say in relation to their providers.

Regulation

Most regulatory authorities currently consider the market for VoIP services as an emerging market. Thus, they are generally concerned to let the market develop and reluctant to apply strong forms of regulation as long as the market seems to develop with the speed and innovativeness that has been observed the recent 2-3 years. It may also be that this market proves disruptive to the traditional PSTN market in the sense that when developed it will reduce the need for market specific ex ante regulation to avoid anti-competitive behaviour in this market. Most national regulatory authorities have investigated the VoIP markets in their corresponding countries as well as internationally, and written policy documents and reports on how they intent to regulate VoIP related markets if necessary. For example, in Norway, VoIP services, termed broadband telephony by the national regulatory authority, has been categorized as follows (NPT, 2006): Category 1 is telephony services restricted to users of the same service, such as basic Skype. Category 2 enables either access from the service to the PSTN or vice versa, but not both ways, such as SkypeOut. Category 3 is the traditional VoIP service offered by a multitude of providers with seamless two way interconnection to PSTN. Only category 3 services are considered to be regulated as a public telephony service. Also, several exceptions have been accepted to the general requirements of public telephony services for VoIP services, such as call origination identification and quality of service (QoS) documentation. With respect to significant market power (SMP) regulation, VoIP is considered part of the end-user markets 1-6 and the relevant wholesale markets 8-10. Thus, providers of VoIP services are supervised for potential significant market power. The approach applied seem to be followed by several other countries with an intent to stimulate innovation in the VoIP market while at the same time signalling that providers also have public obligations, if not full universal service obligations.

There seem to be no differences in the regulatory policy of consumer and business markets for VoIP. Still, most of the obligations referred to by regulating authorities refer to consumer market obligations. Obligations meeting the potential requirements of VoIP services of category 3 and public telephony services do not seem to include issues of particular relevance to the seamless interconnection or handover of non-voice services of relevance to corporate VoIP customers. Thus, market competition at the solution level is believed to sufficiently stimulate the development of such service offerings. Consequently, regulatory policy in the area of Corporate VoIP seems to be predictable and at least to a certain degree, to stimulate innovative business models in this service area.

In general, Corporate VoIP is a service area where market related and regulatory structural conditions do not to a great degree seem to represent sources of heterogeneity problems or to represent strong barriers to the development of innovative business models.

3.2 Technological structural conditions

For fixed and mobile operators new solutions based on IMS (Camarillo and Garcia-Martin, 2004) are on the horizon, and investment strategies for VoIP solutions are difficult. Enterprises will need to select the right strategy for cost-efficient and flexible voice and application services, as well as being prepared for future business. Operators need to address the enterprise market with new services while manufacturers have to invest in the right product portfolio. However, enterprises cannot wait for IMS. Some enterprises have already started using SIP VoIP soft-switch solutions. The key element in a basic enterprise VoIP/SIP solution is a soft switch (SIP PBX) which might implement a combination of several SIP entities,

such as SIP registrar, proxy server, redirect server and forking server (Rosenberg et al., 2002). SIP clients can be SIP hard-phones, soft-phones on PCs or PDAs. A PSTN gateway links the enterprise SIP PBX to the public PSTN. Enterprise applications, media servers, presence servers, and the VoIP/SIP PBX are interconnected through a company IP-network. Many of these entities can be operated by the companies themselves or externally through managed service providers and operators. The company has an own domain name, e.g. “enterprise.com” that is linked via broadband access to Internet. Users can be called by a number belonging to a block of PSTN phone numbers linked to the enterprise, or by SIP URLs such as sip:user@enterprise.com.

Standardization

The heterogeneity of interconnecting VoIP/SIP solutions comes (1) from different network solutions, to handle, e.g., firewalls, (2) from features of different system architectures, e.g., Asterisk and IMS, and (3) from using different collections of enablers with own data models and procedures, e.g. IETF Simple presence vs. 3GPP IMS Presence, and from (4) operator/ISP & vendor specific implementations.

Different Network Solutions

A call establishment requirement between two SIP clients can vary based on the location of the SIP clients. Clients located within the same LAN have no restrictions like firewall or Network Address Translation (NAT), hence avoiding the need for traversal technologies. Simple Traversal of UDP (User Datagram Protocol) through NATs (STUN) has major difficulties with the most common enterprise NAT systems and requires support from the clients. Application Layer Gateways (ALG) and secure tunnels are solutions when it comes to allowing

incoming calls, but they are also complex. The final selection of a firewall traversal solution depends on the network structure and security policies of that particular enterprise. The IETF is currently working on a solution to resolve these issues.

Different System Architectures

Two major architectural approaches are currently developed. On one side the IETF and the open source community are pushing solutions based on Asterisk (www.asterix.org) and SIP Express routers, while the telecommunication communication is pushing IMS (Camarillo et al., 2004) for fixed and mobile networks in ETSI TISPAN and 3GPP IMS. In addition some proprietary solutions such as Skype, have gained significant market share.

IMS will play a key role in the future all-IP infrastructure, but it is still in its development stage. It will take time for all 3G mobile networks to upgrade to 3GPP Release 5 networks and for fixed networks to migrate from PSTN to IMS based Next Generation Networking (NGN). In addition, VoIP equipment manufacturers also develop their own solutions for bringing intelligence to all-IP networks such as Juniper's "Enterprise Infranet" and Cisco's "Service Oriented Network Architecture (SONA)" (Dixit, 2006, p. 58). Regardless of alternatives, it will still take several years before full IMS or equivalent functionality is realized. 3GPP uses several extensions not used in current SIP implementations and therefore there is a problem when using such services by legacy clients. Asterisk is a complete PBX in software. Asterisk does voice over IP in many protocols, and can interoperate with almost all standards-based telephony equipment. The list of Asterisk features and supported protocols is long and allows it to interoperate with many PSTN and VoIP solutions. Also, Asterisk.org has defined the Inter-Asterisk eXchange (IAX™) Voice over IP protocol to interconnect different Asterisk systems across disparate

networks. Another Open Source project, “SIP Express Router”, is gaining considerable momentum recently as the implementation is very efficient and closer to a full SIP architecture. SIP Express Router (SER) is a high-performance, configurable, free SIP server and acts as SIP registrar, proxy or redirect server. The list of available features is long and SER is used by Fraunhofer, Germany, for their upcoming release of “OpenIMS” servers.

Different Collections of Enablers

IMS supports several enablers not directly compatible with other SIP/VoIP based solutions such as SMS, MMS, and Push-to-talk. They are central to mobile users but need gateways and proxies to interface with Internet applications such as email and instant messaging. Presence is a key enabler for corporate VoIP. 3GPP, IETF, MSN, ICQ, AOL, YAHOO and many more have defined their own protocols and user profiles to manage a user’s presence status. Organizations such as Jabber.org have reverse engineered several of these protocols and created clients and servers that are compatible with most of these standards. IETF RFCs specified their core XML streaming protocols for instant messaging and presence technology under the name of XMPP in RFC 3920 and RFC 3921.

Operator & Vendor Specific Implementations

Operators have developed their own 3rd party portals to interconnect their business domain with external partners. These domains are usually proprietary using different standards, platforms and architectures, e.g., Parlay/OSA/CORBA, OMA, Java J2EE based or Web Service based. Large vendors such as Ericsson and CISCO have a wide range of IP telephony solutions following major standards but also containing proprietary elements to interconnect enterprise sites or for managing users and services.

Technological disruptiveness

Authors have evaluated the technological disruptiveness of general VoIP services to be considerable (e.g. Osterwalder et al., 2005a). Despite issues related to obstacles of heterogeneity, the disruptiveness potential of this technology is also considerable in the corporate voice area. Open source initiatives have gained considerable momentum in the SIP/VoIP area. A new Nordic initiative "EUX2010" is planning to provide a complete enterprise solution based on Asterisk for the private and public sector. Once such complete "packages" exist, they will be attractive to users who are worried about initial investments and continuous upgrade costs. Skype, VoIPbuster, and Jajah are examples of three companies using partly their own and partly open software to offer Internet Telephony, Messaging, and Presence services either for free or at a very low price. This has certainly affected the investments and business cases for more standardized solutions.

Technological barriers and challenges

One of the challenges of corporate VoIP is mobile services. Companies are interested in integrating mobile phones into the enterprise environment. However, mobile phones are linked to one or several mobile operators and therefore have their own mobile numbers. Desirable would be a solution where customers refer to the initially fixed enterprise phone numbers and enterprise SIP URLs, whilst mobile phone numbers and SIP URLs belonging to the mobile operator would be hidden. Employees would then be able to pick up calls on their fixed phone, PC or mobile phone.

A second feature would be that the calls are automatically redirected to mobile phones if employees have not registered with the enterprise domain, e.g., because

they are on a business trip or currently not in their office. If possible the solution should allow an enterprise to change or disengage their mobile operator altogether, if price or performance is not satisfying. Further on, it should be possible to have contracts with many operators in parallel to support global business and market presence. A well know problem of VoIP solutions is that the location of a user is unknown. Thereby emergency services cannot locate users in case of emergencies, but this represents less of an obstacle to corporate VoIP than to residential VoIP value. Regulation may, however, make location through caller ID required and thus, a technological condition for business model design rather than a customer value driven requirement.

3.3 Business model options and considerations

Corporate VoIP may be implemented in several ways described along a continuum of full corporate control to a fully outsourced service through application service providers. Robison and Yedwab (2004) define four approaches to corporate VoIP:

a. **IP-Enabled** – enables PSTN to communicate with IP end points via existing LAN or WAN infrastructures.
b. **IP-PBX** where one or more IP-PBX servers are added to the corporate data network. IP phones are connected via LAN or WAN.
c. **Converged** using both traditional voice switching and IP/Ethernet switching (also called hybrid systems).
d. **Hosted VoIP** where the call processing functions are located outside the enterprise (ex. IP-Centrex).

Players, roles and actor networks

The four approaches represent a mix of technological approaches and sourcing arrangements. Thus, the choice of technological solutions and governance form for

both providers and corporate users are intertwined in corporate VoIP. This makes this service area different from many others, where the roles of the provider and the service customer are much clearer. In the corporate VoIP area, the roles of the user, customer, voice and non-voice service providers, connectivity service provider, application provider, and equipment vendor and distributor differ across customers and solutions, and are also often mixed. This makes it difficult to describe the service in a general actor or value network. It is, however, possible to contrast two historical developments leading to different distributions of roles in alternative solutions. One is the development from the traditional PBX vendors where the platform is looked at as an extension to the PSTN/PBX system into VoIP. Another is from the data network oriented vendors who provide routers, servers and access points, where VoIP is just another application mediated by the corporate data network. These developments share their origin as being in the corporate context, whether the PBX or the data network. A third development that has been less obvious is that of the public carriers embracing corporate VoIP as part of their general involvement in public access VoIP service offerings. Relevant business model dimensions may differ considerably depending on which provider position is taken in the business model analysis.

Governance forms

Due to the difficulty with identifying clear roles of corporate customers, service providers and equipment providers, an analysis of governance forms in this service area would best be approached at the case level. Still, a few general observations are found from our review. While the flexibility to carry out innovations in business models differs across different players in the corporate VoIP area we believe the flexibility in governance forms in this area to be greater than in many other service areas. Resource investments have been made by firms, vendors and

service providers, but equipment vendors seem to be well positioned to cover innovation in provider business models whether these are service providers or the corporate user. Corporate users have made investments in network equipment, but these investments have seldom been made for VoIP services specifically, but VoIP implementations are more often used as an argument to utilize already existing capacity. Consequently, service providers, particularly incumbent providers, are those with the least governance form flexibility in this service area.

While most corporate VoIP solutions have grown out of vertically integrated governance forms, whether corporations' or vendors' governance forms, current forms are highly relational and standardization has made market based governance forms more relevant as well. Market based governance forms, however, are more often used for components or specific service offerings within the corporate VoIP solution. Examples are components offering presence, integration between presence and calendar or email, integration of different messaging formats and so on. A complete corporate VoIP service solution will have to allow combining relational and market governance forms to fulfil the requirements of individual corporate customers.

For some service areas it is fruitful to separate governance forms for production and distribution from governance forms of innovation. For corporate VoIP there may also be some differences due to strong positions of equipment vendors in service innovation. This would suggest innovation to be supplier dominated and thus more reluctant to applying vertical governance forms. Still, the importance of standardization and relational forms of production also require using more relational forms of innovation.

Value propositions

As presented in section 2, providers' value proposition may differ considerably from the perceived value of end users. For corporate VoIP the value propositions may be described by a collection of benefits believed to be valuable to corporate customers (not necessarily end users). Among these are (Intel, 2006):

a. *Reduced costs* – Because the voice is delivered over the same data channels as any other data, it results in more efficient use of bandwidth and fewer leased lines. Intel has made a case study of corporate VoIP business values and lists the following costs elements (Intel, 2006):

- Telephone costs
- Move/add/change costs
- Data centre footprint reduction, audio conferencing cost savings
- Cabling and wiring
- Monthly usage cost savings

b. *Productivity gains* – Intel's White paper describes significant productivity gains by employees in terms of accessing voice mail and looking up phone numbers. Also, ICT management is simplified.

c. *Increased functionality* – As e-commerce in businesses increases the operations become more network-oriented and the need to integrate voice with back end systems increases. VoIP eases the implementation of added functionality, such as CRM integration.

Value propositions may offer all the above benefits or focus some of them illustrating the difference between broad and focused value propositions. Currently, cost savings have been marketed heavily, whereas many providers also argue that VoIP investment decisions should not be made for cost efficiency benefits alone. Vendors and larger service providers offer the broader set of benefits whereas smaller service providers' offerings are narrower. Few service providers currently

focus the increased functionality of non-voice services related to VoIP, and even fewer focus interoperability of such services with PSTN.

Value propositions of new services must relate to customers' perceived value of current offerings. Also, new offerings may offer some benefits that are often valued against a set of drawbacks. The reduction or elimination of such drawbacks is also an important part of a value proposition of a new service or provider. For example, corporate VoIP services are often proposed to suffer from lacking quality (typically voice QoS) and reliability as well as interoperability problems of cross-provider and international calls when compared to the value proposition of current non-VoIP services.

Market strategies

Due to the differences in approaches to corporate VoIP, the market strategies taken by corporations (no external market), equipment/solution vendors (several markets) and service providers (corporate market) will differ. However, this also means that the different approaches to corporate VoIP are reflected in the segmentation of the corporate VoIP market. Even though we have found very little statistics on the segmentation of this market[1], we believe that at least two dimensions are relevant. Size typically discriminates between corporate customers with resources and investments in own network infrastructure that may be utilized for carrying voice as well as other services, and customers without such resource investments seeking mainly to implement a cost efficient corporate telephony service. Geographic distribution is another segmentation dimension that is indicative of roaming costs

[1] For example, the statistics and reports of the Norwegian Post and Telecommunication Authority are mainly focusing the residential VoIP market.

and thus, the potential of cost savings from VoIP solutions. Because size and geographic distribution are often correlated, we primarily consider size here.

While traditional vendors may approach large customers directly, they have to rely on indirect sales channels for small size customers. Service providers may represent the indirect sales channels of vendors and thus, focus mainly on small and medium sized customers. This segmentation logic holds at least for the cost efficiency part of the VoIP value proposition, and as seen from section 3.1 the fragmentation of the service provider market reflects this segmentation. For the added value part of the value proposition, more sophisticated and focused market strategies are required. Developments in this direction, however, are not easily identified in the current corporate VoIP market.

Revenue models

While it is difficult to identify what we traditionally mean by revenue models for the type of corporate VoIP controlled by the firm, there are differences in revenue models when seen from vendor or service provider perspectives. Robinson and Yedwab (2004) describe two price models when seen from the service provider perspective: voice per-port pricing and per-seat pricing. In terms of VoIP networks it per-seat pricing means charging by the number of terminals connected to the network. According to Robinson and Yedwab (2004) this pricing model is particularly appealing to the LAN people. Per-port pricing means charging by flow and is used in the traditional voice market. When investigating the service provider market for corporate VoIP solutions we recognize most of the revenue models as translations of revenue models for traditional voice services. Few providers seem to use the disruptive potential in alternative revenue models at the current stage of development (e.g. by offering flat pricing models or other innovative price plans).

From our review of the area we have been unable to identify extensive use of revenue sharing agreements except for voice internetworking, such as handover and roaming agreements. Such agreements are, however, required to enable interoperability and be able to terminate calls in PSTN. The necessity of these agreements may also represent a potential barrier to innovative pricing of VoIP services to both residential and corporate customers. Currently regulation, however, favours greenfield providers due to current and future price caps on incumbent provider termination fees.

3.4 Customer behaviour and customer values

Conditions related to customer behaviour and customer values can be seen as antecedents of how consumers will perceive the value of the service. Although research on many of the issues is scarce, this discussion is based on the existing research and induction from existing research. The discussion is organized by customer behaviour issues (attitude towards using the technology, behavioural control, normative influences, segmentation), customer value issues (intrinsic attributes, user network attributes, complements network attributes), price sensitivity, and compatibility. Many of the constructs defined here will be used also in later sections discussing customer behaviour and customer value.

Customer behaviour issues

Attitude towards use is defined by Fishbein and Ajzen (1975, p. 216) as "an individual's positive or negative feelings (evaluative affect) about performing the target behaviour". Formation of attitude towards using corporate VoIP will be based on beliefs about the service. We have been unable to identify any study reporting companies' attitude towards corporate VoIP. However, attitude can be

induced based on existing research. Both potential positive (such as lower costs and more services) and negative (such as switching costs, lacking interoperability and security issues) effects of implementing VoIP are discussed in several articles (First Tuesday Zurich, 2004; Lucent Technologies, 2006; Simon, 2005), indicating a mix of positive and negative attitudes. However, the recent increase in corporate VoIP implementations may reflect a positive attitude towards corporate VoIP. Sathish (2006) reports that investment in business VoIP software and hardware will be about three times higher in 2007 than in 2006. The numbers are valid both for Asian and American companies. An extreme increase in the usage of corporate VoIP is also predicted by Rajendran, Ganguly, Izmailov, and Rubenstein (2006).

Behavioural control is defined as "perception of the ease or difficulty of performing the behaviour of interest" (Ajzen, 1991, p. 183). It includes both skills and financial resources necessary to use a service. Although some uncertainty regarding the cost of implementing corporate VoIP systems are discussed (Tobin and Bidoli, 2006; First Tuesday Zurich, 2004), most studies emphasize cost reduction as the main motive for corporate VoIP implementations (Simon, 2005; Luo, Liu, Shao, and Ye, 2006). Fiorini (2000) reports a cost reduction of 70 – 80 percent by implementing voice/fax over IP data networks. Lack of skills internally and industry-wide is discussed as a potential barrier by Tobin and Bidoli (2006), but this is only considered a significant barrier among 26 percent of the respondents. Consequently, behavioural control does not seem to be a major barrier for adoption of corporate VoIP.

Normative influences are defined as "a person's perception that most people who are important to him think he should or should not perform the behaviour in question" (Fishbein and Ajzen, 1975, p. 302). Although normative influences may

be more relevant among consumers than among corporate customers (where rational factors are dominating the decision process), normative influences from other actors in the same industry, normative influences from important partners, and normative influences from companies' boards may increase companies' intention to invest in corporate VoIP systems. If several partners have invested in corporate VoIP, the pressure on other partners to make the same investments for purposes of system- and service integration across the organizations, may exist. A study by Zhang, Chan, and Fang (2004) propose effects of normative influences on the intentions to invest in corporate VoIP systems.

In general, the size of the company will say something about the proclivity to use advanced technologies such as VoIP. However, another dimension of this type of segmentation is often the branch or industrial segment. Some segments are naturally more open to the use of telephony in their work than are others. Public administration, for example is more telephone based than is the construction industry. Geographical dispersion of a company is also a relevant variable for segmentation because corporate VoIP will be more relevant for geographically dispersed companies than companies with one location. Furthermore, communication intensity is also relevant as a variable for segmentation because the advantage of corporate VoIP is higher for companies with high communication intensity (as for example public administration) than for companies with low communication intensity. The fact that several value-added services can be integrated in corporate VoIP systems also makes such systems more relevant for service firms and firms that depend on integrated systems for coordination of work processes than for companies where such needs are less salient.

Customer value issues

Intrinsic attributes refer to the inherent attributes of the service itself. Among more generic intrinsic attributes, corporate VoIP systems are user friendly solutions, and they do have the potential to be useful for corporate organizations because of low cost solutions and the possibility to add several complementary services to corporate VoIP systems. Both ease of use and usefulness are revealed to be major antecedents for users' attitude towards a service/technology and actual usage of the service/technology (Davis, 1989; Davis, Bagozzi and Warshaw, 1989). Another intrinsic attributes of corporate VoIP is access to an employee on the same phone number independent of the employees' location. If the employee travels to a different branch in a different country, she is still available on the same number. The international toll bypass and the free calls on the Internet also make corporate VoIP a low cost application when it comes to usage. Finally, the possibility to link various value-added services to corporate VoIP systems also makes corporate VoIP a flexible system for rationalizing internal processes and improving consumer service (First Tuesday Zurich, 2004). Other services enabled by corporate VoIP are 1) toll free intra-company voice and fax between corporate locations, 2) wireless roaming, 3) calling cards (enables telephony services and proper billing), 4) local portability (allows telephone users to change local carriers), 5) call waiting, 6) caller ID (enables a caller to be identified), 7) pagers (ability for callers to page subscribers of the service), 8) PC-phone to PC-phone, 9) IP based call centres, and 10) IP line doubler (a PC user with just one connection to the Internet can subscribe to a new service that facilitates a single phone line to carry one or more phone calls in addition to data) (Fiorini, 2000). Luo, Liu, Shao, Lu, and Ye (2006) studied the effects of switching from a traditional call-centre solution for supporting customers/user of an online game to a context-aware VoIP based call centre. Based on the inherent service characteristics of the VoIP based call centre, their results

showed an improvement in customer service level and a reduction in customer waiting time. Also, reduction in the company's costs related to customer support was revealed, mainly because of a reduced need for consumer support agents. The availability of employees on the same phone number anytime and anywhere is also a feature that can improve customer service because of the easier access to employees. Improved service has the potential to strengthen customers' satisfaction and loyalty to the corporate organization.

User network attributes reflects direct network effects. For corporate VoIP, we may argue that direct network effects exist in the sense that the value of VoIP is larger the more people that are using corporate VoIP. If the company only has a few employees, only operates nationally or regionally, and the intensity of mediated voice communication is low between the employees, the advantage of corporate VoIP systems seems marginal, and the possible cost reductions will probably not justify the investment. For a larger company with several employees, in particular a company with employees in many countries and high intensity of voice communication, the investment in corporate VoIP will more easily be justified in cost reduction. Also, given the idea that VoIP based call centres will increase service quality, we may also argue for direct network effects on the customer side – the more customers the company is serving, the higher the value of corporate VoIP.

Complements network attributes reflect the variety of additional and value-added services that can be integrated with corporate VoIP systems. Several services can be built on the VoIP platform in the corporation. Corporate VoIP systems can be the basis for development of several other complementary and value added services. Examples are mentioned above. Thus, the potential for indirect network effects does exist.

Price sensitivity

Price sensitivity refers to the change in demand given a change in price. When small changes in price lead to large changes in demand, price sensitivity is considered to be high. The following factors may influence consumers' price sensitivity; unique value, awareness of alternatives, price level, who the payer is, price and quality, whether the product can be stored or not, and switching costs (Pedersen, 2001). The end-users are not the ones who pay for corporate VoIP, contributing to a reduction in price sensitivity. However, companies surely know about alternative solutions and corporate decision makers are generally price sensitive. Also, corporate VoIP systems can be purchased in a year or two, probably to a lower price, and some companies may therefore wait for a while to reduce the investment costs. All these factors are forces increasing price sensitivity.

Compatibility

Compatibility is defined as "the degree to which an innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adopters" (Moore and Benbasat, 1991, p. 195). Also, technological compatibility is an issue for adoption decisions. Factors directly related to heterogeneous network technologies influence investment decisions. Varshney, Snow, McGivern, and Howard (2002) highlight uncertainty about network management, interworking with diverse networks, possible effects on traffic volume in IP networks, and service integration as potential barriers to investment in corporate VoIP. On the other hand, the centralized network and simplified network management enabled by corporate VoIP systems is considered to have a huge potential to make an organization more efficient (Päivärinta and Koikkalainen, 2003; Lucent Technologies, 2006). The possibility for fixed-mobile convergence is also an issue

with investments costs but with high potential for savings in the future (Gibson, Bilderbek, and Vestergaard, 2005). Still, compatibility with users' values, needs, and experiences is also an important issue. The employees satisfaction with existing systems, uncertainty about investment costs, security and privacy concerns are all factors that can create inertia in organizations' investments in corporate VoIP systems (Tobin and Bidoli, 2006; Varshney, Snow, McGivern, and Howard, 2002). If corporate VoIP systems differ from what the employees are used to, they may choose not to use the system optimally because the system is not compatible with their preferences and values. Employees may also have trouble learning how to use the corporate VoIP system and are therefore not able to take fully advantage of the system. Both technological and behavioural compatibility represent potential sources of heterogeneity problems in corporate VoIP solutions. As is obvious from the discussion above, however, instrumental benefits related to cost and usefulness are the main drivers of corporate VoIP investments. Thus, lack of behavioural compatibility is unlikely to be a considerable source of heterogeneity problems once the firm decides to invest in a corporate VoIP solutions and directions for its use is implemented.

4 SERVICE AREA MOBILE VoIP

Both 2.5G and 3G networks bring IP based packet switching data services to the cellular networks. Full All-IP solutions are however, still under deployment and in the window of opportunity before full IMS implementations are deployed, new service providers take the opportunity to utilize the cost advantages of intermediary VoIP technologies also for mobile services. At the service level, mobile VoIP refers to private solutions for both corporate and domestic customers as well as solutions for public mobile VoIP services over open hotspots. Several business models for such service offerings are currently commercialized ranging from the use of dual mode handsets applying SIP clients and IMS solutions to different types of "smart" services utilizing characteristics of currently offered cellular service plans (e.g. IPdrum.com). Here, we focus voice services, but non-voice services are also believed to be important to the value of the total mobile VoIP service offering due to service complementarity (e.g. presence and voice).

For mobile VoIP the commercial focus is currently on voice and large scale deployment of voice over IP the mobile at users' homes and in public hotspots by dual mode handsets. The providers here pay no particular attention to corporate requirements, but market this as solutions for all/any customer. Thus, this is a service area where general customer (consumer) values are of relevance and the heterogeneity lies mainly on the voice side of the service. Seamless transition of voice services between cellular and wireless networks, however, requires problems of technological, business strategic and consumer behaviour heterogeneity to be resolved.

4.1 Market and regulatory structural conditions

Mobile VoIP is a direct substitute for traditional circuit switched mobile telephony. However, once the telephony application is based on the general IP platform, it can be integrated with data services of different kinds, which is, for instance, the idea in IMS (IP Multimedia System). Mobile VoIP is thus not only a cheaper substitution for traditional mobile telephony but also a service that will more easily be a complement to or be complemented by IP-based data services.

Market

As VoIP services are generally interconnected with the PSTN telephone system, there are no direct network effects, which constitutes barriers to entry in the VoIP telephony market emanating from the telephony market as such. However, to the extent that mobile VoIP is offered in packages of services, which are more or less closed, there will be direct and indirect network effects relating to these service packages. Mobile VoIP can be offered on managed IP networks as well as the general Internet. In the case of a managed solution, we are, most likely, dealing with a vertically integrated solution from a specific provider, while a general Internet solution is one where different VoIP providers can come in and offer telephony based on an open IP platform (e.g. SIP). However, the most likely solution to be developed by the traditional mobile operators is a managed solution, which is then a vertically integrated solution.

Mobile VoIP can be provided on different access networks, e.g. cellular networks, WiFi or WiMAX. If a cellular network is used, it does not have to be 3G. GPRS, EDGE or other mobile data networks can also be used, but due to QoS constraints, the most likely scenario is that mobile VoIP will be offered by 3G operators selling unlimited access to the data channel for a flat rate. WiMAX (in its mobile version)

is a potential competing access technology, while WiFi access, due to coverage, is a niche product, which, if it is to be used for telephony, will have to be priced very differently, i.e. cheaper than today. However, some operators have already started to offer roaming between cellular and WiFi using UMA (Unlicensed Mobile Access) and are providing an integrated cross-service platform with cheaper prices than in the case of stand-alone use of commercial WiFi.

Mobile VoIP is potentially an interesting market, or that is to say, mobile VoIP as an application together with a range of data services will be a possibility for mobile and other wireless operators to develop a package of services that will push the market for mobile data services, which presently is only very slowly taking off. Mobile VoIP can thus be considered as a service that will push the mobile data market as well as a defence for mobile operators that can foresee that the circuit switched mobile telephony market eventually will be undermined and already today is under pressure because of falling ARPU.

It is much too early to say anything about actual concentration or fragmentation of the mobile VoIP market. But it can be stated that the existing mobile network operators will seek to retain the mobile telephony market by gradually transferring the existing mobile telephony market to a general IP platform with integrated services. Potentially, however, the IP platform opens the market to new service providers, among them mobile VoIP providers. Barriers to entry will, therefore, depend on whether the mobile network operators will be successful in transferring their customers to such an integrated new platform or whether there will be more open platforms, where alternative VoIP providers can enter the market. A similar argument can be made with respect to economies of scale. The integrated solution requires much more scale than the open model. Regarding scope economies,

predictions are much more certain, as the take-up and economic profitability of mobile VoIP to a large extent builds on the integration with data services. There are definitely economies of scope related to mobile VoIP.

The level of technology knowledge necessary to enter the mobile VoIP market is not extensive, and the same applies to knowledge of the market, if we are speaking of the residential market, while the business market is more complex. To the extent that the VoIP technology used to provide services has a sufficient QoS, customers will be willing to shift providers. This willingness has been far greater in the mobile market when compared to the fixed-line telephony market. However, quality of service is important. This applies to the business as well as residential market. Customers are interested in cheaper telephony, but the quality of the service has to be at an acceptable level. The development of the fixed-line VoIP market is an indication of this.

Regulation

In addition to most of the regulatory issues discussed in section 3.1, there are additional regulatory issues for mobile voice services. In particular, spectrum policy is an issue not relevant to services provided over fixed networks that represents a structural condition for providers of wireless services.

With the main revenue generated by mobile services coming from voice and messaging, and demand being elastic to voice and messaging services pricing, mobile VoIP providers are likely to market their service as a cost reducing service offering. A likely trajectory for this service for both consumers and corporate customers would be the service to develop in three stages. Stage one is the use of phones enabling Mobile VoIP restricted to customers own WLAN's while offering

cellular services from virtual or other operators outside this area. Stage two would include roaming agreements between WiFi hotspot owners to enable Mobile VoIP over most available WLAN's whether public or private. Still, mobility in the form of mobile handover and availability would be restricted and supplementary cellular access would be required. At stage three, mobile VoIP providers are given access to or themselves control wide area networks with coverage comparable to cellular networks. At this stage, regulatory authorities' spectrum policy would be an important additional structural condition for innovation in providers' business models. Currently, the status of mobile VoIP is mainly stage one. However, we already see initiatives of stage two type and business models supporting this (e.g. http://www.digi.no/php/bransje.php?id=53115).

At the current stage of development, mobile VoIP is better characterized as nomadic VoIP (the Norwegian regulatory authorities apply the term nomadic broadband telephony). At this stage regulatory authorities are likely to stimulate innovation and because the public obligations are not so universal for mobile services they are likely to pose few requirements of mobile VoIP providers in order to stimulate innovation. For example, Norwegian regulatory authorities have announced that they will accept exceptions to the requirement of identification for nomadic VoIP services and a separate non-geographic number series has been reserved for these providers. Also, market specific regulation is much less of an issue in most countries for mobile telephony services where anti-competitive behaviour is believed to be less of an issue due to well-functioning markets. Thus, market specific ex ante regulation is believed not to represent a very important structural condition or source of heterogeneity problems for the development of innovative mobile VoIP business models. With the focus of EU regulation in wholesale markets and infrequent revisions of regulatory policy, regulation is likely

to be in favour of innovative mobile VoIP business models (e.g. with no price cap regulation of termination for greenfield mobile VoIP providers and strong price cap regulation on termination in incumbent providers cellular networks).

4.2 Technological structural conditions

VoIP solutions for mobile devices have recently gained wider acceptance as popular VoIP services such as Skype are now available for mobile phones and PDAs. Mobile VoIP can today be used over WiFi, 3G, or DECT for very low cost. Microsoft Windows Mobile is currently dominating other platforms as Symbian based phones until now has been more closed devices and also more expensive when it comes to phones with WiFi capabilities.

Standardization efforts in order to overcome heterogeneity problems

For mobile VoIP, heterogeneity exists due to (1) different client platforms, (2) different wireless access networks; (3) different VoIP solutions.

Different Client Platforms

The main competition on the client side is between Symbian, Microsoft Windows Mobile, and soon Linux for embedded systems. When it comes to Mobile VoIP, Microsoft Windows Mobile currently runs on the more attractive terminals (i-mate, HTC, Motorola) with WiFi and GPS support, with lots of downloadable software, easy office synchronization, and the best development environments. Symbian is the most widespread terminal platform, but it will take a while until popular VoIP clients such as Skype or SjLabs SIP clients are ported to it. Meanwhile, dual mode Symbian based terminals are now provided with SIP and UMA support, and these terminals seem to gain in popularity in the high-end market.

Different Wireless Access Networks

Current Mobile VoIP client software is based on IP and SIP protocols and therefore can run over any access network. For example, the operator "3" offers flat-rate use of Skype over their 3G network. This enables users to reach at least other fixed VoIP users, and to reduce long distance call costs significantly. While this suggests heterogeneity of wireless access networks is therefore not an important obstacle for Mobile VoIP, heterogeneity in handover and roaming across access networks are still an issue. Thus, true mobility is thus still a technological issue limiting the attractiveness of mobile VoIP implementations.

Different VoIP Solutions

Most VoIP providers allow using a range of software and hardware clients after configuration of a few parameters such as Userid, Password, STUN server (firewall), and SIP Proxy. Often a service provider can deliver clients already pre-configured with these parameters. For example, for Nokia's S60 phones, pre-configuration or OTA-configuration of SIP settings are the only options. Still, IMS and current SIP/VoIP solutions may not easily interoperate due to incompatible features, protocols, and policy options.

Technological disruptiveness

Windows based mobile devices are now very affordable and very attractive. For example, the QTEKS620 contains Quad-Band GSM 850/900/1800/1900MHz, Quad-band GPRS/EDGE, Bluetooth and WiFi for about NOK 3250. Thus, Microsoft will most likely gain market share and thereby VoIP solutions which we know from fixed PCs. These clients and VoIP providers are new players without the legacy investments of traditional Telecom manufacturers and communication providers. As VoIP technology offers long distance calls either for free or for much

lower prices than we are used to when roaming, users will increasingly adopt VoIP. For example, calling from Brussels, Belgium on a cellular call to Norway is about NOK 10 per minute. With mobile VoIP using a hotel or office hotspot it will be either for free to a landline phone (VoIPBuster) or very affordable, approximately NOK 0,2 per minute via Skype Out. That is up to 50 times cheaper than corresponding roaming charges.

Technological barriers and challenges

Users can now easily switch between mobile operators and keep their phone number using "number portability". This has increased competition and has considerably lowered prices and increased churn. However, VoIP identities are based on SIP URLs, e.g., thor.norge@telenor.no, and cannot easily be moved to another domain. Therefore a user would have to update all other users about the new identity, or rely on services for mapping identities when switching providers.

A VoIP provider can be hosted anywhere in the world. If a VoIP provider misuses their subscribers' trust, users will have a difficult time enforcing their rights in a different country under different laws. Police investigations may require eavesdropping on key conversations. However, as anyone can call anonymously from any place, and possibly use strong encryption, it will be more or less impossible to trace calls back to their origin, and follow a conversation. To solve these issues, regulatory means may have to be applied.

Information and calls are routed over the Internet where they can be more easily intercepted than over a cellular network. VoIP users are currently receiving "spam"-like invitations with strange messages from total strangers. As there is no option to deny invitations to join chat groups or establish bidirectional links, spam

may soon be annoying for VoIP users and few technological solutions to this problem are currently available.

4.3 Business model options and considerations

Solutions for mobile VoIP are often discussed under the broad umbrella of "Fixed-Mobile Convergence" (FMC). On the way to full FMC, however, several solutions for mobile VoIP seem to flourish. These range from solutions utilizing opportunities in incumbent providers' service plans to route traffic from the mobile cellular to fixed IP networks (e.g. Ipdrum and Jajah) to solutions using dual mode handsets and SIP clients giving freedom of choice between IP and cellular service providers (e.g. Truphone and Gizmo). Also, offerings with flat rate mobile data and Skype clients on the mobile terminal are offered (e.g. 3's X-series services). All of these intermediary solutions are still rather complex from the end-user perspective but they give examples of innovative business models growing on our way towards full FMC. It is also likely that many of the business models created during the transition to full FMC will get significant momentum and prove successful in a heterogeneous network infrastructure.

Players, roles and actor networks

Verkasalo (2006) suggest categorizing actors in VoIP in general along two dimensions:

- Proprietary or standard solutions
- Owning or not owning networks

The three main groups of actors that may be derived from the above dimensions are the incumbent operators, virtual VoIP operators and the Internet players, here denoted '3rd party proprietary clients'. *Incumbent operators* are currently observing the developments in VoIP defending the major source of revenues, namely voice on

cellular networks. They are experimenting with IMS platforms and UMA to connect cellular with WiFi networks. *Virtual VoIP* operators provide a service, possibly implementing some billing and charging mechanism, but do not own network infrastructures. The *3rd Party proprietary clients* group including Internet giants such as Microsoft, Google and Yahoo are moving in to maximize their network externalities by keeping clients proprietary. Skype is an example of a provider of proprietary solutions whereas all SIP client based providers as well as operators' UMA offerings apply standardized solutions. Most providers of innovative business models for mobile VoIP currently do not own their networks. Instead they are given access by bridging the service to backbone networks or collaborate with providers or aggregators of WiFi access networks (e.g. The Cloud). A few providers own their own networks, but most of these offer mobile VoIP currently as a more experimental service. For example, 3 offers Skype clients on their X-series service with flat rate data services regardless of the type of traffic. Thus, X-series users are free to place the call through the cellular network or place it as a Skype call using the cellular network as the access network to the Internet and Skype-out to terminate the call in whatever network needed. These examples illustrate the multitude of roles currently involved in mobile VoIP. While there is a multitude of roles, however, we find few mixed roles like in the case of corporate VoIP. In general, only service providers that own network infrastructure are plagued with mixed roles and the potential cannibalization of mobile VoIP on current service offerings.

Some authors have proposed that there are great differences across mobile VoIP actor networks in Asia, the US and Europe (Lindmark et al., 2006). These differences reflect the general mobile service differences of the three regions (Vesa, 2006).

Governance forms

There is an ongoing battle between the integrated model of the telecom operator world, where access, services and management are closely integrated and coordinated, and the Internet world, where the Internet offers access for anyone that is interested in developing new content or services for the global market. Vesa (2006) denotes these two models as technology-centric and user-centric approaches respectively. The technology –centric approach is a 'top-down' approach with heavy investments upfront in standards and technologies while in the user-centric, or bottom-up approach, services or technologies start small but value to the user is high, thus spreading quickly.

The vertically integrated network governance model resembles the current mobile cellular business which is much operator-driven. In this model, UMA and IMS play a big role in integrating cellular with other wireless access technologies to coherently support the emergence of IP-based services. The Internet-type of openness and modularity is absent here. It seems that the mobile VoIP driven by telecom operators is moving toward platform-based service architecture. However, the questions are who will take control of the platform and will the platform be open (market driven) or closed (vertically integrated). These general differences in governance forms are also reflected in mobile VoIP services. Closed forms are applied in particular for the use of UMA for mobile VoIP under mobile operator control. Relational forms are applied by virtual operators signing agreements with operators owning both cellular and WiFi infrastructure, and market forms of governance are used by pure play mobile VoIP providers. Still these providers need relational agreements to terminate calls when the called party is outside the reach of open access networks (fixed IP or WiFi access). They also provide calling party

network access (wholesale origination) through relational forms. For example, Truphone provides mobile VoIP using their SIP-client in all the hotspots of The Cloud. As in the cellular MVNO and resale markets, incumbent origination policies are likely to represent an important determinant of the governance forms available to innovative mobile VoIP providers.

Platform based service architecture requires a network organization of business partners in the service supply chain. Mobile VoIP is moving from voice centric to content centric services. Content centric services are complex services consisting of non-decomposable wholes of various components (handset, application, network, and services). Thus, while vertical governance forms may still be used for service distribution it is likely that relational forms must be used in service innovation. Because voice and data services are complementary, successful mobile VoIP services are unlikely to be voice-only services. Instead, IP-based access to most services is expected by end-users once they adopt mobile VoIP. Most standardized solutions like UMA, SIP and naturally, IMS provides these services.

Value propositions

Two basic determinants of the types of services and business models that mobile and wireless technologies support are *speed* and *mobility* (Lindmark et al., 2006). Speed is associated with bandwidth and mobility is associated with seamless handover between networks. Generally, packet-switched networks are more efficient than circuit switched networks. Therefore VoIP should offer consumers lower call costs. The main customer value of mobile VoIP is to be found in a single terminal that can connect to several network technologies allowing the best and most cost effective network to be used at a given time. Also, the delivery of unified

communication to a single device through a single number can be obtained, and access to services should be independent of the networks used.

Also, convergence allows bundling of services that may create indirect network effects and the broader scope of services that may be offered through convergence enables service providers to utilize and expand their existing customer base; thus, creating direct network effects. This is a strategy we see used by the giant Internet service providers by moving into VoIP including a value proposition composed of attributes of the service itself, size of the user network and not the least, the complementarity of bundled VoIP with other Internet-based services.

In practice, however, *current* value propositions are more limited in the area of mobile VoIP. Cost savings is the main benefit of all providers' value proposition. User and complements network value is only part of the value proposition of providers of proprietary solutions. These providers use their complementary services and their user networks as a basis for their mobile VoIP service extension (e.g. eBay/Skype, Microsoft/MSN, Google/Google Talk).

Market strategies

In a full FMC scenario mobile voice is believed to be mobile VoIP. In this scenario, mobile VoIP providers may as in today's voice market consist of both broad and focused providers. Broad providers offer a multitude of service plans including flat rate plans. Focused providers are likely to serve specialized segments. It is also possible that mobile VoIP will be treated as a universal service and that segmentation will be based on the willingness to pay for non-voice services rather than voice. Most of this is, however, speculation and it is likely that developments at the current pre-FMC stage will affect segmentation in the full FMC scenario.

At the current pre-FMC stage, mobile VoIP is a specialized service focusing the cost oriented and/or technologically skilled mobile users. Typically, current offerings require separate installation of clients on the mobile terminal and registration by service providers. Calls must often be routed particularly to Internet calls when making them and the end-users must often search available hotspots and check roaming agreements before placing the call. This requires considerable skills and thus, only the particularly price sensitive segments are focused by most current providers. Technological developments are constantly making mobile VoIP easier to use, so that providers may soon address a wider set of user segments. In the meanwhile, incumbent operators offer different forms of flat rate plans, for example when calling family members or any other pre-specified numbers, to make the price sensitive customers have little to gain by adopting current mobile VoIP services.

Revenue models

There is a close correspondence between value propositions, market strategy and the choice or revenue objects and the pricing model of each revenue object. As for current voice services mobile VoIP may be priced by combinations of period subscription rates and usage rates based on call initiation and/or length of the call. Also, usage rates may be set at the calling and/or called party. There has also been experimentation with free call plans using e.g. advertising revenue models without any widespread success. Free call plans may also be applied in bundling plans where the revenue is generated by other offerings in the service bundle.

In current mobile VoIP offerings, models from the traditional voice market are applied, but typically with a lower usage fee or with a flat rate fee covering calls in

a local or otherwise geographically specified area. Revenue is mainly generated by income from calls outside the flat rate area by providers mark-up on their agreed roaming prices. Recently, we have also seen examples of free mobile VoIP bundles where the revenue is mainly generated from flat rate bundle pricing or usage revenues of other offerings of the service bundle (e.g. the X-series service of 3).

In the case of current mobile VoIP offerings, revenue sharing is simple and mainly horizontal using agreements corresponding to traditional roaming agreements in traditional voice services. Due to strong regulation of cellular termination pricing, termination as a source of revenue is, however, not insignificant. By attracting price sensitive segments with low cost outbound calls, providers may base much of their revenue model on the termination of inbound calls from cellular networks in low or zero cost WiFi networks. For bundled service offerings, revenue sharing is more complex. Such sharing agreements are currently most often relational and confident. It is difficult for external researchers to uncover these agreements. Open revenue sharing agreements, like the Scandinavian CPA model, could in principle, also be applied.

4.4 Customer behaviour and customer values

In this section we review some of the research on the behaviour of mobile VoIP consumers. Here, we also include consumer research on fixed-mobile convergence.

Customer behaviour issues

We have not succeeded in finding studies measuring consumers' attitude towards mobile VoIP directly. However, based on the logic of the multiattribute model (Fishbein and Ajzen, 1975), all of the positive beliefs about mobile VoIP should lead to a positive attitude towards mobile VoIP. Examples of positive beliefs are

lowered costs, user friendliness, improved mobile coverage, etc. (Capgemini, 2005). According to results from InStat (2006), 41 percent of North American households are willing to upgrade primary fixed lines with an FMC service. This result reflects an underlying positive attitude towards mobile VoIP.

The cost advantage of mobile VoIP (Capgemini, 2005) is a major factor leading to an increase in behavioural control among potential consumers. For end-users, mobile VoIP is also considered easy to use (Capgemini, 2005), and no specific skills are necessary for taking advantage of the technology/services. While this is far from true for current mobile VoIP offerings, we may argue that perceived behavioural control will be relatively high for mobile VoIP, stimulating adoption of mobile VoIP services. However, Gibson, Bilderbeek, and Vestergaard (2005) do underline the need for simplicity and low complexity of technical implementation (self assembly), and emphasises the need for proper and fast customer support to ensure that the skill dimension will not be a barrier to mobile VoIP adoption.

In adoption studies of traditional mobile services, normative influences are found to have a positive influence on adoption of wireless financial services (Kleijnen, Wetzels and de Ruyter, 2004), wap enabled mobile phones (Teo and Pok, 2003; Hung, Ku, and Chang, 2003) and mobile service in general (Nysveen, Pedersen, and Thorbjørnsen, 2005). Although mobile VoIP will have functions beyond traditional mobile services, the unambiguous effect of normative influences on intention to use traditional mobile services should be considered relevant also as an antecedent for acceptance of mobile VoIP services. In addition, the gratification of sociability of voice services (e.g. Dimmick, Sikand and Patterson, 1994) further strengthens the importance of social influences.

When considering private customers there are several major segmentation approaches that are sometimes conflated. One approach for segmentation of consumer VoIP is presented by Lucent Technologies (2006). *Single youths* are people between 18 and 25 years, mainly men. They are avid communicators and technophiles. The segment has a preference for live conferences services and instant messaging, text messaging, chat room activities, and they frequently send and receive pictures. *Power adults* are also enthusiastic users of mobile phones. They are more efficiency oriented in their usage of mobile phone, both when using the phone at work and in a personal context. They are typically using services as voice, text messaging, multimedia tools, camera, gaming, etc. Finally *Teens and tweens* are people between eight and eleven years (tweens) and between 12 and 15 years (teens). Text messaging, gaming, ringtones, and multimedia services are typically used. For current offerings of mobile VoIP, typical segments will be innovative and cost oriented users with their main contacts in the same segment. Adoption of mobile VoIP offerings outside these segments is likely to require considerable improvements in user benefits beyond cost advantages. This illustrates how mobile VoIP at the current state of heterogeneity represents an opportunity for new service providers applying a focused market strategy as part of their business model.

Customer value issues

One of the intrinsic attributes of mobile VoIP is availability anytime and anyplace, like it is for traditional mobile voice services. These intrinsic attributes are not as strongly supported by current mobile VoIP offerings as for traditional mobile voice services. Although we do not find studies on the uses and gratification of mobile VoIP, the close kinship between traditional mobile services and mobile VoIP makes results from uses and gratification studies of traditional mobile services

relevant. According to Leung and Wei (2000), expression of fashion and style, affection and sociability, relaxation, mobility, immediate access, instrumentality, and reassurance are relevant gratifications of mobile services. Both instrumental antecedents as perceived usefulness and non-instrumental antecedents as enjoyment and expressiveness are also found to be drivers of mobile service adoption in general (Nysveen, Pedersen and Thorbjornsen, 2005). What is more unique for mobile VoIP (compared to traditional mobile voice services) is the availability for value-added services as a result of convergence between fixed and cellular systems (fixed-mobile convergence). Some of the potential inherent characteristics/intrinsic attributes of FMC are 1) seamlessness at device, network and architecture, 2) user flexibility of access methods, 3) converged customer premise equipment – possible to use one device for the applications currently accessed only using several devices, 4) personalization, and 5) possibility to choose the best of cellular, fixed and wireless world (Gibson et al. 2005). Again, these benefits are not found in current mobile VoIP offerings. Also, restrictions in availability when using current mobile VoIP services when compared to traditional mobile voice services represent a heterogeneity problem. For example, all adopters of current mobile VoIP offerings constantly switch between their traditional mobile voice service and their mobile VoIP service to reduce cost and obtain availability.

The value of mobile VoIP increases with the number of users (direct network effects). The more users of mobile VoIP, the higher is the possibility to take advantage of the voice and the other services available on mobile VoIP. A study by Wang, Hsu, and Fang (2004) found positive direct network effects on ease of use, usefulness and intention to use for an Internet Instant Messaging service. When a lot of people are using a technology, the usage of the technology can be learned from observing other peoples usage. Also, when many people are using a

technology, non-users get an impression that the technology must be easy to use, lowering non-users threshold for adopting the technology. A technology is also *perceived* to be more useful when a lot of people are using it (so many people cannot be wrong). The main argument for the positive influence of direct network effects on intention to use the technology is related to safety in numbers (Wang, Hsu, and Fang, 2004). Because mobile VoIP and instant messaging are related technologies in many ways, the results from the study by Wang, Hsu, and Fang (2004) should be relevant for mobile VoIP. Current offerings of mobile VoIP services suffers from serious heterogeneity problems related to direct network effects due to lack of roaming between service offerings. For some service offerings, roaming is simply unavailable (e.g. between Skype and GoogleTalk), whereas for other service offerings, the roaming costs are considerable. For some segments, however, network strength may be more important than network size. In these segments, there may be positive direct network effects increasing the value of the mobile VoIP service. Still, it is the indirect network effects of the complement network that mainly drives customer value in these segments.

Some of the main complementary network attributes of mobile VoIP may be 1) instant access and direct communication, 2) possibilities for hands-free operation, 3) no need to remember extension numbers or to keep track of who is on duty, 4) tighter control of people resources within an organization, and 5) server-based design allows integration with other systems (e.g. inventory systems, CRM systems, messaging systems) (Purdy, 2005). As can be seen, some of the attributes are mostly relevant in an organizational context while other attributes have a general interest among potential users. For consumer offerings of mobile VoIP, mainly current proprietary solutions (Skype, GoogleTalk, Voice over MSN) offer packages of complementary services that are broadly adopted. For most of these

offerings, the complementary service offering is used as a basis for leveraging the voice service. A complementary service not mentioned by Purdy (2005) is presence. It is likely that the complementarity of presence and voice will be an important driver of customer value for mobile VoIP services. The proprietary character of some of these complementary services is, however, a source of heterogeneity problems in mobile VoIP services.

Price sensitivity

At least some mobile VoIP services have unique value both when it comes to their intrinsic attributes and their complementary network attributes. Compared to other mobile voice services, the relative price level is also low. This may contribute to low price sensitivity, but mainly it contributes to attracting price sensitive segments. In addition, most consumers with knowledge about mobile VoIP are probably also aware of alternatives to mobile VoIP. Thus, current mobile VoIP customers are price sensitive and less likely to stay that way. Mobile VoIP services may in future mobile package solutions, however, be seen as "free" standard offering leading to less price sensitivity. However, for a free service, price sensitivity is of little relevance. Another aspect of mobile VoIP related to price sensitivity is that portability of e.g. SIP-addresses may or may not represent an issue creating or removing switching costs. As we know today, various types of switching costs are also often an implicit part of the deal between operators and customers, and the way these issues will be resolved is still uncertain. Consequently, much indicate a rather high level of price sensitivity among customers of mobile VoIP services, and new issues of portability may lead to both higher and lower switching costs in the service area. Investigations of customer reactions to new forms of switching costs may thus be of relevance to reveal this as a potential heterogeneity problem.

Compatibility

Many of the arguments presented about compatibility for corporate VoIP (section 3.4) are also relevant in this discussion of mobile VoIP. However, the complexity and manifolds of technological compatibility may be a bit lower in the consumer context. The availability of compatible services on Mobile VoIP is typically currently much lower than for corporate VoIP. This, however, does not have a technological basis, but rather a business strategic basis. Consequently, we can conclude that the challenges of technological compatibility are lower for mobile VoIP than for corporate VoIP, but unfortunately, the business strategic sources of lacking compatibility more than compensate for this. To make consumers adopt mobile VoIP, compatibility with their values, needs and experiences must be satisfied. This may be particularly relevant for the development of devices and user interfaces. Thus, it will be important to design devices and interfaces that are compatible with consumers' needs and prior experiences. Currently, mobile VoIP offerings may best be characterized as "add-ons" to traditional mobile voice services. The lack of roaming between both voice services and complementary non-voice services of different proprietary offerings further reduces the compatibility of current mobile VoIP offerings. This is a major source of heterogeneity problems in current mobile VoIP offerings.

5 SERVICE AREA – MOBILE BROADBAND

A mobile user can choose amongst many wireless technologies to gain Internet connectivity while on the move. Today mobile business phones support 2G, 3G, Bluetooth, and WiFi. New solutions such as WiMAX and Wireless USB are currently deployed. In 2005, NTT DoCoMo demonstrated wireless technologies for 4G beyond data rates of 1 Gbps. Current laptops are delivered with both PSTN modems and WiFi access functionality. Laptop chipset manufacturers are also heavily involved in the development of future high-capacity broadband solutions such as e.g. WiMAX. Wireless Broadband above 1 Mbps is now available in many areas. First, 3G/HSDPA PC-Cards are offered to enterprise users offering speeds beyond 1 Mbps at reasonable cost by, e.g., Vodafone UK. Many hotel chains (e.g. SAS Radisson) and cities (e.g. Google WiFi for San Francisco) offer WiFi services either for free or for a relative low fee. In the long run an enterprise can select from competing technologies to fulfil their needs. However it is unlikely that one technology alone can address all requirements, when it comes to coverage and cost, and consequently that mobile broadband choice will be an inter-platform choice. Consumer broadband users are currently familiar with wireless broadband solutions in their homes due to widespread adoption of residential WiFi.

At the service level mobile broadband is used for Internet access mainly, either as access to public and private open Internet services or to corporate or private services tunnelled over the Internet (e.g. VPN). While mobile and wireless broadband typically is considered as access to these services from a laptop terminal, current developments leading to overlapping functionality of terminals with different form factors, mobile and wireless broadband is also relevant as a service giving public and private Internet broadband access from mobile phones

and PDA's. This terminal convergence challenges the customer habits of discriminating laptop service functionality from mobile phone functionality domesticated by many end-users. As such, mobile broadband represents a service area where heterogeneity caused by behavioural patterns may challenge technological convergence at the network and terminal levels. We currently see tendencies in this direction for e-mail access where advanced e-mail clients are available on mobile phones and solutions are implemented at the server platform to enable e-mail push. It is not unlikely that general mobile broadband will develop as a service in a similar direction.

5.1 Market and regulatory structural conditions

A range of different access technologies will be on the market providing broadband access, e.g. LTE and HSDPA (High Speed Downlink Packet Access) on 3G and mobile WiMAX. An important technical issue in the coming years will, therefore, be the extent to which access to these network facilities will be integrated so that the user will be able to roam all services across different networks seamlessly. This is the vision in many projects on future wireless technologies and is already at least when it comes to standards, implemented in the case of UMA/GAN.

Market

Depending on the degree of roaming and seamlessness in communications, there is an issue regarding network effects. If there is roaming, there will be room for more and different access networks. If there is less roaming, network effects will work in favour of fewer technologies (and providers). If there is seamless roaming, there will be an increasing degree of differentiation in the market with different access possibilities that, to a large extent, substitute for one another. On the other hand, a number of these technologies will not be able to cover the whole geographical

space and the question of interconnection/roaming is, consequently, on the agenda. This applies, to a high degree, to WiFi, but will also apply, for instance, to WiMAX. There will, therefore, be a question of substitution and complementarity, where some networks are more complementary (for instance 3G and WiFi), while others are more substitutional (for instance 3G and WiMAX). This is, to some extent, a technical issue but is also very much a market and competition issue, where different providers use different technologies to win the market (or market shares).

At present, the mobile broadband market as it is defined above is mainly a business market. Business people away from office use mobile broadband to access not only public data services but also their company IT system via VPN (Virtual Private Network). However, it is Internet access service at home once attractive flat rate price plans are available. But currently, mobile broadband supplements fixed broadband access. Mobile broadband is clearly a two-sided market. On one side of the market are the end users who are the primary customers of the provider. On the other side of this market are the suppliers of services and content and/or aggregators with whom the mobile broadband provider must cooperate to offer its end user services. Some operators will use a 'walled garden' approach and others a more open business model. From a market structure point of view, this is important for the possibilities not only for service and content providers to enter the market but also alternative network providers – in the case where one or a few network operators dominate the network market. The issue of concentration is, consequently, horizontal as well as vertical in the mobile broadband market, and the market is characterised by scale as well as scope advantages.

The market for mobile broadband has grown more slowly than formerly expected. But the market potentials are huge and a large growth is expected to take place in the coming years. Mobile broadband is, therefore, a potentially lucrative market. This is, at least, the expectation of most observers seeing mobile broadband as a major revenue source for mobile network operators in the years to come. There are, as mentioned, considerable scale and scope economies in this field. Moreover, the requirements on the level of technological knowledge necessary to gain a market share are relatively high. All in all, this means that the barriers to entry in the market are generally high. Furthermore, social relationships also work in this direction, where the sheer power of large network operators in this field plays an important role, both in influencing policy and regulation and in the daily practices in the market.

Regulation

The general tendency that more advanced technologies offers higher data rates suggest technology neutrality to be an issue of mobile broadband regulation. This requires technologies that may be used at the service level for substitutable services to be covered by the same regulation. Data rate is, however, only one of several attributes describing access technologies. As mentioned above, coverage, low latency handover under mobility and costs are other attributes of relevance to substitutability that may also be considered in regulatory decisions.

As for mobile VoIP spectrum, policy is important to innovation in mobile broadband services. In particular this is the case for policy decisions of unregulated spectrum, for spectrum available after shutdown of outdated services and for spectrum allocation to technologies under standardization or development. Generally, spectrum allocation is predictable and there are several opportunities for

influencing spectrum allocation decisions. Participation in this process and obtaining licences may be costly, particularly to new, greenfield providers. This suggests policy decision makers should carefully consider the effects on innovation of spectrum decisions. For example, spectrum auctions may inhibit innovation if the potential source of innovation comes from new, greenfield providers.

If the assumption above on supplementarity is correct, market specific regulation would not represent a major issue for mobile broadband. However, as soon as the technology allows complementarity or substitution, the issue of inter-service competition turns into an issue of inter-platform competition (Richards, Foster and Kiedrowski, 2006) In this case, current market specific regulation and in particular, the definition of relevant markets may have to be revised. In this case, regulatory predictability is reduced making providers hold back on innovation investments. With the current set of technologies of relevance to mobile broadband, market specific regulation, however, is predictable and does not represent a very significant issue in business model innovation.

Content regulation is an issue for services provided by mobile broadband not focused here, but for traditional Internet access for business users it is not a big issue. For consumer services, however, content regulation represents an issue.

5.2 Technological structural conditions

As seen from the introduction to this section, a number of technologies are currently available to the user in demand of mobile and wireless broadband. While some of these are restricted to nomadic use, some offers truly mobile access. In this section, however, we include issues of technological heterogeneity relevant across all these access network technologies.

Standardization

The telecom industry standardizes in 3GPP and ETSI TISPAN. This common "All-IP" "Next Generation Network" (NGN) allows users to roam freely between fixed and wireless networks worldwide. The GSM Association has issued the IR.61 reference document to define Wireless LAN/2G/3G roaming using SIM cards (GSM Association, 2003). IT manufacturers and Telecom operators currently test WiFi/Cellular roaming in the IRAP (International Roaming Access Protocols) forum allowing even non-SIM based access (Weinrib, 2006). Interestingly enough, no major telecom manufacturer like Nokia, Ericsson, Alcatel or Siemens is participating. The forum has a vision indicating that "seamless roaming" may not be about access alone, but needs to be related to device and service access too.

IETF has standardized the Extensible Authentication Protocol (EAP). EAP is an universal authentication framework frequently used in wireless networks and Point-to-Point connections. It is defined by RFC 3748 (IETF, 2004). Although the EAP protocol is not limited to wireless LAN networks and can be used for wired LAN authentication, it is most often used in wireless LAN networks. According to Wikipedia, recently, the WPA and WPA2 standard has officially adopted five EAP types as its official authentication mechanisms. "Generic Access Network (GAN) is a local area access technology that enables GSM and WCDMA service to be delivered over broadband and WLAN, at homes or in offices (Ericsson, 2006). GAN is adopted in 3GPP Release 6. Thus users will be able to use services such as voice calls and SMS/MMS messaging in the same way as in 2G/3G networks over WiFi or other access networks.

"The Cloud" is Europe's leading WiFi hotspot aggregator supporting many of the methods mentioned above. They offer unlimited monthly WiFi access for GBP 11.99 (about NOK 145) across over 7000 hotspot locations throughout the UK, Germany and Sweden (www.thecloud.net). Operators such as BT, Vodafone, O2, and Telenor are some of their partners. Similar, Skype is offering access to 18000 hotspots worldwide via "Skype Zones" (www.skype.com). Also, aggregators not owning their own access network infrastructure offer service roaming across WiFi hotspots from various providers. For example, Birdstep offers such a service under the SmartRoaming brand (www.smartroaming.com). In summary, several standards exist that address roaming with or without SIM card across fixed and wireless networks. Large hotspot aggregators cooperate with mobile operators to allow cellular subscribers to roam across hotspots WiFi world-wide.

Technological disruptiveness

Some 3G operators have started to offer access at flat rate tariffs on a national basis. This threatens fixed and WiFi based access as it offers more convenience and freedom of movement. On the other hand, once cities like San Francisco offer WiFi access for free or very low fees users can easily roam from their homes and offices never loosing connectivity. That may be all that is needed for companies operating on a local level and will also extend established customer behaviour developed in WiFi enabled homes to non-residential access. In addition, new access technologies are also under deployment affecting the battle between 3G and WiFi. Because WiMAX networks do not have to be backwards compatible, and because their control networks is much simpler (e.g., no complex handover) they are theoretically deployed and operated at lower cost. In some rural areas they are likely to enable broadband access for everyone.

Technological barriers and challenges

Roaming issues still make easy to understand cost-control models such as flat rate difficult to implement. In current roaming scenarios users are still faced with unknown or high prices. Several of these issues are related to "single-sign-on" and security problems as well. The Liberty Alliance has proposed solutions for "single-sign-on" to access and services. However, federation of trust between federations is not standardized yet. Therefore trust based on operators, banks or other players cannot easily be linked.

Also, the decision to use a certain access link is not only based on price or bandwidth but may involve much more complex decisions. E.g., importance of a message (e.g., alert), reliability of availability (e.g., fleet management), reputation of a certain access provider ("modem hijackers"), available battery power, and more. Thus, complex access choice decisions may be required beyond simple price/bandwidth assessments. Experienced users may like to still be in control of such decisions, whereas inexperienced users may find such decisions much too complex.

5.3 Business model options and considerations

Rao and Parikh (2003) see two models emerging for building large-scale wireless broadband networks: (1) The top-down approach involves building a network in the traditional way with the network operator charging a fee for access. (2) The bottom-up approach involves loose federations of enthusiasts who offer free access. Rao and Parikh (2003) describe the business models of four organizations involved in the rollout of wireless broadband networks; Boingo, Joltage, Sputnik and NYC Wireless. Each organization has adopted a different strategy and provides a unique value proposition in attracting and retaining its customer base. The dimensions

found relevant by Rao and Parikh (2003) are network model, user model and technology model. This differs considerably from the traditional business model literature, exemplified by a corresponding analysis of the wireless internet service provider market in Switzerland by Campanova et al. (2003) applying the dimensions: Value proposition, customer relationship, infrastructure management, and financial model.

Players, roles and actor networks

Mobile broadband players are, however, not limited to players offering WiFi access. Mobile broadband is also offered by cellular operators as a part of their 3G services. Technological limitations, such as indoor coverage and price sensitivity of customers have also made 3G operators offer mobile broadband bundles with WiFi access. For example, Telenor offers this as a vertically bundled service in Norway and as a relational bundle with The Cloud in Sweden. Most 3G providers price mobile broadband access by "modem" differently from mobile Internet access from the mobile phone or other handheld device. For example, in the X-series flat rate service offering of 3, modem data traffic is not included in the flat rate bundle in UK, but it is included in the offer in Sweden. Such service plan diversity leaves space for WiFi operators to offer single hotspot, multiple hotspot and roaming hotspot wireless broadband as an attractive service. In Europe, however, traditional telecommunications companies have seen this opportunity and as a consequence, the European hotspot marked differs considerably from the US market. Currently, only The Cloud represents significant greenfield players in this area (see the table in Ofcom, 2006, p. 54). In addition, roaming agreements seem to be flourishing and also roaming aggregators contribute to reduced disruptiveness of greenfield wireless broadband providers.

New technologies may change this "harmony", but HSDPA investments are made by 3G providers to meet future challenges and future technologies will be complementary to many of the current offerings. In particular, when evaluated by QoS, investment costs, coverage potential, data rate and mobility, new wireless broadband technologies will be complementary and call for agreements among network owners to ensure interoperability, handover and roaming.

Network owners are, however, not the only relevant players in this market. We have seen how the integration of WiFi technology in laptops by vendors has affected the costs and availability of equipment and access. Similar developments have not been seen in technology for operator controlled cellular access. The investments of vendors in WiMAX standardization indicates that this current harmony of heterogeneous access roles may be challenged in the near future.

Governance forms

As seen from the discussion above, vertical, relational and market based governance forms are used in the wireless and mobile broadband service area. Vertical forms are found that originate from traditional telecommunications companies investing in traditional 3G and HSDPA networks and in WiFi investments made by hotspot operators. For the last category of players, however, relational governance forms are more typical. This does not, as we have seen above, exclude relational governance forms involving both telecommunication companies and hotspot service providers. The examples we see of access aggregators in this area offering cross cellular and WiFi roaming as well as cross WiFi provider roaming represent market forms of governance very similar to the market forms of governance used to provide horizontal roaming across telecommunication networks in general. A few exceptions are found though. The

open model used by bottom-up hotspot communities such as FON (http://en.fon.com/) and partly also by more commercialized community based networks such as NYC Wireless (http://www.nycwireless.net/) represents more open governance forms, but these forms do not seem to have gotten the widespread adoption that was predicted at the introduction of WiFi technology, at least not in Europe.

Governance forms of innovation on the other hand, are more difficult to disentangle. While innovations in the established mobile broadband market are mainly business model innovations, the innovations resulting from new technology are naturally both technological, business strategic and behavioural. For example, standards including both technology and business strategic behaviour are currently developed in forums like the WiMAX Forum (http://www.wimaxforum.org). Participants include equipment vendors, chipset manufacturers, network owners and operators illustrating the wider participation in standard developments for this technology than for telecommunications technology. This is also illustrated in the difference between licence holders for WiMAX spectrum, e.g. in Norway (http://www.npt.no/pt_internet/ressursforvaltning/frekvenser/utlysninger/auksjonsinfo.html). The role of chipset vendors in new technologies for mobile broadband may result in governance forms of innovation being more vertical, but this is speculation only.

Value propositions

The difference between wireless and mobile broadband access reflects mobility as the added value proposition. Mobility as a unique attribute appeals to moving users such as users in trains and cars. Due to a correlation between mobility and coverage of technology supporting mobility, good coverage is also a benefit offered to

mobile broadband users that currently is not offered by wireless broadband services. Due to the availability of hotspots, coverage in rural areas may be very good, and the practical difference in coverage between mobile and wireless broadband may be of little practical importance to the user. Wireless broadband, however, often offers higher bit rates at more affordable prices. Due to roaming agreements, single bill and single sign-on arrangements are also currently offered. The trade-off between mobility and bandwidth may be challenged by new network technologies, such as HSDPA and WiMAX. In particular, developments in mobile WiMAX, standardized in 2005, may make alternative wireless and broadband service access technology more substitutable. Rollouts of national level mobile WiMAX has already been announced by large players such as Sprint in the US (http://www.wimax-industry.com/ar/8i.htm).

Due to the wide implementation of WiFi technology in laptops and the use of WiFi in broadband connected homes, wireless broadband access is widely adopted. When compared to cellular based access, the users are skilled users and often perceive WiFi access to be easier to use. In addition, WiFi providers offer more predictable pricing. It is by no means obvious that the end-user costs are lower for a specific use case with WiFi, but due to experience with using the WiFi service and predictability of pricing and predictability of bandwidth, the benefits of WiFi providers' offerings may be perceived as more favourable.

Market strategies

The mobile broadband customer is easily identified and except for bundled solutions bought by corporate customers, the customer and the end-user are the same individual. Originally, mobile and wireless broadband customers were corporate end-users signing individual agreements with service providers as part of

their mobile service plan. Later, they typically also signed individual agreements with hotspot service providers. As roaming developed for hotspot services, wireless broadband and mobile broadband were bundled and bought by corporate customers responsible for giving corporate end-users secure access to enterprise applications, typically through VPN. This segment is still important, and there are some providers still mainly focusing this segment, for example by focusing hotel and business venue services mainly. With the widespread adoption of WiFi, other wireless broadband segments have grown considerably. Thus, most service providers now also find consumer segments interesting. There are, however, few examples that this segment is differentiated, for example by pricing plans. Instead, it is believed that mobile VoIP and corresponding cost saving for voice calls may be a more important driver for public wireless broadband adoption in consumer segments.

Revenue models

The revenue models of wireless broadband varies from free or low flat rate models of open, community based providers like FON and NYC Wireless to usage based models of hotspot service providers specializing in short time access in cafes and bars. Thus, revenue objects differ considerably from sales of specialized WLAN routers (FON) to minutes accessing the network. Most commercial providers offering widespread hotspots or roaming agreements with other hotspot providers use combined revenue objects in ways similar to traditional telecommunication services.

Mobile broadband access is typically offered as part of all service plans by 3G network operators. Some plans, particularly those focusing corporate customers offers flat rate pricing for mobile broadband. As mentioned above, they sometimes

often offer this as part of a mobile and wireless broadband bundle (e.g. Telenor in Norway) and sometimes keep these services strictly apart (e.g. Netcom in Norway).

For service providers bundling mobile and wireless broadband or those offering some form of hotspot roaming, traditional revenue sharing in the form of horizontal roaming agreements is used. Implementation of AAA solutions for wireless broadband has enabled this development. For community based service providers, "revenue sharing" is based on a mutual benefit type agreement where only benefits, not revenues, are shared.

5.4 Customer behaviour and customer values

The discussion in this section focuses research on dimensions of consumers' behaviour and attitudes towards mobile broadband. This project mainly focuses broadband data access through a "modem" for other terminals – primarily laptops. Although the review has a somewhat broader focus in parts of its discussion, the conclusions are based on the above mentioned definition of mobile broadband.

Customer behaviour issues

Results from several studies unveil consumers' attitude towards mobile broadband. A study conducted by TMNG (2005) illustrates the interest among US consumers between 13 and 34 years in using various mobile broadband services. The percentage of extremely and very interested consumers is reported here. Commercial free radio (39 percentage), music download (34 percentage), mobile TV (33 percentage), video clips (21 percentage), and multi player 3D gaming (21 percent). "*Nearly one in four young mobile users would be extremely likely or very likely to switch to a competitive carrier if their existing carrier did not offer these mobile broadband services*". Results from ArrayComm (2004) show that

consumers' willingness to pay for mobile data services are about one tenth of consumers' willingness to pay for mobile voice services (calculated per MB delivered). However, a note by Siemens (2006) argues that the demand for mobile broadband services is increasing and that subscribers are willing to pay for such services. Overall, we must conclude that consumers attitude towards mobile broadband seems positive. This is also reflected in study by TietoEnator (2006) predicting the number of mobile WiMAX subscribers worldwide to increase from 1.7 million in 2007 to 21.3 million in 2012.

Both financial abilities and skills are dimensions of behavioural control. According to Motozine (2006) and Sprint Nextel (2006), mobile broadband is cost effective. Netgain 1200 (Accessed 13.01.2007) emphasizes the importance of a positive user experience with easy and fast browsing for adoption of mobile broadband. Farpoint (2006) also discuss costs and ease of use (it must be cheap and easy to purchase, install, configure, and use) as decisive antecedents for adoption of mobile broadband. Based on this, we can conclude that mobile broadband is easy to use and cost effective. Mobile broadband is particularly relevant to business people away from the office using mobile broadband to access public data and their company IT system via VPN. For most of the users, the company will therefore pay the costs, reducing the importance of costs for the user. Access is mainly limited to content and systems the users already know, reducing eventual problems related to skills. Thus, behavioural control should not be a barrier for acceptance of mobile broadband.

Services available through mobile broadband can be classified into communication services (for example chat and e-mail) and content services (for example access to Microsoft office and CRM systems). The effect of normative influences will

depend on what kind of service that is used. For communication services, which is used publicly and in a social context, social influences will probably influence potential users perceived value and adoption of the services. If the purpose of using mobile broadband is content services, elements related to utility and efficiency are probably more significant antecedent for service usage than social influences. Given the focus in this project on business market mobile broadband and access to public data and company IT systems, it is reason to believe that social influences has a low to medium importance for consumers acceptance of mobile broadband.

Customer value issues

Because mobile broadband enables access to public data services and company IT services anytime and anyplace for business people, intrinsic attributes as ubiquitous, usefulness and user friendliness have to be pinpointed.

The importance of direct network effects for the success of mobile broadband services does also depend on service usage. For content services, direct network effects will not be of decisive importance. However, the results presented by wcdma.org (Accessed 13.01.2007) indicate that communication services as e-mail and instant messaging/text messaging are the two services mostly used via mobile broadband. Based on this, we may infer that direct network effects will be present as a significant antecedent for the success of mobile broadband. However, these are attributes of the service used on the mobile broadband, not the mobile broadband service itself. Thus, direct network attributes are of little relevance to mobile broadband.

In this section we have discussed several inherent services for mobile broadband, defining inherent services as services relevant for a business context. Other services

that will be present in the future are 1) videoconferencing, 2) gaming, 3) enhanced messaging services, 4) mobile office, 5) mobile commerce, and 6) mobile instant messaging (Ralph, 2002). Although some of these services are relevant for a business context, they can also be considered to be personal services, home services, and entertainment services, and must be considered as complementary services. This may indicate a higher usage level of entertainment and communication services on mobile broadband in the future. However, given the definition of mobile broadband for the purpose of this project, access to private and entertaining complementary services will have limited influences on perceived value and adoption of mobile broadband. Still, mobile broadband are of little value without the complementary services listed above for both corporate users and consumers. Thus, the relationship between mobile broadband and the complementary services accessed through the mobile broadband connection are of great importance in understanding the value of mobile broadband. This also illustrates the importance of the mobile broadband service as being application agnostic and represent a general platform for providing complementary services in order to create customer value. For example, a mobile broadband service closing ports used by corporate customers for security or protectionist reasons is likely not to be adopted by end-users (e.g. T-mobile closing ports used by VoIP in their flat rate 3G data service offering or banning users using VoIP services on it (http://www.engadgetmobile.com/2007/03/02/t-mobile-usa-gets-dicey-about-handset-based-internet-usage/)).

Price sensitivity

For the mobile broadband service focused here, the company pays for employees' (the end users) access to the service. Although the costs are not insignificant, it is often for the best of the company if employees are able to work from anywhere and

anytime when they are not present in their office. By and large, a company will see the advantages of this, and concerns about the price of letting employees use mobile broadband will be marginal. Mobile broadband services are rather standardized and a company will be aware of alternatives to mobile broadband. This suggests a high level of price sensitivity to the access service and less price sensitivity to its use. However, the price level is not very high (a company can typically negotiate an acceptable flat fee) and the purchaser in the company are not the ones who pay for the service. Parks Associate (2006) also shows that the price sensitivity to mobile broadband services is rather low. For consumer mobile broadband, however, it is likely that price sensitivity will resemble that of the fixed broadband market which is generally found to be rather price sensitive (Falkner, Devetsikiotis and Lambardis, 2000).

Compatibility

According to Motozine (2006, p. 6), technical solutions for mobile broadband as for example WiMAX, is "*simpler in structure and more cost effective because it collapses wireless technology-specific functionality from other network elements into the WiMAX access point*". Compatibility with other access technologies like WiMAX, is therefore of importance for the success of new mobile broadband technologies. Netgain 1200 (Accessed 13.01.2007) also point to the importance of fluctuation in bandwidth, high latency, changes in reception conditions, and sporadic disconnection as potential hindrances for mobile broadband success. These potential hindrances can typically exist because of problems related to compatibility between heterogeneous networks involved. Compatibility to values, needs and experiences should be no problem. Except for the usage of a mobile device as a modem, the interface and the functionality of the services should be more or less similar to what the users are used to.

6 SERVICE AREA – MULTI PLAY

The combination of voice, data, and video services offered as a bundled service for a price that is less than the price of the individual services is often called triple play services. Quad play is the first step in the converged wireless/wireline (FMC) evolution. The four services that comprise the quad play are: Video/TV, voice, high speed data or broadband Internet and wireless services including mobile voice services and perhaps also mobile broadcast services. Beyond just bundled services, true multi play services develop from convergence as the ability to provide uniform and ubiquitous services or applications across multiple technologies and access devices. Converged services, starting with a seamless quad play offering, may represent the next wave of the communications evolution. Quad play can be seen as a logical extension of triple play. Mobile handsets are already evolving to be smarter with greater connectivity and media functionality. This can enable WiFi mobiles handover to a local network when in range to keep costs down. When around the house, your mobile could also act as a straight forward VoIP handset. There's a wide range of other potential applications, including things like video playback, remote home automation and monitoring, gaming and adding email/instant messaging with presence.

At the service level, multi play may be business strategic bundles with integration at the bill level or it may be provided with a more technical integration utilizing the variety of infrastructure controlled by integrated and full service providers as suggested above. Multi play also represent an interesting service area to contrast closed versus open business models. In particular, the provision of multi play as an open access service where the customer is offered a variety of service providers for each of the individual services of the service bundle and where the customer is free

to compose the bundle of services to his/her preferences, represents a vastly different business model than the closed model currently applied by most cable, fiber and telecommunication network providers.

6.1 Market and regulatory structural conditions

The term multi play denotes a package of services (mostly) delivered on a single access platform – in the fixed area either via fibre, DSL or cable, but it could also be via stationary WiMAX or mobile platforms, e.g. mobile TV, Internet and telephony on the mobile terminal. The reason that the word 'mostly' is inserted is that a multi play service also can be delivered using a combination of access networks. This is, in a sense, what multi-platform operators do when delivering telephony as well as Internet and cable-TV to subscribers using different access networks. At any rate, such a multi-platform offer is what multi play operators compete with when they enter the market.

Market

As discussed above, a multi play package can either be, at the one extreme, simply a discount if the user buys a package/bundle of services or, at the other extreme, a really integrated service offer, where the services are not only provided via a single access network but also are functionally integrated. Between these extremes, there are a number of different models. In the case of triple play (telephony, Internet and TV), there are truly integrated offers on the market; in the case of quad play (also including mobile communications), a technologically integrated solution requires a higher degree of FMC (Fixed Mobile Convergence) than mostly found on the market presently. Multi play is thus a rather differentiated market with diverse package forms.

The market for multi play services using a single network is generally driven by newcomers as, for instance, utility companies offering multi play via fibre or cable TV companies entering the Internet and telephony market. Multi-platform incumbents like the former telephone monopoly companies will often not be the innovators in this market but will tend to retain their users on the multiplicity of platforms they offer, as this is where the users are presently. In the coming years, incumbents will also increasingly move towards multi play, and bundling of services is generally a strategy taken up by market players to lock in customers. However, in the present situation, using multiple access platforms is the most profitable business model for multi-platform incumbents, as they already have these access networks. A more obvious network strategy is to implement NGN (Next Generation Network), where the core network functions as one integrated network, while there are still different access networks.

In most cases in countries with a wide penetration of Internet access, multi play enters the market as a substitute for separate telephony, Internet and TV services. The operators driving this market are, as mentioned, mostly newcomers using different business models. Some offer vertically integrated services, while others operate on the basis of more open business models, where utilities, for instance, offer fibre access, while they leave the provision of service packages to service operators. It is thus a two-sided market, where access network operators offer their services to end users as well as to service providers.

Mostly, the multi play services are offered as integrated packages and not as separate services. This creates a market, where users are tied closely to the service providers and it is difficult for users to switch provider. However, in a broader competitive picture, this does not presently constitute a competition problem, as the

multi play providers in no way dominate the market for the individual services offered via multi play. These markets are still dominated by the multi-platform incumbents.

The multi play market is, therefore, not a market with a high degree of concentrated market power. On the contrary, it is, at the moment, a market with little concentration and the barriers to entry are not constituted by a quasi-monopolist blocking the way. The barriers to entry in the access network market are made up of high network costs and large economies of scale, which is why this market mainly is entered by utilities and eventually the telecom incumbents. In the service market, barriers to entry are low: it is a new market, while it may eventually become more closed when service providers/aggregators are in place and have considerable market shares. It is a market with new economies of scope, for example in maintaining the customer relationship across previously unbundled services.

With respect to growth, the multi play market seems to have huge growth potentials. The more services migrate to an integrated IP-platform, the more multi play services will seem as a natural way forward. The technological knowledge required to operate a fibre network is high but can be bought – as utilities have done. The level of market knowledge required is also high and the right business model is important. The telecom incumbents claim that utilities do not have the right competences to be in this market and the only reason that utilities can afford it is that they have capital from their utility business. There is a politico-regulatory game in this area, where the political power of the different players may be important.

Regulation

Whereas telecommunication regulation is rooted in a combination of universal obligations regulation and competition regulation, media regulation is a combination of content and competition regulation particularly focusing the interplay between the two considerations. Local media regulation and telecommunication regulation are not unified and typically regulation is controlled by different national authorities. Only in Germany has there been established a general regulatory authority covering several industries originally believed to be characterized by natural monopoly. Here, however, broadcasting is not covered. In UK, Ofcom regulates both telecommunications and broadcasting and this is one of the countries were regulation of a converged infomedia sector seems to have been most well developed (see e.g. Ofcom, 2006). Sectoral regulation may cause problems with for example harmonizing structural conditions for linear and non-linear services providers. Recently, EU initiatives have been made to harmonize these areas (see e.g. Schulz, 2006 and Richards, Foster and Kiedrowski, 2006).

Starting with telecommunications regulatory issues, bundling of services may affect customers' ability to identify cost efficient service offers. For example, the Norwegian regulatory authorities has created an online service assisting consumers choice of operators (www.telepriser.no), but such services may be less relevant when services are bundled. Developments in the financial industry have shown that this is a barrier to market efficiency. Bundling also creates switching costs that may further reduce competition in existing SMP markets, and due to complexity, bundling also creates information asymmetry problems in consumer choice within service bundles and comparison across service bundles is more difficult. Thus, anti-competitive instruments may be applied to extensive service bundling if believed to

be used by significant market power providers (see also Okamoto and Reynolds, 2006 for a good overview) to lock in customers.

To the extent that services influenced by universal access obligations are bundled, regulatory measures are also likely to be taken for these services. Most of the services covered by multi play bundles are also regulated through market specific supervision. It is likely that if bundling affects the status of market power in these individual markets this will be covered indirectly by the supervisory analyses of each market and appropriate measures to eliminate anti-competitive behaviour will be taken. Thus, to the extent that current services that are regulated by these measures are just bundled, regulation is likely to be an important structural condition for innovative business model development. To the extent that true multi play services are offered, it is likely that the same attitudes will be held by regulatory authorities as those discussed in sections 3.1 and 4.1. Thus, regulation is less likely to affect the development of innovative business models for true multi play services than for bundled services. This is also supported by the argument that recent EU-regulation seem to favour platform competition over service competition (e.g. Reding, 2006).

For the broadband and broadcast parts of the service offering, competition is also an issue, but here national regulation also affects content. Due to a blurring of the barriers between content distributed linearly on broadcasting networks and non-linearly on broadband networks, the issue of broadcast and television specific content regulation is problematic. This affects issues such as advertising regulation, regulation of content with respect to children and regulation with respect to public access to television services (must-carry). A few examples may be mentioned. Service providers may have bit caps on their broadband subscription part whereas

these are not counted for the television part of the bundle. Thus, this could be a regulatory issue of relevance to linear versus non-linear content. Closely related are regulatory issues of service blocking as part of ensuring net neutrality. Currently, net neutrality is only partially covered by regulatory frameworks, but this is currently considered a hot topic. A milder form of blocking involving traffic priority using QoS arguments may be used whereas the providers' strategic reasons for traffic priorities may be anti-competitive. These problems increase as service providers control several network platforms (horizontally), and network, service and content platforms (vertically). For example, true multi play providers may seek to optimize revenue from distributing content in various forms. Linear content may be distributed as part of their public obligations, but non-linear versions of the content may be distributed in a variety of forms accompanied by advertising content to generate revenue. This makes content regulation difficult, and the identification of which parts of bundled services are covered by public obligations and which parts are not, is not trivial. This may call for a more integrated perspective on regulation that covers both telecommunication and media content regulation under one umbrella. Such a situation may make regulation less predictable, at least for a period of time and represent a significant structural condition to innovative business models.

To summarize, current regulation is a relevant structural condition possibly limiting innovation in business models for bundled multi play services. For true multi play services, current regulation is believed to be favourable to innovative business models, but due to a need to integrate telecommunications and media sector regulation for true multi play providers, these providers may face a period of unpredictable regulatory conditions. In general, this indicates that for all types of

multi play service offerings, regulation represents an important structural condition affecting business model dimensions that should be further investigated.

6.2 Technological structural conditions

In recent years a lot of attention has focused on communication protocols as the key to quad play — the ability to blend content and programming across a branded offering that combines TV, phone, Internet, and wireless services. It is a common understanding that IMS must be fully deployed for consumers to enjoy the quad play experience. Once diverse access types (IPTV, DSL, WAN, GPRS, etc.) can interoperate, then diverse services can converge. However, standardization efforts are required in order to overcome heterogeneity problems present even in this scenario.

Standardization

According to many industry experts, IMS is considered as the long-term solution for converged services (Bodzinga, 2005). However, UMA and GAN may play an important role in enabling service providers to launch fixed-mobile converged offerings sooner. IMS is an architecture based on IP that can help operators reducing operating cost and generating additional revenue from converged services. IMS offers flexible, open and standardized service delivery architecture that supports numerous applications via common control plane across multiple access networks. UMA is the only standardized solution that enables Fixed-Mobile convergence by tunnelling GSM and GPRS services over unlicensed spectrum technologies e.g. 802.11 and Bluetooth. UMA is the only currently available approach that provides seamless roaming between RAN and WAN. The main drivers for operators to launch UMA are: to improve in-home coverage while improving the economics of wireless minutes used in-building, to counteract the

fixed-mobile substitution trend, and to reduce churn through bundling. Operators providing only fixed broadband services can leverage their networks and increase revenues while decreasing the customer churn rate. On the other hand, combined fixed-mobile operators can adopt a defensive approach that mitigates the threats from VoIP providers.

IMS is in the process of being embraced by cable operators and other forms of broadband service providers. IMS is becoming increasingly important as the architecture of the future network (NGN). At its core, IMS is an architecture that aims to deliver a broad range of IP-based services across any form of IP access network. That means cable, FTTH, WiFi, WiMAX and cellular networks. IMS also makes "considerable" use of SIP. Voice services, however, do not require IMS, and therefore voice probably won't be the first, big driver of IMS, and UMA and/or SIP-implementations are likely to be used for a long time before converged IMS solutions are launched. SIP is still an evolving standard, making interoperability a challenging task.

IP provides a cost-effective way to converge video (IPTV), voice and data onto a single unified network. IMS utilizes IP to deliver video, voice and data services over any access type, fixed or mobile, and creates one consistent user experience that is independent of a user's access or device. By linking IPTV with IMS, television set-top boxes become multimedia IMS end points, along with mobile phones, PCs and other consumer entertainment devices. Voice or data services can be extended to IPTV with the same look and feel as on a SIP-based wireline or wireless device. Still, some authors are sceptical about the maturity of IMS when applied to multi play settings. While this seems an attractive scenario when seen from incumbent operators' perspective, Dixit (2006) mentions several potential

interoperability problems due to underspecified standards and Smith (2006) refers to experts being afraid that as a result of underspecified standards, vendors' solutions may include proprietary elements resulting in lacking interoperability. Dixit (2006) does not question the investments in IP as the convergence layer, but fears lacking investments in unified control structures to be a source of interoperability problems. He also mentions the pace of change as an additional source because providers are likely to take a "wait and see" approach delaying de facto standardization.

Technological barriers and challenges

As competition to provide quad play services increases, QoS may become an essential commercial asset. And, having experienced fixed-line broadband, customers will expect a high level of service from high-speed wireless data systems – regardless of whether they are accessed through a roaming device. Bodzinga (2005) suggests IMS will be important in ensuring QoS for triple and quad play services. Fredriksen (2006) actually suggest the triple play market will be differentiated by providers with and without QoS. In discussions of problems with ensuring QoS in particular for the voice part of the multi play offering. However, other authors have concluded that *"…voice will increasingly just become a data stream in the next generation network. Voice traffic patterns are reasonably predictable…*" (Flagherty, 2006). This suggests that QoS, at least for voice, will not represent an important technological barrier to multi play service offerings. For the video/TV part of the offering, similar conclusions have also been made by empirical tests (El-Sayed et al., 2006). That does not mean all technologies are equally effective and in particular the last mile issue is still a technological obstacle to advanced multi play offerings. This has led experts to propose that at least in US

markets, cable and FTTH providers are currently better positioned for converged multi play offerings than traditional telcos (e.g. Finneran, 2005).

According to a survey done by IBM Internet Security Systems, 55 percent of respondents indicated that security issues are impeding their ability to roll out triple play and quad play service bundles. 78 percent said security is vital to the long-term viability of VoIP and 30 percent said they believe IPTV not to be secure at all. Access control is also an element in security of multi play services. Again, it is believed that one of the main advantages of IMS may be used to offer unified access control mechanisms across multi play service offerings (Bodzinga, 2005). One of the main reasons why this may be important this is that multi play services will also enable cross media services integrating each part of the multi play offering. Examples are mobile access to personalized EPG's as well as to personal picture, music and video collections. In addition to access these types of services the availability of development platforms and API's for developing such services is also a potential barrier, in particular the availability of open API's for service development in this area (Dixit, 2006, p. 59).

Industry efforts

According to a paper by InCode (2006), in the US, the partnership between Sprint-Nextel and four leading cable operators has shown that cable operators seek to develop their own converged service offerings. They do this partly to counter the decision by Verizon, SBC and BellSouth to offer IPTV. Verizon, SBC, and Bellsouth had previously signed partnerships with satellite service providers, such as DirecTV and Dish Network, to provide video services as part of a voice, video, broadband Internet, and wireless bundle that was neither technically integrated nor seamless. Also in the US, providers like Google and Apple not traditionally

offering the services bundled in multi play are forming strategic alliances and making investments to position themselves to participate in this evolution. Google is launching WiFi services in San Francisco that will put certain pressure on traditional wireless and wireline players, and Apple is offering converged features on its new iPods as well as its recent launch of the iPhone.

Europe has taken a different approach to converged services partly due to country specific regulations and market conditions. France Telecom, has built its own quad play capabilities by upgrading its xDSL network to provide video services, while NTL, a cable operator, acquired Virgin Mobile, an MVNO, to extend its capabilities to wireless. In France, Free.fr currently also offers triple play services over ADSL2 at aggressive prices as low as 30 euros pr. Month.

Five different approaches to converged services in the US and Europe are presented by InCode (2006). These include bundled services over existing infrastructures, converged triple play offering over cable or DSL with MVNO or own infrastructure mobile offering, converged triple play offering over new FTTH infrastructures with or without added MVNO mobile offerings, and converged quad play offerings over new or existent converged infrastructures with mobile VoIP based mobile services. Based on these observations, signs of multi play offerings based on converged infrastructures are found, but most multi play offerings are currently bundled offerings with corresponding heterogeneity problems. In addition, even bundled offerings seem to be oddly marketed by some providers. For example, the bundled triple play offering by Lyse in Norway is marketed by a separate brand (Altibox) and is priced at exactly the same price as the sum of the three unbundled services (NOK 818 pr. month as compared to the NOK 250 of the

higher bandwidth and channel collection offer by Free.fr in France) (http://www.lyse.no/category.php?categoryID=5234).

6.3 Business model options and considerations

The economic arguments for providing multi play services are found at both the cost and revenue side of the providers' profit equation. The cost arguments are typically economies of scale and scope from converging to all IP infrastructures. Economies of scale are found primarily for the transport and distribution parts of the service whereas economies of scope are found at the production, distribution and marketing parts. On the revenue side, bundling enables providers to better adapt to the price sensitivity of customers and may also include customer value elements related to single point of billing and increased loyalty that may be reflected in pricing (Okamoto and Reynolds, 2006). Thus, the cost related advantages of multi play require infrastructural convergence whereas the revenue related advantages are almost unrelated to network convergence. While this may lead to interesting multi play offerings when leading operators finalize their NGN projects (Telecom Italy, BT and KPN are the operators most innovative in NGN deployments in Europe), current multi play offerings are almost exclusively based on bundling advantages.

Players, roles and actor networks

Being a complex service offering multi play involves several players and roles. Most current service offerings are triple play offerings that may be delivered by integrated providers with fixed network access to the customer (fiber-, DSL- or cable network providers). The Internet access part of the offering is provided through their regular services, TV services requires agreements with equipment vendors for set-top boxes and content providers or aggregators/brokers for content.

Telephony services are offered as fixed VoIP services requiring at least some agreements with PSTN providers to enable call termination. Depending on the standards used, equipment vendors may also be involved for adapters and/or handsets. To provide network capacity, triple play providers also need core and backbone network capacity.

The shift from triple play to quad play services adds mobile services to the bundle. Currently, this is typically done by adding a regular cellular mobile service through am agreement with a mobile operator. For integrated providers the operator is typically the mobile operator branch of the provider, but for newcomers, an MVNO or a mobile reseller branch may also be established. With a well developed virtual operator structure, however, multi play of this kind may be offered by almost all triple play providers. Currently, there are few examples of added mobile service offerings focusing mainly on mobile VoIP (Okamoto and Reynolds, 2006, p. 18).

Mobile and wireless also brings an additional dimension to the multi play offering. Future wireless access technologies such as WiMAX and HSDPA may substitute fixed access networks used for current fixed access triple play offerings. This also makes the mobile services of the quad play offering much more integrated in the service offering, and the mobile service offering is no longer necessarily voice or simple messaging service focused. Thus, the full multi play service offering distributed over these access technologies could, in principle, be available to the customers' mobile as well as stationary terminals. Currently, however, these are future scenarios and seamless multi play offerings including multi play services to both mobile and stationary terminals are likely to be distributed using a number of heterogeneous access networks. Also, the business models developed under such a

heterogeneous access network scenario are likely to affect the business models that will develop under a full FMC scenario.

Governance forms

As seen from the discussion above, integrated providers apply a more vertical governance form than service bundle providers. Service bundle providers will have to rely on a number of relational and market based contracts depending on the availability of market based sub-contracting offers in their particular market and region. Regulatory policy may have affected the degree to which market based sub-contracting is possible for service bundle providers. This is an example of how regulatory policy affects the availability of possible governance forms to a provider.

Whereas the integrated provider applies a more vertical governance forms, the governance form of each service offering may still differ somewhat. The differences in governance forms across parts of the service offering will be greater for a service bundle provider, but that does not mean integrated providers do not use relational forms for parts of their offerings. For example, distribution networks for TV may be controlled in joint ventures (e.g. NTV/RiksTV in Norway) and content provider agreements may be both relational (integrated operator has shares in content provider company) or contractual (commercial contract with content provider). For the telephony service part contractual agreements for termination are required regardless of infrastructure ownership. For the agreements with content providers, two different governance forms are typically applied. Most current triple play providers apply a closed governance form in particular for TV content. This applies the IPTV form of walled gardening in triple play offerings. A more open option, however, is currently gaining momentum based on two different ideas. One

idea is the transformation from IPTV to Internet TV enabling distribution of linear content integrated in traditional Internet content. This allows for more interactivity that is believed to be highly valued, in particular by younger TV viewers. The other idea is the added value of freedom of choice where open access models enable end-users themselves to compose their channel packages. While the idea of more is better is much debated in current customer behaviour studies (see section 6.4), many providers believe freedom of choice to be a competitive advantage in their offering. Open access will however imply much more use of relational and market based governance forms than current walled garden offerings and also accentuates the importance of managing multi play services as services in a two-sided market.

The shift from tripe play to quad play offerings including mobile services also increases the complexity of the applied governance forms. For full mobile service offerings of all services in the quad play bundle it is likely that different governance forms must be used for the mobile part of the service and the fixed service offering. This is the current situation facing providers trying to offer full quad play services across mobile and fixed terminals. This situation also provides fantastic opportunities for studying variation of governance forms for heterogeneous access network services.

Value propositions

The futuristic value proposition of multi play is nicely summarized by Okamoto and Reynolds (2006) as: "*Multiple play offers represent the first stage in a two-part evolution of converged ICT service delivery. This first stage has seen video, voice and data services consolidated on a given infrastructure (e.g. cable networks). The second stage will include consolidation of access platforms on one IP network,*

allowing users to seamlessly access content while moving over a variety of wired and wireless networks" (Okamoto and Reynolds, 2006, p. 6). While the second stage multi play offering described above includes value propositions of seamlessness that are truly new and unique, currently available commercial offerings include value proposition mainly covering the first of these stages. This triple play offering and its corresponding value proposition is described in the introduction to this section.

For the value proposition including mobile services, the added mobile service may offer simple voice and messaging services through a GSM network service and/or a somewhat more extended service based on cellular 3G networks. This is what may be termed a limited quad play service offering. A full quad play service offering would enable parallel service offerings to both mobile and stationary/fixed terminals, each with their individual value proposition. This also means each service offering would differ in functionality from being distributed to mobile or stationary terminals to capture the unique value driving attributes of each terminal and context of use. This creates a complex value proposition that currently can only be realized by a using a heterogeneous access network business model. Thus, the full value proposition matrix of a full quad play offering may be illustrated as in table 6.1 where we have also indicated potential governance forms for the different parts of the service offering.

Table 6.1 Full quad play offering (limited quad play shaded)

Terminal/service	Telephony	TV	Internet
Stationary	Bundled PSTN or stationary IP telephony Termination agreements required	Bundled TV or stationary IPTV/ Internet TV. Open or walled garden content agreements	Internet access over fixed or wireless (WiFi/WiMAX) networks. Typically vertically controlled.
Mobile	Bundled GSM/3G and/or mobile VoIP service. Termination or virtual operator agreements required	Bundled or own mobile TV service distributed over cellular or digital terrestrial. Complex governance forms required	Bundled or own Internet access services over cellular or wireless (WiFi/WiMAX) networks. Complex governance forms required

As seen from table 6.1, the shaded areas of the limited quad play offering that some providers currently offer is rather simple when compared to the complexity of the value proposition as well as the governance forms of the full quad play offering. For the Internet access part of the service offering, questions of the value of network neutrality also are raised. This is currently a debated topic, and only minor violations of the principles of net neutrality seem to generate negative customer

reactions (e.g. http://itavisen.no/php/art.php?id=341620). For some Internet services net neutrality may also extends to port neutrality bringing the neutrality issue beyond just bandwidth restrictions.

Market strategies

Multi play customer may be end-users, but typically decisions to sign multi play contracts involve more then one end-user. In a residential situation, multi play services affect the whole family and preferences may differ across family members (bandwidth, channel choice, telephony options, multiple TV's and PC's etc.). Many customers of current triple play providers are housing associations or other organizations managing the services on behalf of one or several building blocks or a neighbourhood. This is often more professional customers and they may also own their infrastructure and thus, represent a much more powerful and skilled customer. It is likely that service providers use these segmentation criteria to identify target customers and design appropriate value propositions for specific segments (see e.g. http://www.snap.tv/case-studies/index.php).

Regardless of the focus on individual end-users, residential groups or housing organizations as three distinct segments, multi play customers are currently segmented. Due to requirements of bandwidth, currently fixed access dominates the market. This means the segments of the population that are offered multi play services live in highly populated areas. Wireless technologies may to some degree change this, but coverage of these technologies is also likely to focus the highly populated areas first. Thus, an indirect segmentation is already made in the availability of multi play services.

Revenue models

Current revenue objects of triple play reflect the bundling of the services with corresponding revenue objects varying by the services bundled. This creates complex revenue models that are difficult to control by the customer. An overview of some European pricing models is found in Okamoto and Reynolds (2006). As an alternative to these complex revenue models, a true bundling of triple play services would imply flat rate revenue models using some time period as the revenue object. When investigating flat rate offerings in detail, bit caps, installation costs, roaming charges etc. are most often added to the bundle leaving the true flatness of the rate open for discussion when seen from the customer perspective. While this seems to be rather typical of most providers, flat rate prices vary considerably across markets (Okamoto and Reynolds, 2006). For example, Free.fr offers flat rate triple play at approximately 30 Euro a month, the offering of Lyse in Norway is at approximately 120 Euro a month for a comparable quality.

Revenue sharing arrangements naturally reflects the complexity of the governance forms applied. Thus, a multitude of revenue sharing arrangements are relevant in multi play business model design. Flat rate pricing at the customer interface and complex revenue sharing arrangements at the supplier interface represents a challenging situation for the multi play provider. That said, cost/revenue differences also create great profit opportunities but require advanced management accounting.

6.4 Customer behaviour and customer values

Multi play includes both triple play and quad play. As seen above, current bundling of voice, data (Internet) and TV is denoted triple play while quad play also includes mobile voice.

Customer behaviour issues

Several potential useful and enjoyable attributes are made available through multi play and should, according to the multiattribute model (Fishbein and Ajzen) result in positive attitude towards multi play. A study by Sekino, Pecorari, Douglas, and Gates (2006) on consumers' perspective on multi play found that, in general, about 1/3 of consumers are interested in triple- play while about 1/3 are interested in quad play. A bit more than half (52 percent) of the respondents would be willing to buy multi play products within the next six months. According to InStat, the market penetration of triple play among broadband subscribers in North American households is 18.2 percent. The statistics on willingness to buy multi play reported here indicate a medium to positive attitude level towards multi play.

An important antecedent for adoption of multi play is savings. This seems to be understood by suppliers of multi play products. In a study by IBM (2006), the main triple play pricing strategies among multiple system operators and direct broadcast satellite providers was a 5 – 10 percent discount (45 percent of the respondents) while the corresponding pricing strategy among telecom companies was a 10 – 30 percent discount (61 percent of the respondents)[2]. However, users' skills may be a potential barrier to the adoption of multi play. Excellent customer support is therefore a key variable for the diffusion of multi play among potential customers. Supposing excellent customer support, which is also a major part of the providers' multi play value proposal, behavioural control should only have a marginal influence on adoption of multi play. Recent studies have focused the importance of behavioural control in services that are characterized by increasing complexity and choice (Pedersen et al., 2005; Schwartz, 2004). This is particularly important in the

[2] Respondents were recruited equally from USA, Europe, and Asia.

choice between adopting a walled garden multi play offering or an open access network offering. Following these empirical findings it is likely that only consumers with high perceived behavioural control will adopt the open access network offering. Even if so, the findings of Schwartz (2004) suggest that these consumers may prove to be less satisfied than those adopting the walled garden offering, alone due to the effect of freedom of choice. This is a particularly important problem for further investigation in the multi play service area.

Multi play service is a residential service – not a public context service. According to Nysveen, Pedersen, and Thorbjørnsen (2005), private user context usually minimize the effect of social influences while a public usage context typically stimulate the effect of social influences on users' adoption of the technology/service. Consequently, social influences may have a limited effect on users' adoption of multi play. Opposing this suggestion is the finding that sociability is an important gratification of both telephony (see above) and TV-services (Rubin, 1983). Multi play is relevant both in the corporate and consumer markets. Consequently, segmentation criteria as discussed in both section 3.4 and 4.4 are relevant. For the consumer market, the segments with the highest preference for quad play are families with children, households with larges telecom budgets, and cable customers (Sekino, Pecorari, Douglas, and Gates, 2006).

Customer value issues

Some of the inherent attributes of multi play are integrated features and integrated services (please see discussion of adoption criteria for multi play). Some of the inherent attributes of triple play are discussed by Alcatel (2005). In particular, they call attention to 1) Service availability – the importance of 24/7 access to the three services, 2) Service velocity and user volatility – where the "*goal is instant user*

gratification by rapidly and cost effectively providing and adapting services in response to evolving users needs", and 3) Service innovation and mass customization – "*allowing subscribers to create personalized bundles with flexible pricing schemes that adapt to their individual service needs, budget, and usage pattern*". "*By combining a flexible service creation and delivery environment with service subscription self-care portals, users can "add toppings" and make service profile changes on-line with minimal effort and cost for both end users and service providers*". Having all of these possibilities in mind, traditional attributes as perceived usefulness, perceived user friendliness, and enjoyment should also be included as important intrinsic attributes.

Multi play includes access to several services. Through Internet access, customers also get access to several chat and other communication services. VoIP is also one of the services included in multi play, and the value of this service is most definitely affected by network effects. In quad play, mobile voice services are included too. We therefore have to conclude that many of the services included in multi play have a communication potential where direct network effects are driving forces. It is of course possible to take part in communication through voice- and chat services without multi play. Nevertheless, it is reasonable to expect that access to several communication services in one package will be a driving force for the development of multi play in the market. Consequently, user network attributes will have a significant influence on the development and usage of multi play among customers. This assumption is further strengthened by the importance of user networks in new content services, such as P2P based content distribution (e.g. Joost) and video sharing services (e.g. YouTube).

A rich service catalogue includes access to complementary network services as TV, program guide, video on demand, gaming, real time video/voice, legal download, firewall, parental control, on demand bandwidth, peer to peer control, e-mail, and Internet. Multi play can be considered a platform to access all of these services, and these complementary network attributes will have a significant influence on future diffusion of multi play. As discussed above, the value of complementary services, however, may be moderated by behavioural control. This may suggest a segmented approach to bundling of complementary services is required in multi play.

Price sensitivity

Although multi play can be differentiated a bit on quality of service, it is difficult for suppliers to differentiate on unique value. Rather, price is often the differentiating factor. It is a rather transparent market, and customers know the price of the various suppliers. The providers are also very active in the market, and customers know the available alternative providers. For most customers, the price is not an insignificant part of their budget, and the purchaser is in most cases also the payer. The product can be purchased anytime, and switching costs are typically associated with the purchase of multi play. Consequently, all of the indicators suggest that price sensitivity will influence the adoption of multi play. The study by Sekino, Pecorari, Douglas, and Gates (2006) also revealed that discounts are expected among most consumers if they purchase multi play, in particular those provided in open access networks. Highest discount is expected among younger people, relatively low-spend consumers, and dial-up customers. From a provider perspective, bundling is likely not only to increase satisfaction but also to create switching costs. Customers are also likely to perceive the switching costs to be higher for a multi play offering than for an offering of unbundled services. For example, investments in proprietary set-top boxes may be required as well as

proprietary adapters for the VoIP offering. Because these investments are aggregated in the multi play offering, switching costs may increase. If fuelled by underperformance in expected value, these switching costs may be a source of dissatisfaction. Again, these issues are potential sources of heterogeneity problems that should receive more attention.

Compatibility

Other critical factors influencing the adoption of triple play are speed, quality, simplicity, number of services, and integration. These factors are again a function of reliability, bandwidth, compatibility, and signal/noise ration (Karlsson, Lindroos and Särefjord, Accessed 21.01.07). However, according to the same authors, multi play offer only slightly more value than stand alone services. However, the value from compatibility across these service offerings may be considerable. For example, the value of legally redistributing content over alternative fixed and mobile terminals in the home without compatibility problems is not without importance. For the segments believed to be early adopters of multi play, compatibility with consumers' values, preferences and experiences will be high. In addition, individual interfaces and the usage of the various services bundled in multi play will not be much different than what the consumers are used to. Single bill and lower costs are probably the two most salient differences from currently bundled service offerings.

7 SERVICE AREA – M2M SERVICES

M2M is a general term referring to data communications between machines using communication networks and standards such as SMS, GPRS, WiFi, Bluetooth and ZigBee. At the service level, M2M communication is relevant in a wide range of application areas including healthcare, transportation and logistics, retail, facility management, manufacturing and the utilities industry. Services may be provided using either a) cellular networks or b) combinations of cellular and other communication networks, such as sensor and actuator networks or ad hoc networks. Consequently, the M2M service area is includes the wireless sensor network area. This area is believed to be of profound importance to a future society of pervasive and ambient service offerings integrating physical and online environments. The main challenges of heterogeneity are found in the services of category b) above, and will be focused here. Services may be offered in a typical client/server context or in more ad-hoc or mesh network categories. Again, heterogeneity at the technological level is believed to represent challenges particularly for services offered in ad-hoc or mesh network or for services integrating such networks into a more traditional client/server model.

7.1 Market and regulatory structural conditions

M2M is a broad term covering all kinds of communications where machines communicate with machines – but also human users communicate with machines. Formerly, the most common M2M applications were telemetry but nowadays and in the coming years, a variety of M2M applications, for instance sensor based communications and context-awareness applications are expected. M2M applications mostly complement person to person communications. They may, in

some cases, substitute for person to person information seeking communications but will in most cases be an add-on to other kinds of services.

Market

M2M applications will increasingly be included in the portfolio of services offered by network operators but will generally be put at the disposal of users by a multitude of different players, private and public, commercial and non-commercial. Although telemetry services can be transmitted via known mobile networks, GPRS, UMTS, etc, they will contribute to an increasing heterogeneity of wireless communications. Market-wise, many M2M applications will be offered by small and local providers, and many will be non-commercial.

It is, therefore, not an area characterised by market concentration, and mobile incumbents have no dominance. There may be specific types of M2M services that some providers will dominate, but because of the highly differentiated character of the area with a mass of different potential applications, it is likely to be an area with many and diverse providers. This is clearly shown in a study by Lan (2005) finding that the wireless sensor network providers he studied had problems obtaining a disruptive foothold in their industry. There may also be economies of scale in some applications and likewise economies of scope. However, the general picture is characterised by many different small and local providers. The barriers to entry are, consequently, low. Another observation made by Lan (2005) was that almost all wireless sensor network providers he studied applied an open and collaborative innovation model typical of high fragmentation service markets.

It is an area with vast growth potentials. There already is and will in the future be a gigantic mass of communicating devices (pervasive computing), which can provide

services to people. Whether it is a lucrative market cannot be said in general. Again, the diversity of the field is too big to make clear statements. And, the same applies to the rest of the parameters which have been examined for other service areas in this report. Just to illustrate the multitude of M2M application markets, Akyildiz et al. (2002) lists a number of military applications, environmental applications, health applications, home applications and other commercial applications, just for the sensor network part of M2M services. Wang, Zhang and Wang (2006) propose a list of application areas specific to the agricultural industries including five categories of applications for environmental monitoring, precision agriculture, machine and process control, building and facility automation and traceability systems may be identified with individual market characteristics.

Regulation

When considered as a general service area, M2M services business models are not likely to be influenced or limited by lack of predictability of regulatory policy. Of the regulatory issues believed to be most relevant to M2M services as a general area is spectrum policy. At least for many of the sensor-oriented M2M services, unregulated spectrum will be used and further innovation in this area may depend on the availability of unregulated spectrum or the application of spectrum particularly regulated for sensor-oriented services. Authors, however, suggest that unregulated and flexible spectrum strategies of both service providers and regulatory authorities may make spectrum issues less of a bottleneck (Dixit, 2006). Also, shutdown of previously analogue and phased-out services may free spectrum for services and applications in the M2M service area as well.

When considered by each individual M2M service or application area, however, regulatory issues may be more important to business model designs. Thus, the

M2M service area differs from the previous service areas in having to be analyzed at the individual service or application area level. Two important application areas may illustrate this. For security applications, security and privacy legislation are two important regulatory structural conditions. Privacy legislation is often mentioned as an argument why the full potential of networked RFID applications has not yet been utilized. For example, consumer reactions to the lack of privacy protection have made many initial RFID applications fail in the US and Europe, whereas these have become widely adopted in e.g. Japan. For automated metering reading applications (AMR), which is currently a large M2M application area in utilities industries, local regulation of the utilities industry is an important structural condition. For example, in Sweden, the new metering regulation was passed by the Swedish parliament in 2003 requiring AMR to be fully implemented in the Swedish electricity network by 2009. This created an equipment and services market of approximately 10 billion SEK over night (figures estimated by AMR vendor Senea). Thus, local regulation of the application area and correspondence between telecommunication regulation and application area regulation are more important than telecommunication regulation per se.

7.2 Technological structural conditions

M2M communication is a communication link set up between two devices for remote communication. Technologies such as broadband connection, SMS, GSM, GPRS, EDGE and UMTS may therefore be suitable for this purpose, but also short range communication technologies like Bluetooth and ZigBee are relevant. Often, different communication technologies are combined, for example using ZigBee for sensor communication and cellular communication technologies like GPRS for remote control of and data download from the sensor network. Even though M2M applications use well-known communication technologies there are very few

widely used and well-defined M2M standards regarding the data exchange (application layer). There exists a wide range of standards for data exchange between computer devices today, e.g. HTTP used by a web-server and a web-browser, but not all of these seem equally suitable for M2M. Instead, M2M applications are often specific to each of their application areas applying specialized communication standards developed (and/or agreed upon in the application industry) for each application area. For example, standards for communication over powerline may be relevant to AMR applications, and in this case, considerations for telecommunication standards and technologies are surely of less relevance.

Standardization

The function of standards in M2M is to make it easier to transport machine data and for software systems to more efficiently interpret it and make deployment easier and less expensive. Designing M2M connectivity can be a very complex process, but it can be simplified if hardware suppliers obtain wireless certification for their products. By purchasing certified hardware a company can start communicating with its assets in a relatively short period of time, letting the adopter focus on the challenge of incorporating the new information into its business processes. Therefore certification by the major cellular network operators is an important attributes of M2M hardware products. Already now the range of such certifications and available hardware products is enabling broad market adoption. For example, Digi Connect WAN family of products (www.digi.com) provides cellular connections for reliable primary and backup network connectivity to remote sites and devices. To illustrate the heterogeneity of relevant technologies, we give brief summary of some M2M related communication standards that exist on the global market.

- Common Industrial Protocol (CIP) is an industrial standard for automation systems maintained by ODVA (Open DeviceNet Vendor Association; www.odva.org) and ControlNet International (www.controlnet.org).
- Modbus (www.modbus-ida.org) is an open application protocol for master-slave/client-server communication developed by Modicon.
- LonWorks, often address as lon, is a complete architecture for automation systems developed and owned by Echelon (www.echelon.com). Lon is today mostly used for AMR and building automation.
- NES (Networked Energy Services) (www.echelon.com) is Echelon's AMR solution. This solution consists of meters connected to a data concentrator through a powerline network.
- Pyxos is a wired sensor network solution, also from Echelon, designed to compete with ZigBee (www.zigbee.org).
- The KNX standard (www.dlms.com) is a specialised form of automation system designed for building applications.
- Together DLMS and COSEM (www.dlms.com), also known as IEC 62056, is a recent object-oriented standard for AMR.
- M-bus (www.m-bus.com) is a low cost home electronic system (HES) designed to fill the need for networking and remote reading of utility meters such as a gas, water and power meters.
- In the security segment, DTMF, or DTMF like methods, is widely used to report an alarm or event from a building or unit to a central system. In "modern" applications, GSM or ISDN may be used to establish the analogue communication channel. Some also transfer the same bit sequence coded within a SMS or an IP-package.

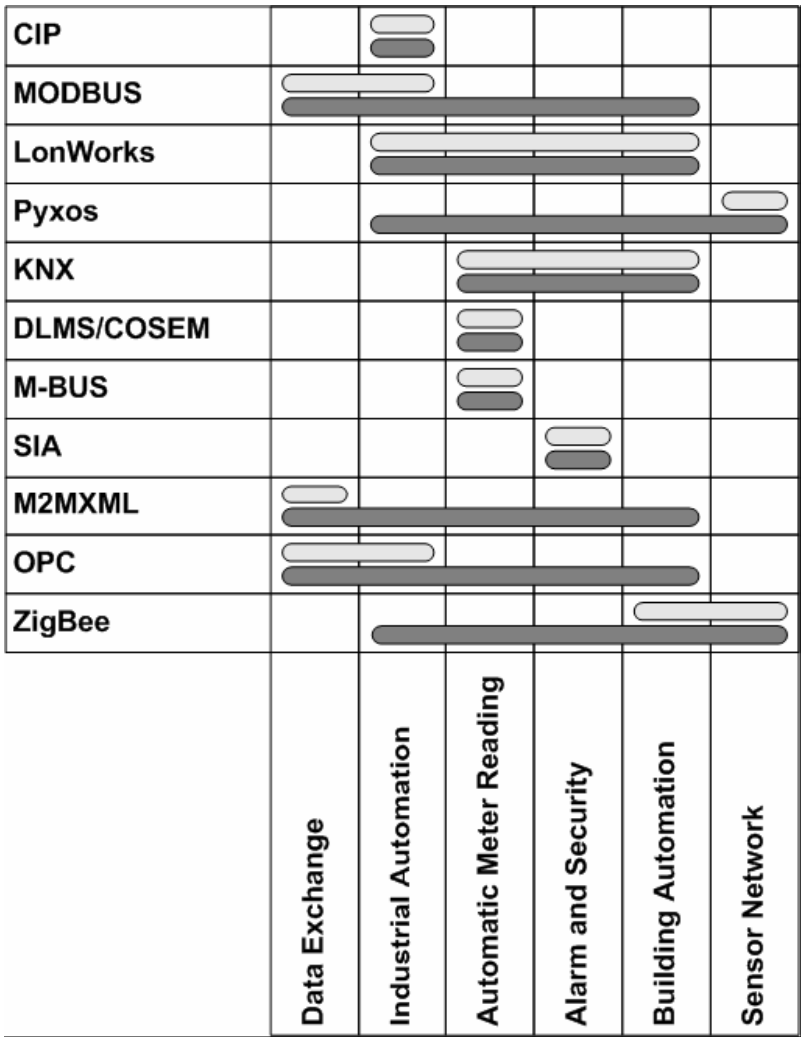
- M2MXML is a lightweight open standard for M2M communication based upon XML, initially developed by Sensor Logic (www.sensorlogic.com).
- OPC, OLE for Process Control, maintained by the OPC Foundation (www.opcfoundation.org) consists of a collection of standards for open connectivity.
- ZigBee [M27] is a new up and coming standard for wireless sensor networks maintained by the ZigBee Alliance (www.zigbee.org). ZigBee is designed to support a large number of interconnected low power battery driven devices.

As seen from the selection of standards of relevance to M2M communication, many of the standards are controlled by private organizations. Some are controlled by public organizations and some are governed by open source like players. They are, however, almost all specific to their application area, whether being the security or the AMR area illustrating the application area oriented heterogeneity of M2M communication standards.

One possible way of categorizing the M2M applications is by application area. In table 7.1 we consider vertical applications areas: data exchange, industrial automation, automatic meter reading, alarm and security, building automation and sensor network. Each of the applicable standards is constructed to cover one or more vertical application. Table 7.1 illustrates which vertical application each of the standard supports. The light grey box describes the applications supported when the standard is used alone. The dark grey box describes the applications supported by combining a server-to-gateway standard and a gateway-to-device standard. By combining different standards for server-to-gateway communication and another to support gateway-to-device communication we can provide architecture for desired

M2M applications. For example, combination M2MXML and M-BUS provides architecture for AMR applications.

Table 7.1 Relations between applications and standards (from Albretsen, 2006)



Technological barriers and challenges

Industrial-networking M2M protocols are not designed to interoperate with today's communication networks and software systems. This means that to use data from those assets in an M2M system, an extra layer of software is required to translate the old protocols into a data language that can be integrated. While the bottom

layers of the protocol stack are fairly well established, there is still very little standardization at the application level. In fact, there is a broad consensus among technology providers that most of the development work done in M2M is still largely customized for each adopter.

Another challenge is that wireless data plans are still not optimized for low-bandwidth M2M. Most telecommunication services are charged by the amount of data transferred. This adds an extra cost factor to the M2M solution providers, since the bandwidth consumption will affect the total price of the solution and most M2M communication is not time critical. Applications where the communication bearer is charged based upon amount of data transferred needs a router-enabled gateway to control the flow of the data. Full featured networks such as LON, CIP and KNX support this. DLMS/CODEM differs from the other standards with a transparent gateway since each meter acts as a server, and the collection system acts as a client. DLMS/CODEM meters cannot talk to each other, and the collection system has therefore full control of the bandwidth used. MODBUS consumes least bandwidth of the standards applicable to transfer any type of data. OPC, MODBUS and M2MXML enable the support of transporting data from multiple services behind one gateway using one standard in the server-to-gateway communication.

When interconnecting networks, the address space might also be a problem. OPC, which uses IP all the way, is therefore the most suitable standard for such applications.

7.3 Business model options and considerations

M2M communication services differ from the other service areas by several dimensions. First, the M2M term is rather vague and covers both communication in

a client server type of network, a P2P network and a more ad hoc mesh type network. It also covers a wide area of potential application areas, in which the type of network, the requirements of bandwidth and QoS and the context of the application differ. It is, consequently, difficult to specify business model dimensions and issues of *general* relevance to all these application areas. Much of the further exploration of this service area would thus have to focus on identifying relevant application areas.

Another issue is that the empirical material on this service area is considerably more scarce than on the other areas, at least when seen from a general application independent perspective. Most of the literature we have identified focuses on wireless sensor network (WSN) application areas (e.g. Lan, 2005).

Players, roles and actor networks

To describe players and roles in M2M, we may use the approach of Lan (2006) identifying two different components in any WSN application. These are:

- Multiple nodes, or endpoints, which are responsible for collecting data and passing data
- One or more base stations, access points, or gateways, which are responsible for synthesising and processing the data

For M2M applications not including sensors, the components above are reduced to one node or endpoint and one or more base stations. Starting with the first component, the sensor network part, major players are equipment vendors, application providers, network providers, sensor network enabler or customer. In most applications, the end-user is not directly involved in the sensor network component unless the network is implemented at the end-users premises or body.

Also, the sensor network may communicate using unlicensed spectrum eliminating the network provider role. For the second component, network providers are almost always required. In this component, the role of the end-user is also more important and other types of service providers than application providers may also be involved. Examples are providers offering secure infrastructure for communication.

From the multitude of roles described above, it is obvious that the actor networks of M2M communications services may be complex. Further complicating the actor networks are a multitude of legacy players of the application area. For example in the case of AMR applications, utilities companies, regulating authorities for the utilities industry and other legacy players must be included in the actor network.

Governance forms

Governance forms of M2M communication services will vary across application areas. It is, however, unlikely to produce and distribute complex M2M communication services using a vertically integrated governance form. For simple applications, however, vertical forms may apply. Also, in application areas where security is critical, such as in some health applications or in defence and homeland security applications will a vertically integrated form be applied. For all other application areas, relational and market based forms will be applied for large parts of the service offering. A particularly interesting situation occurs when developing governance forms for widespread sensor networks, such as for example in traffic control. In such application areas, governance forms seen in P2P networks are likely to be relevant. These relational governance forms often rely on trust and service exchange is more typical than monetary exchange among network peers.

Lan (2006) discusses the value network and governance in terms of openness. Openness is measured on five features: use of venture capital, patents generation, exchange of intellectual property, alliance/modularity, and business model. On all features, almost 50% of the companies apply open networks in their innovation and development processes. More than 70% use alliances and platform leadership networks. Other openness features are the use of venture capital and exchange of intellectual property rights. Thus, open and relational forms of governance are typical in M2M communication services innovation.

Value propositions

As for governance form, the value propositions of M2M communication services are application area specific. In terms of general value proposition, Lan (2005) defines three types of product feature disruptiveness contributing to value: low cost, new consumption and add-on. The last two types are the dominant components of the value proposition within 75% of the companies investigated by Lan (2006). Thus, cost savings are not the main value proposition of the WSN providers studied by Lan (2006). This is rather surprising, when looking at application areas like supply chain management, AMR and remote control, typical application areas for M2M communication services.

Thus, added value to end-users in the form of new functionality is an important part of this service area. Examples of this type of added value are quality control and traceability, as in food value chains, ubiquitous control of applications and equipment, as in remote control of residential equipment and in health applications, and improved predictability, as in traffic control and transportation applications. When compared to current value propositions of replaced services there will be few functional trade-offs. Instead, non functional trade-offs are often a problem in this

service area. Security and privacy has been much debated as a result of the implementations of M2M communication based services. For example, end-users have been unwilling to buy products tagged by RFID tags due to what they consider threats to privacy. In these cases, it has typically been difficult for end-users to perceive the added benefits of the M2M based service, and there has been little or nothing to trade the increasing threat to privacy for (see e.g. http://www.boycottgillette.com/).

Market strategies

This service area is characterized by a similar relationship between customers and end-users as corporate VoIP. Corporate customers of M2M services are often the enablers of the service which they sometimes utilize for company internal services or for offering added value or reduced costs of traditional services and products to end-users. This is typically the case in logistics, transportation and retail application areas. Corporate customers of M2M communication solutions may also integrate and provide the resulting service directly to end-users. This is typically the case in traffic control and healthcare applications.

The target customers of M2M communication service providers are thus, spread on many different branches. Lan (2006) defines providers' market strategy by measuring the gap between conceived usage and actual usage according to three criteria: small gap, big gap, and huge gap. If the company has clear target of customers, and there is a small gap between the conceived usage and the actual usage, then it is defined as a narrow market positioning. Lan's (2006) findings show that 60% of the companies have a big gap, meaning that few customers are testing their product. This indicates that marketing of WSN is comparatively week.

Also the findings show that 25% of the companies are targeting niche markets and 25% are marketing niche technologies.

Revenue models

From the two principal market strategies identified above we may infer that two very different types of revenue objects are involved in M2M communication services. For services used by corporate customers to obtain cost advantages or added value, the revenue from the service must be reflected in cost savings or increased willingness to pay for traditional products or services. Thus, the M2M communication service is indirectly priced. For the services offered directly to end-users, the service itself is the revenue object, and this object may be priced by anything from flat rate to traffic/usage depending on the application area. As discussed under in the governance form section, P2P types of governance may also be applied leaving pricing policies to be replaced by service exchange or "favour" exchange mechanisms.

Due to the complexity of governance forms including relational and market based forms, revenue sharing agreements may also be complex. Some of the application areas also raise questions of pricing and sharing of revenues from common goods. An interesting situation though, is that for some of these application areas, a reversed form of common goods exists. For example, car owners may agree to let providers of traffic control services use their RFID tags, originally used to pay for passing toll roads, to provide traffic routing services. In this case, car owners contribute to a common good that is resold to traffic routing customers. Complex revenue sharing agreements may have to be designed to solve the problems of two-sidedness in these kinds of services if they are to be adopted on both sides of the market.

7.4 Customer behaviour and customer values

As mentioned above, end-users, corporate customers and service providers may be the customers of M2M communication services. Thus, customer behaviour and customer value should best be discussed at the application level.

Customer behaviour issues

According to a multiattribute perspective (Fishbein and Ajzen, 1975), several attributes of great advantage can be realized by M2M technology. However, the technology is novel, and several factors related to the applications of M2M in various contexts are still not settled. Consequently, potential consumers are probably a bit unsure about the potential of M2M so far, and we conclude that the customer attitude towards M2M is a bit waiting. In a few of the examples of M2M communication based services offered to consumer customers, negative attitudes have been expressed. For example, consumers' attitudes towards RFID applications have been negative in some countries due to perceived threats to privacy. These attitudes are likely to vary considerably by application area, and areas of M2M communication applications not perceived to threaten privacy are likely to be met by positive attitudes.

Brazell et al. (2005) mention high product costs as a potential barrier for adoption of M2M in some of the usage contexts discussed. Thus, the financial resources part of behavioural control may influence the development and value of M2M services. Furthermore, potential customers are at the beginning of the education curve in understanding how the magnitude of data can be useful and properly managed, and the complexity of the technology involved can be intimidating. According to ESE Magazines (2006), M2M systems will require better system integration skills. Such

skills will have to be developed before we see a high level of adoption. Consequently, the skill element of behavioural control also seem to be a potential significant factor influencing adoption of M2M in, at least, some of the usage contexts discussed by Brazell et al. (2005). We have to conclude that behavioural control will be a significant factor influencing the future development of M2M.

M2M communication technology will mainly be used in a commercial context. Commercial decisions are typically based on rational criteria rather than social influence. However, there may be some indirect effects of social influences. For example, a consumer may purchase a car with a wireless sensor network because of social influences. Indirectly, this will also influence how willing commercial actors will be to adopt M2M technology in their products, illustrating the two-sidedness of this service area.

M2M technologies can be used both in residential and commercial context. Consequently, several of the segmentation criteria discussed both in for example section 3.4 and 4.4 should be relevant. A typical situation will probably be that we as consumers purchase products where M2M technology is implemented. We therefore suggest application areas as potential segments in this discussion. According to Brazell et al. (2005), potential application areas include wireless sensor networks, logistics, intelligent transportation systems, telematics, structural health monitoring, natural environments, building automation, retailing and wholesale, automated meter reading, healthcare, and home. Thus, both residential and corporate contexts are included.

Customer value issues

Of the intrinsic attributes creating value in M2M communication services, usefulness through the functionality of monitoring, tracking, actuating, control, management, identification and authentication is focused (Lawton, 2004, Brazell et al. 2005). This is obvious from the applications 1) escalators and elevators, 2) heavy equipment (fleet) monitoring, 3) exit signs monitoring, 4) energy management, 5) home security systems, 6) vending machines, 7) traffic monitoring suggested by Baikie and Gaede (2006). M2M technology is also expected to be more cost efficient in a few years, making these technologies even more attractive to use (Lawton, 2004). Thus usefulness is the main intrinsic attribute of most M2M application areas.

The value of M2M may increase when the number of other machines to communicate with increases. User (machine) network attributes must therefore be considered significant for M2M communication services. Brazell et al. (2005) discuss antecedents for adoption of M2M in 11 different usage contexts. Network effects are listed as significant antecedent for adoption of M2M in all of the 11 contexts, underlining the significance of direct network effects. Looking at M2M as a general communication platform, many of the application areas may be considered as complements to the M2M communication platform. As such complementary network attributes are important to value. For each of application area of M2M, a complete set of complementary services are relevant. The value of the M2M communication services in itself is greatly affected by the attributes of the complements network, such as the variety and quality of complementary services, for most of these service areas.

Price sensitivity

M2M can add unique value, but whether it is possible for the future suppliers to differentiate from other suppliers based on unique value is somewhat difficult to predict today. Typically, technology becomes rather standardized over time, so differentiation will typically be on price or customer service. Because M2M will be dominated by commercial and professional buyers, we expect that the buyers will be aware of available alternatives. Although the buyer will typically not be the payer (business context) and the price level of such services is expected to be high, price sensitivity will be high. A purchase will probably also mean commitment to some specific technology and standards, and for several M2M services, industry standards are not yet agreed upon. Because of this, many potential customers will probably wait before they make investments that may lock them into standards (high switching costs) that will not be optimal in the future. Brazell et al. (2005) discuss high product costs for some of the potential usage contexts, and also ague for the importance of government funding to stimulate the adoption of M2M. Based on this, we have to expect relatively high price sensitivity among customer in the near future.

Compatibility

Compatibility of the systems is a key factor for the success of M2M. Brazell et al. (2005) discuss potential hindrances for the diffusion of M2M, and the proprietary nature of systems and lack of interoperability with other systems and networks are among the potential barriers mentioned for many of the application areas discussed. The potential problem is made even more significant because of the lack of agreement on common technology standards and the slowness of the industry to grasp how real-time data available from M2M systems converge with enterprise systems. Furthermore, Brazell et al. (2005) point to the increasing number of

protocols discouraging potential users who fear adopting a protocol that will become obsolete. The list of protocol examples shown in section 7.2 illustrates this problem. Consequently, compatibility is a significant issue for the future development of M2M systems. The diffusion of M2M services means that consumers have to adapt to a new reality that differ from their existing experiences and expectations. Cars will make more decisions for the drivers and homes will be more intelligent. Thus, consumers will probably experience some of these changes as rather complex and potentially threatening.

8 CONCLUSIONS, DISCUSSION AND IMPLICATIONS

In this report we have presented the methodology and results of a pre-study of five different service areas believed to be characterized by problems of heterogeneity in its current status and its future development. The service areas have been studied within a structure-conduct-performance (SCP) framework previously applied for mobile services. We have sought to extend the SCP framework by including and discussing issues of relevance to each of the five service areas that have been identified in literature surveys. This approach has been applied to serve the two-dimensional purpose of the pre-study: 1) To suggest extensions and refinements to the original SCP-framework to better reflect the context of business model design for heterogeneous network services, and 2) To provide a basis for deciding which of the five service areas represent particularly challenging problems of heterogeneity and in which parts of the SCP-framework these challenges are located**.**

To summarize our achievements with respect to these two purposes, findings are presented in tables 8.1-8.4. The first column of these tables reflects the potential dimensions that should be considered included in the SCP-framework, and the rest of the columns reflect our findings with respect to the importance or specific problems of each dimension. The summary is organized by market and regulation dimensions, technology dimensions, business model dimensions and customer value dimensions.

8.1 Market and regulation

In table 8.1, a summary of relevant market and regulation dimensions for the five service areas is shown.

Table 8.1 Summary of market and regulatory relevant issues for each service area

Dimensions	**Corporate VoIP**	**Mobile VoIP**	**Mobile bb**	**Multi play**	**M2M**
		Market related issues			
Growth	High	Potentially high	High	High	High
Incumbent market power	Moderate	Medium	High	Low	Low
Concentration	Low	Medium (potential)	High	Low	Low
Knowledge requirements	Medium	Moderate	Moderate	Medium	Application area specific
Barriers to entry	Moderate	Medium	Medium	Low/High	Low
Scale economies	Low	Low	High	High	Low (generally)
Scope economies	Medium	High	High	High	Low (generally)
Revenues and costs	Lucrative	Potentially lucrative	Lucrative	Lucrative	Application area specific
Importance of social relationships	Moderate	Moderate	Medium	Moderate	Application area specific
		Regulatory issues			
Technology neutrality	Irrelevant	Irrelevant	Partly relevant	Relevant	Irrelevant
Public service obligations	Generally relevant but not so much for corporate	Partly relevant	Irrelevant	Relevant	Irrelevant
Spectrum policy	Irrelevant	Relevant	Relevant	Partly relevant	Relevant
Anti competitive issues	Relevant	Partly relevant	Irrelevant	Relevant	Irrelevant
Content regulation	Irrelevant	Partly relevant	Partly relevant	Very relevant	Irrelevant
Security and privacy legislation	Irrelevant	Little relevance	Little relevance	Relevant	Very relevant

With respect to heterogeneity problems, the dimensions of incumbent market power, concentration, knowledge requirements, barriers to entry, technology

neutral regulation, public service obligations, spectrum policy and harmonization of regulation and legislation are particularly important.

Mobile VoIP and mobile broadband are two service areas where existing incumbent market power is high. The source of power differs between these areas. Incumbent market power may be an issue resolving heterogeneity problems but generating a need for anti-competitive regulation. In the multi play area, there are also powerful incumbents, but they are more fragmented, at least in some of the Nordic countries. Thus, there is a correspondence between incumbent market power and concentration. The knowledge requirements vary across service areas with respect to technological and business strategic knowledge requirements. Currently, knowledge requirements are probably highest for multi play, but while the technological knowledge requirements are fairly moderate for the other service areas, business strategic knowledge requirements may still represent a source of heterogeneity problems and opportunities.

The barriers to entry are fairly moderate for most service areas. Still, the barriers to entry may vary due to the applied solution and the position taken by the provider. For example, mobile VoIP applying an UMA solution will require access to or changes in incumbent providers' network technology, whereas SIP based solutions may be offered with much fewer barriers (but perhaps less functionality). For multi play, the barriers to entry for existing "double" or "triple play" providers are low, but for greenfield providers they may be very high.

For structural conditions related to regulation, the position taken by regulating authorities on technology neutrality is important to mobile broadband and multi play. Some of the service areas include public service obligations which may have

to be lessened for innovative business model growth. This is not a heterogeneity problem per se, but it is important to business model innovation. Spectrum policy is relevant to all services including some element of wireless communication. Finally, harmonization of regulation and legislation, such as harmonization of media and telecommunication regulation or harmonization of privacy legislation are important potential sources of heterogeneity problems in multi play and M2M service areas.

8.2 Technology

When reading technology journals, one often get the impression that technology is no longer a source of heterogeneity problems and that technological convergence better characterizes the current situation. Looking more closely at individual service areas, a somewhat more complex picture emerges. The technological sources of heterogeneity problems comes from lack of standardization, unresolved issues in security, access control and privacy, problems with technological interoperability and lack of established technologies for QoS. To counteract these sources of heterogeneity and ensure technological convergence, technological investments are made. For example, despite the development of open standards, industry investments may result in de facto standardization that overcomes problems of heterogeneity.

Standardization is important for all areas except for corporate VoIP, where standardization is more an issue of economies of scale. For both mobile VoIP and multi play, unresolved issues in standardization contribute to heterogeneity problems. Of the five areas, however, lack of standardization is most obvious in M2M services due to the vast heterogeneity of application areas. This is the situation for the M2M area for all of the other technology dimensions as well.

For security and access control, multi play is the area with most unresolved issues. This is also the case for privacy, where there also is a close correspondence between technological dimensions and legislation discussed above. This is particularly true for M2M service areas, for example when using RFID to bridge virtual and physical contexts.

Table 8.2 Summary of technology relevant issues for each service area

Dimensions	**Corporate VoIP**	**Mobile VoIP**	**Mobile bb**	**Multi play**	**M2M**
		Technology related issues			
Standardization	Only partly required	Required but still unresolved	Required and partly resolved	Required but still unresolved	Application area specific
Security and access control	Mainly resolved	Mainly resolved	Resolved through tunnelling	Unresolved access control	Application area specific
Privacy	Resolved, but issues of e.g. Spam control	Resolved, but issues of e.g. Spam control	Resolved through tunnelling	Many unresolved issues	Many unresolved issues
Technology interoperability	Resolved for voice, but not for non-voice	Unresolved issues of handover and roaming	Unresolved issues of handover and roaming	Many unresolved issues	Application area specific
QoS	Some issues unresolved for non-voice	Some unresolved issues	Mainly resolved	Many unresolved issues	Application area specific
Industry investments	Investments made at the firm level	Infrastructure investments required	Infrastructure investments required	Infrastructure investments required	Application area specific

While technological interoperability is often less of a problem for access, there are still unresolved issues beyond access. For example, interoperability in handover and roaming across heterogeneous networks and between provider controlled domains are important issues. Another example is unresolved issues in non-voice services for corporate VoIP solutions. This is in fact so important that it may justify

specific studies in the corporate VoIP area. Many also suggest both QoS in itself as well as control of QoS across networks to be potential sources of heterogeneity. For example, to guarantee a specific quality of a TV broadcast, a multi play provider may have to "handover" transmission to a terrestrial network. As mentioned above, industry investments have been made that may overcome technological sources of heterogeneity. In all service areas investigated here, however, industry investments are still in a phase of alternative trajectories. Thus, technological uncertainty with respect to leading providers' and competitors' investments in specific technological trajectories is an important source of unresolved heterogeneity problems. Thus, technological windows of opportunity represented by technological investments are still open to powerful and/or innovative providers in all of the five service areas.

8.3 Business model

For corporate VoIP, the customer is a corporation with the employees as users. The VoIP platform can be sourced and bundled by the customer, bought as a product or hosted by a service provider. Thus, the roles here depend on the solution chosen by the customer. For mobile VoIP, providers have unified perspectives and roles but they may differ in terms of proprietary or standardized solutions. Broadband services are offered by diverse providers: Cellular network providers who are mostly incumbent operators, or WiFi access providers who are mostly new entrants. Multi play is a complex, integrated service involving a number of different players along the value chain. However, their roles are pretty clear. M2M is another integrated service with a complex value chain involving a multitude of different players.

The flexibility to innovate in new governance forms differs between incumbents and new entrants across all services. For M2M, however, it varies greatly across application areas. Corporate VoIP has evolved towards software-based solutions opening up the value chain and incorporating multiple actors in alliances (relational governance forms). In mobile VoIP, we see vertically integrated governance forms applied by incumbents, while others apply more open forms. In mobile broadband and multi play no particular governance form is dominating, but in multi play, we currently see an upcoming competition between offerings applying the traditionally applied vertically integrated forms and new open forms. Along with the more complex, software-based solutions and open value chains in corporate VoIP, we expect innovations to be governed by relational forms here. For the other service areas we expect the innovation process to follow more or less the governance forms of production and distribution.

VoIP for both residential and corporate users are primarily marketed as a cost efficient solution, although in both cases added values in terms of productivity gains, convenience and increased functionality are also included. Mobile broadband and multi play put more emphasis on added values than on costs. Value propositions may also be benchmarked against current offerings. Coprorate VoIP, mobile VoIP and M2M services are characterized by trade-offs with current value propositions, whereas mobile broadband and multi play mainly offers added value to current propositions.

The size of the corporation is a suitable segmentation variable for corporate VoIP marketing, at least from a cost efficiency perspective. More focused strategies may be used where emphasis is more on added values in the value proposition. For all other services, we find segmented markets addressed by focused strategies.

Table 8.3 Summary of relevant business model issues for each service area

Dimensions	Corporate VoIP	Mobile VoIP	Mobile bb	Multi play	M2M
		Business model options and considerations			
Provider perspective and role	User firm and vendor, unclear role	Incumbent or greenfield, clear roles	Operator incumbent or greenfield, clear role	Operator and content owner, clear role	User firm, service provider and operator, mixed roles
Governance form flexibility	Few restriction related to resources	Differs between incumbent and green	Differs between incumbent and greenfield	Infrastructure owners' BMI restricted by resources	Differ by application area
Governance form of production and distribution	Relational forms required	Vertical in proprietary providers, otherwise relational and market	All forms currently applied	All forms currently combined, complexity high and increasing	Relational and market, few applications with vertical forms
Governance form of innovation	Vertical and relational forms used	Vertical in proprietary, otherwise relational	Relational forms, but may shift to more vertical	All forms currently combined	Relational forms
New value proposition	Narrow and cost focused, some new values	Narrow and cost focused, new values only by proprietary providers	Availability, mobility and cost control, benefit comparison easily done	Multitude of added values, benefits, not cost focused	Multitude of benefits as well as cost arguments
Current value benchmark	Functional drawbacks of new offering	Functional drawbacks of new offering	No trade-off of new service functionality	Few trade-offs of new service functionality	Security and privacy trade-offs
Object of market strategy	Customer and end-user differ	End-user	Customer and end-user may differ	Groups or end-users	Corporate customer and end-user
Market strategy focus	Segmented market, partly focused	Segmented market, currently focused	Segmented market, currently focused	Segmented market, currently focused	Segmented market, currently focused
Revenue object and pricing	Traffic based pricing	Flat rate and traffic based pricing	Flat rate and traffic based pricing	Complex objects, bundling important	Revenue objects vary by application area
Revenue sharing	Mostly roaming only	Mostly roaming only	Mostly roaming only	Complex sharing arrangements	Challenging sharing arrangements

For corporate VoIP the revenue objects may vary by service provider. Traditional voice providers use traffic flow as object while data network providers use more flat rate or number of connected terminals as objects. Mobile VoIP and Mobile broadband providers use a combination of flat rate and traffic flow, while the revenue objects used in multi play vary considerably from flat rate to added charges according to the bundled service. For Corporate VoIP, mobile VoIP, and mobile broadband the only sharing of revenues seems to apply to roaming while for multi play services revenue sharing agreements reflect the complexity of the governance forms applied. In table 8.3, these findings are summarized.

8.4 Customer value

Discussion about attitudes towards the services has been based on the level of diffusion of the service and the potential positive effects of service attributes. Consequently, our conclusions are rather subjective and not based on empirical results directly measuring attitude towards the services. Behavioural control is based on users' financial resources and skills, mainly inferred from service price and a subjective evaluation of service complexity. Conclusions about effects of social influences are mainly based on whether the service will be used in a public context and whether it is machine-interactive or person-interactive. Segmentation criteria focus rather basic segmentation criteria for corporate- and consumer segmentation. As can be seen from table 8.4, all of the services are described as including many intrinsic attributes. This may be differentiated a bit more, but the main point is that there are many service attributes that can be realized within each of the service.

Table 8.4 Summary of relevant customer behaviour and value issues

Dimensions	Corporate VoIP	Mobile VoIP	Mobile bb	Multi play	M2M
		Customer behaviour issues			
Attitudes	Medium/ Positive	Medium/ Positive	Medium	Medium/ positive	Waiting
Behavioural control	Medium/ High	High	High	High	Low
Social influences	Medium	High	Low/ Medium	Low	Low (Potentially indirectly)
		Customer value issues			
Intrinsic attributes	Many	Many	Many	Many	Many
User network attributes (Direct network effects)	Depends on company character-istics	High	Low	High/Medium	High
Complements network attributes	Many	Medium	Few (Potentially many)	Many	Many
Price sensitivity	Medium/ High	High	Medium	High	High
Technical compatibility	Medium complexity	Medium complexity	Low complexity	High complexity	High complexity
Consumer compatibility	Medium complexity	High complexity	Low complexity	High complexity	Low complexity

User network attributes are characterized as high for services where the number of actors in the network is a main antecedent for adoption (Mobile VoIP and M2M) while complementary network attributes are evaluated based on a subjective evaluation of the number of complementary services available on the service platform.

Studies of price sensitivity for the various services are next to absent. Consequently, our reasoning about price sensitivity for the services is based on a discussion of how the services relate to variables that typically influence potential

consumers' price sensitivity. Technical compatibility is evaluated based on anticipations about the network complexity for the services to work. Consumer compatibility is concluded based on the degree to which the usage of the services will differ from consumers' values and preferences and how they expect such services to work as well as the complexity of the customer context that the service should fit into. Based on the lack of empirical studies directly measuring and studying the constructs for the various services discussed in table 8.4, the table should be considered as an input for discussion rather than a final conclusion.

Please also note that the categorizations in table 8.4 refer to the level of the issues for attitude, behavioural control, intrinsic attributes, complements network attributes, price sensitivity, technical compatibility, and consumer compatibility. For social influence and user network attributes, the categorization is more related to the assumed effect on usage of the service.

8.5 Conclusions and discussion

From the investigation of the above five service areas we have found that our original SCP-framework needs to be extended and revised when applied to heterogeneous network services. For example, issues of harmonization of regulation and economies of scope across services represent structural conditions for business model design that are less of an issue when applying the framework to mobile services only. When applied to suggest service areas suited for further study of heterogeneity problems, the investigation also offers new insight and raises new and interesting problems. For example, it seems obvious that not all parts of the SCP-framework are equally important when looking at the sources of heterogeneity problems for each service area. Because this is a particularly important conclusion

from this study, this issue is elaborated for each of the four parts of the SCP-framework.

In terms of heterogeneity we have, in section 2, made the assumptions that this:

- Changes the structural conditions and customer values of relevance to providers' business models
- Reduces the predictability of structural conditions and customer behaviour
- Creates strategic opportunities for providers seeking to influence and adapt to changes in structural conditions and customer behaviour.

An overview of the five service areas analyzed in the preceding chapters shows that a salient feature in all these is expectations of high growth and profitability in the future. In general, this optimism reflects the market attractiveness of ICT and the perception that ICT development will provide numerous opportunities for innovations and entrepreneurship. In addition, this corresponds well with the public perception of ICT, in particular mobile communications, as a "technology of freedom", in addition to its potential for contributing to a sustainable social and cultural development.

Market and regulation

The relationship between the five service areas is not a zero sum game; in fact, there may be synergies between the areas in so far that growth in one service area may boost growth in another and contribute to convergence processes, such as that of corporate VoIP and mobile VoIP. Still, there are some distinct aspects that differentiate the five services areas in terms of market related issues, as shown in table 8.1. In particular, the reason why mobile broadband is distinct from other

service areas in almost all issues may be because this type of service has been developed and fostered by the traditional telecommunications operators for a long time – and more recently as part of the 3GPP/ETSI activity.

In analyzing the other differences between the service areas shown in table 8.1 in terms of market related issues, the service area of multi play emerges as potentially the most interesting service area in an innovation perspective because it seems to represent the highest degree of heterogeneity. In addition – and somewhat contradictory to this interpretation – multi play also has the highest potential for innovative convergence. Furthermore, one may imagine a scenario in which multi play evolves from quad play into "penta play" because it may absorb or merge with the service area M2M in many market segments. The realism of this scenario is based on concepts of "ambient communications" and the potential of RFID, which is still at its infancy. In the "penta play" scenario, the issues of social relationships will become amplified.

In looking at the regulatory issues related to the five service areas, spectrum policy holds a very critical position for the four service areas that depend on radio technological solutions. Radio spectrum scarcity – and regulatory policies for frequency allocations and management – may constrain development of these service areas, ultimately as a cost driver. However, this may also spur a rapid development of more efficient radio technology and system solutions, and/or search for alternative technological solutions that are more economical in terms of radio frequency demand. Hence, this may also contribute to heterogeneity, however, it may also make multi play solutions more sustainable and robust.

Although multi play in the overview shown in table 8.1 may be interpreted as the most attractive in terms of innovation potential, this service area has a greater exposure to various types of regulations, not only content regulation, although this is important. As shown, anti-competition issues may emerge because of potential asymmetric power of multi play operators, however, this may be mitigated by the two-sidedness of these markets and complementarities/interdependencies that are required in service deployment. In addition, privacy and security (also national security) issues may constrain the development of multi play, specifically in the "penta play" scenario. However, in the ex-post regulatory intervention policies that have increasingly been adapted, these issues should not obstruct entrepreneurial initiatives and activities.

Technology

From the summary of technological dimensions of relevance to each of the five service areas in table 8.2, we see that there are many unresolved problems of heterogeneity. Still, when compared to sources of heterogeneity in market and regulation and in well established consumer and business strategic behaviour, technological problems of heterogeneity are often well defined and actions to resolve problems are constantly initiated. This makes us conclude that non-technological heterogeneity problems may represent a greater challenge to business model design and a greater obstacle to innovation and increasing customer value than technological.

Of the five service areas, M2M communication services are the service area where the complexity and variety of relevant technological standards are greatest. It is also the area where most of the technological challenges are specific to how the technology is being applied in specific application areas. On the other hand, this

creates interesting opportunities for investigation of the effects of standardization and technology wars on business model design. Such investigations, however, must be conducted for individual application areas. Several categorizations of application areas have been presented in this report, and the table of interactions between standards and application areas (table 7.1) may be used to identify application areas characterized by significant heterogeneity problems for further investigation.

For the other four service areas, technological sources of heterogeneity problems are mainly a consequence of new technologies. For example, with providers' adoption of WiMAX technology, new heterogeneity problems along the dimensions presented in table 8.2 are likely to turn up. For currently existing access networks, the sources of heterogeneity problems are likely to occur at the boundary between business strategic and technological dimensions. For example, unresolved issues of access control are closely related to the choice of billing platforms and revenue models, and consequently, control over the customer relationship. For the corporate VoIP area, technological issues related to the non-voice part of the corporate VoIP offering represent greater sources of heterogeneity problems than the voice part where most technological issues of heterogeneity are resolved.

Business model

The list of dimensions of relevance to business model design shown in table 8.3 is long and suggests business strategic behaviour to be an important source of heterogeneity problems for most of our service areas. This is often believed to represent general barriers to innovation but it may also represent opportunities for business model innovation. The technological disruptiveness of all-IP technology in our service areas is great, but it also varies across service areas. For example,

Dixit (2006) conclude that "*VoIP and TV over the Internet, both in the fixed and the wireless domains are coming down the pike as probably the most disruptive developments to the traditional cable and telecom models*" (Dixit, 2006, p. 57). Regardless of technological disruptiveness, *disruptive strategies* must be implemented in innovative business model design for the technological disruptiveness to have any effect on customer value, second-order innovation and finally, wealth.

Despite a considerable number of problems and opportunities of heterogeneity from business strategic behaviour, the service areas corporate VoIP and mobile broadband are represented by well established business models were the challenges or heterogeneity are well defined and may be predicted. Typically, alternative business model designs may be compared and it is rather obvious which alternative designs are likely to compete for dominant positions. Contrasting this with multi play, we also in this area find well established business models but these are typically isolated to each of the networks or components of the multi play offering. Here, the challenges represented by heterogeneity are much less well defined and it is difficult to predict the outcome of these challenges. This situation calls for more investigation and consequently, it suggests research may contribute to greater predictability and is required to develop recommendations for business model design. M2M communication services are also of this kind, but here, the challenges and problems vary considerably across application areas. Finally, mobile VoIP is also an area where the alternative business model designs that are likely to compete for dominant positions are not yet obvious and where business model innovation is still under way. Also, this area is currently being commercialized leaving opportunities for empirical research on alternative business model design as they evolve in the market.

Customer value

Problems of relevance to customer behaviour and customer value are summarized for each service area in table 8.4. Of these problems, not all may be attributed to or be sources of heterogeneity problems. Of the dimensions listed in table 8.4, mainly attitudes, behavioural control, social influences, the relationship between inherent and network attributes and compatibility represent sources of heterogeneity problems. Also, they represent sources of opportunities for those explicitly designing their business models to fit existing customer behaviour.

As for most new service offerings initial attitudes towards all service areas are generally positive. For the M2M communication area, though, negative attitudes may represent an unresolved issue. Behavioural control increases in relevance as the complexity of a service increases. This is currently an issue in mobile VoIP, mobile broadband and multi play services. In mobile VoIP and mobile broadband it is believed to be of less relevance as the technology matures, but for multi play it will remain a critical issue. Social influence is generally believed to be important for all communication services, but corporate VoIP customers are less subject to social influences.

The attributes that create customer value varies considerably across service areas. The value proposition of all service areas refer to intrinsic attributes as value drivers. The importance of network attributes on the other hand, differs considerably. For all communication services user network value is important. Consequently, lacking user network size and strength may represent heterogeneity problems that remain even if technological roaming issues are resolved. For some M2M communication services, the number of nodes or importance of nodes in the

network is a source of value corresponding to user network size and strength for communications services. Multi play is one of the services where complements network value is particularly important. Because the value of this service is characterized by two-sidedness, and in addition, unresolved issues of how freedom of choice influence customer values for multi play services, this service area is particularly interesting from a consumer behaviour perspective.

While issues of technological compatibility may be resolved for many of the service areas, issues of customer compatibility may still be unresolved. For example, established user behaviour represents a barrier to innovation in both mobile VoIP and multi play services. Thus, services may be technologically compatible, but customers may still relate individual services to individual terminals and access technologies representing inertia in innovative behaviour that preserves already established business models.

Table 8.5 Some important of sources of heterogeneity

Part of SCP/Areas	**Corporate VoIP**	**Mobile VoIP**	**Mobile bb**	**Multi play**	**M2M**
Market structural conditions	Few issues	Few issues	Few issues	Economies of scope	Application area specific
Regulatory structural conditions	Few issues	Spectrum	Spectrum	Harmonization of regulation	Privacy legislation
Technological structural conditions	Non-voice issues	New radio technologies	New radio technologies	New radio technologies	Application area specific
Business model options and considerations	Few issues	New revenue models and governance forms	Few issues	Most business model dimensions unresolved	Application area specific
Customer behaviour and customer value	Few issues	User compatibility	Few issues	Behavioural control and user compatibility	Attitude issues

In table 8.5, some of the above mentioned sources of heterogeneity are listed by part of the SCP-framework and service area. For a full summary we refer to tables 8.1 – 8.4. Table 8.5 is mainly meant to be illustrative.

To summarize our conclusions on the relevance of further study of each service area and which parts of the SCP-model are affected by and should be focused in such studies, we refer to table 8.6. It shows each of the parts of the SCP-framework discussed throughout this report and each of the five service areas.

Table 8.6 Relevance illustration of SCP-framework topics for each service area (shading indicates relevance)

Part of SCP/Areas	Corporate VoIP	Mobile VoIP	Mobile bb	Multi play	M2M
Market structural conditions					Application area specific
Regulatory structural conditions			New technologies	Alignment	Alignment
Technological structural conditions	Specific issues only	New technologies only	New technologies only	New technologies only	
Business model options and considerations					Application area specific
Customer behaviour and customer value					Application area specific

In table 8.6, cells are shaded grey indicating the seriousness and challenges of heterogeneity for each of the topics and service areas. We see that corporate VoIP has been found to include relatively few challenging heterogeneity problems except those related to non-voice parts of the service offering. M2M communication services, and in particular specific application areas of M2M communication services, represent both serious challenges and great opportunities for investigating technological and regulatory sources of heterogeneity problems. To contrast this service area, mobile VoIP represents an area where the challenges of heterogeneity are also serious, but in this service area, the challenges are found in business strategic and customer behaviour. Not surprising, many challenges from heterogeneity are found in the multi play area. As indicated above, this is interesting because here, the greatest opportunities for near-future convergence are also found. This is true for multi play as a near-future quad play scenario including mobile voice as well as the more distant-future multi play scenario including telephony, television and broadband Internet access on both stationary and mobile

terminals. Further investigations of sources of heterogeneity and their effects on business model design in multi play should be based on both these multi play scenarios.

REFERENCES

AeA (2005): *Voice over IP and Productivity: How IP Telephony Enables Experts and Support Staff to Be Seemingly Everywhere at Once*, Technline, Spring 2005, Advancing the Business of Technology Redmond, WA, USA, pp. 6 – 10.

Afuah, A. and Tucci, C. L. (2000): *Internet Business Models and Strategies*, McGraw-Hill, Boston.

Ajzen, I. (1991): The Theory of Planned Behavior, *Organization Behavior and Human Decision Processes*, vol. 50, pp. 179-211.

Akyildiz Ian F., Weilian Su, Yogesh Sankarasubramaniam, and Erdal Cayirci (2002). Wireless sensor networks: a survey. *Computer Networks*, 38(4), 393-422.

Albretsen A. (2006). *Investigation of M2M-related communication standards that exist on the global market today*. Master Thesis, Agder University College, Grimstad, Norway.

Alcatel (2005): *Operational Excellence in triple play Service Delivery*, White Paper, Alcatel.

Alvarion (2006): *Mobile WiMax. Personal Broadband Services for Enhancing Lifestyles and Productivity*, White Paper, Alvarion.

ArrayComm (2004): *Navigating the Harsh Realities of Broadband Wireless Network Economies*, Whitepaper, ArrayComm, Inc., 2004.

Bain, J. S. (1951): Relation of Profit Rate to Industry Concentration of American Manufacturing, 1936 – 1940, *Quarterly Journal of Economics*, no. 65.

Balasubramanian, S., Peterson, R. A., and Jarvenpaa, S. L. (2002): Exploring the Implications of M-Commerce for Markets and Marketing, *Journal of the Academy of Marketing Science*, vol. 30, pp. 348-361.

Ballon, P. (2004). Scenarios and business models for 4G in Europe. *Info*, 6 (6), 363-382.

Basu, A., Mazumdar, T. and Raj, S.P. (2003). Indirect Network Effects on Product Attributes. Marketing Science, 22, 209-221.

Bodzinga, A. (2005). *The Role of IMS in triple play*. Proc. The Communication Network Event, November, 4. Cardiff, UK.

Bouwman, H. (2003): Designing Metrics for Business Models Describing Mobile Services Delivered by Networked Organizations, Presented at *the 16th Bled Electronic Commerce Conference*, Bled, Slovenia, June 9-11.

Brazell, J. B., Donoho, L., Dexheimer, J., Hanneman, R., and Langdon, G. (2005): M2M: The Wireless Revolution. A Technology Forecast, Texas State Technical College, Waco, Texas.

Brousseau, E. and Quelin, B. (1996): Asset Specificity and Organizational Arrangements: The Case of the New Telecommunication Services Markets, *Industrial and Corporate Change*, vol. 5, pp. 1205-1230.

Brynjolfson, E. and Kemerer, C. F. (1996): Network Externalities in Microcomputer Software: An Econometric Analysis of the Spreadsheet Market, *Management Science*, vol. 4, pp. 1627-1647.

Camarillo, G., & Garcia-Martin, M. A. (2004). *The 3G IP multimedia subsystem (IMS): Merging the Internet and the cellular worlds*. John Wiley & Sons, Chichester, UK.

Campanovo, G. and Pigneur, Y. (2003): Business Model Analysis Applied to Mobile Business, Presented at *the 5th International Conference on Enterprise Information Systems*, Angers, France, April 23 – 26.

Capgemini (2005): Mobile VoIP: Knocking at the Gates, *Telecom & Media Insights*, Issue 8, March 2005.

Capgemini (2006): Telcos vs Internet Players: Worlds in Collision, *Telcom & Media Insights*, vol. 15, September 2006.

Chesbrough, H. and Rosenbloom, R.S. (2002). The role of the business model in capturing value from innovation: evidence from Xerox Corporation's technology spin-off companies. *Industrial and Corporate Change*, 11(3), 529-555.

Davis, F. D. (1989): Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Computer Technology, *MIS Quarterly*, vol. 13, pp. 319-340.

Davis, F. D., Bagozzi, R. P., and Warshaw, P. R. (1989): User Acceptance of Computer Technology: A Comparison of Two Theoretical Models, *Management Science*, vol. 35, pp. 982-1002.

De Jong, C. (2006): The Evoultion of VoIP – The Challenge and Business Case, EMEA, issue 206.

Dimmick, J.W., Sikand, J., and Patterson, S.J. (1994). The gratifications of the household telephone: sociability, instrumentality, and reassurance. *Communication Research*, 21 (5), 643-664.

Dixit, S. (2006). On Fixed-Mobile Network Convergence. *Wireless Personal Communications*, 38, 55-65.

Dodds, W. B., Monroe, K. B., and Grewal, D. (1991): Effects of Price, Brand, and Store Information on Buyer's Product Evaluation, *Journal of Marketing Research*, vol. 28, August, pp. 307-319.

Doyle, S. (2001): Software Review: Using Short Message Services as a Marketing Tool, *Journal of Database Marketing*, vol. 8, pp. 273-277. s14

Dulski, A. and Persson, M. (2004): *Mobile Broadband – Operator Opportunities*, Whitepaper, Motorola.

El-Sayed, Mohamed L., Ying Hu, Samrat Kulkarni, Newman Wilson (2006). Comparison of transport network technologies for IPTV distribution. *Bell Labs Technical Journal*, 11(2), 215 – 240.

Ericsson (2006). *Generic Access Network (Former UMA).* Ericsson White Paper, October, http://www.ericsson.com/technology/whitepapers/ 3035_gan_a.pdf.

ESE Magazine (2006): Getting the M2M Experience, *ESE Magazine*, July/August, vol. 14, no. 5, pp. 32.

Eskedal, T.G., Venturin, R., Giric, I., Andreassen, R., Francis, C., Fisher, C. and Danzeisen, M. (2003). *The operatiors' vision on systems beyond 3G*. Eurescom Report, Project 1203, Eurescom, Heidelberg, Germany.

Falkner, M., Devetsikiotis, M. and I. Lambardis. (2000). An Overview of Pricing Concepts for Broadband IP Networks, *IEEE Communications Surveys*, 2nd Quarter.

Farpoint (2006): *Deploying Residential Wi-Fi Wireles LANs: RF Repeaters for Coverage and Reliability,* White Paper, Farpoint Group, Ashland, MA.

Finnaran. M. (2005). Three Architectures for the Telco triple play. *Business Communications Review*, March, 32-37.

Fiorini, P. M. (2000): *Voice over IP (VoIP) for Enterprise Networks: Performance Implications & Traffic Models*, Whitepaper, BMC Software.

First Tuesday Zurich (2004): *Voice over IP – Finally Driving Change?,* Thought Leadership Forum, September, 2004

Fishbein, M. and Ajzen, I. (1975): Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research, Addison-Wesley, Reading MA.

Flagherty, G. (2006). Convergence in Telecommunications Infrastructure. *The Journal of the Communications Network*,

Fredriksen, J. (2006). The change to VoIP and the introduction of TVoIP and xDSL. Info, 8(5), 13-22.

Frels, J.K., Shervani, T. and Srivastave, R.K. (2003). The Integrated Networks Model: Explaining Resource Allocations in Network Markets. *Journal of Marketing*, 67, 29-45.

Funk, J. (2004). *Mobile Disruption: The Technologies and Applications Driving the Mobile Internet*, Wiley, NY.

Gandal, N., Kende, M, and Rob, R. (2000). The dynamics of technological adoption in hardware/software systems: the case of compact disc players. *RAND Journal of Economics*, 31, 43-61.

Gibson, J. F., Bilderbeek, P., and Vestergaard, L. (2005): *Fixed-Mobile Convergence: Unifying the Communication Experience*, An IDC White Paper, November,

Godø, H. (2000). Innovation regimes, R&D and radical innovations in telecommunications. *Research Policy* 29, 1003-1046.

Gupta, S., Jain, D.C., Sawhney, M.B. (1999). Modeling the Evolution of Markets with Indirect Network Externalities: An Application to Digital Television. *Marketing Science*, 18, 396-416.

Hagen, K.P and Nafstad, A. (2003). *Telepolitikk i Europa*. SNF-Report nr. 27/03. Institute for Research in Economics and Business Administration, Bergen, Norway.

Henten, A., Olesen, H, Saugstrup, D and Tan, S.E. (2004). Moile communications: Europe, Japan and South Korea in a comparative perspective. *Info*, 6(3), 197-207.

Hommen, L. (2003). The Universal Mobile Telecommunications System (UMTS). In C. Edquist (ed). *The Internet and Mobile Telecommunications System of Innovation* Edward Elgar, Cheltenham, pp. 129-161.

Houssos, N., Gazis V. and Alonistioti, A. (2004). Enabling delivery of mobile services over heterogeneous converged infrastructures. *Information Frontiers*, 6 (3): 189-204.

Hui, S.Y. and Yeung, K.H. (2003). Challenges in the migration to 4G mobile systems. *IEEE Communications Magazine*, 41 (12): 54-59.

Huitema, G. (2006). Compensation Enabled Business Models. Report D4-G.3 from the Ambient Networks project. [http://www.ambient-networks.org/Files/deliverables/D4-G.3_PU.pdf]

Hung, S.-Y., Ku, C.-Y., and Chang, C.-M. (2003): Critical Factors of WAP Services Adoption: An Empirical Study, *Electronic Commerce Research and Applications*, vol. 2, pp. 42-60.

IBM (2006): *The End of Television as We Know it. A Future Industry Perspective*, IBM Institute for Business Value, Somers, NY.

IETF (2004). Extensible Authentication Protocol (EAP)", IETF RFC 3748, June 2004, http://www.ietf.org/rfc/rfc3748.txt

Incode (2006). The "quad play" —The First Wave of the Converged Services Evolution, InCode White Paper, February, InCode Telecom, US.

Intel (2006). The Business Case for Enterprise VoIP. Intel White Paper. February. Intel Corp., US.

Kadiyali, V., Sudhir, K. and Rao, V.R. (2001). Structural analysis of competitive behavior: New Empirical Industrial Organization methods in marketing. *International Journal of Research in Marketing*, 18: 161.186.

Kannan, P. K., Mei Chang, A.-M., and Whinston, A. B. (2001). Wireless Commerce: Marketing Issues and Possibilities, *Proceedings of the 34th Hawaii International Conference on System Sciences*, pp. 1-6.

Kapur, A. (1998): Voice over IP: A Primer, *InfoComm Review*, vol. 4, no. 3, Price WaterhouseCoopers, pp. 25-29.

Karlsson, L., Lindroos, S., and Särefjord, D. (Accessed 21.01.2007): *triple play. A Strategy for the Convergence of Home Electronics in the Swedish Market*, Working Paper, Chalmers.

Kleijnen, M., Wezels, M., and de Ruyter, K. (2004): Consumer Acceptance of Wireless Finance, *Journal of Financial Services Marketing*, vol. 8, no. 3, pp. 206-217.

Koutsopoulou, M. Kaloxylos, A., Alonistioti, A., Merakos, L. and Philippopoulos, P. (2004). An integrated charging, accounting and billing management platform for the support of innovative business models in mobile networks. *International Journal of Mobile Communications*, 2(4), 418 - 434

Kushman, N., Kandula, S., and Katabi, D. (2006): *Can You Hear Me Now?! It Must e BGP*, DRAFT, DO NOT DISTRIBUTE.

Lan (2006), Commercialising wireless sensor networks technologies, *Int. J. Technology Marketing*, 1(1), 79-93.

Lawton, G. (2004): Machine-to-Machine Technology Gears Up for Growth, *Computer*, September 2004, pp. 12-15.

Lee, Y. and O'Connor, G.C. (2003). New Product Launch Strategy for Network Effects Products. *Journal of the Academy of Marketing Science*, 31, 241-255.

Leung, L. and Wei, R. (2000): More Than Just Talk on the Move: Uses and Gratifications of the Cellular Phone, *Journalism & Mass Communication Quarterly*, vol. 77, no. 2, pp. 308-320.

Liebowitz, S. and Margolis, S. (1998). Network Externality. In *The New Palgraves Dictionary of Economics and the Law*, MacMillan, UK.

Lin, C.A. & Atkin, D.J. (2002). *Communication Technology and Society*. Hampton Press, NJ.

Lindmark, Sven, Pieter Ballon, Collin Blackman, Erik Bohlin, Simon Forge and Uta When (2006). Alternative wireless technologies – trends, drivers and European policy. *Proc. EuroCPR 2006*. 26-28 March, Sevila, Spain.

Lu, W.W.; Walke, B.H.; Xuemin Shen (2004). 4G mobile communications: toward open wireless architecture, *IEEE Wireless Communications*, 11 (2): 4-6.

Lucent Technologies (2006): *Consumer VoIP and Beyond: Service Provider Challenges and Opportunities*, Whitepaper, Lucent Technologies, Bell Labs Innovations.

Luo, L., Liu, J., Shao, L., Lu, W. and Ye, M. (206): A context-aware smart-call-center solution: Improving customer service for online games, *IBM Systems Journal*, vol. 45, no. 1, pp. 145-160.

Madhok, A. (2002): Reassessing the Fundamentals and Beyond: Ronald Coase, the Transaction Cost and Resource-Based Theories of the Firm and the Institutional Structure of Production, *Strategic Management Journal*, vol. 23, pp. 535-550.

Mathwick, C., Malhotra, N. and Rigdon, E. (2001). Experiential value: conceptualization, measurement and application in the catalog and Internet shopping environment. *Journal of Retailing*, 77, 39-56.

Methlie, L.B. and Gressgård, L.J. (2004). Mobile Data Service Markets: Structural Market Antecedents to Business Model Choices. *Journal of Electronic Commerce Research*, 7(1), 14-26.

Methlie, L.B. and Pedersen, P.E. (2002). A taxonomy of intermediary integration strategies in online markets. Presented at the15th Bled Electronic Commerce Conference, Bled, Slovenia, June 17-19.

Moore, G. C. and Benbasat, I. (1991): Development of an Instrument to Measure the Perception of Adopting and Information Technology Innovation, *Information Systems Research*, vol. 2, no. 3, pp. 192-222.s46

Motozine (2006): "Cooperative Approach to Disruptive Technology, *Motozine*, vol. 2, no. 9, pp. 6-8.

Netgain 1200 (2006): *Accelerating the Adoption of Mobile Data*, Flash Networks, Lyndhurst, NJ, USA.

Nicholls-Nixon, C. L. and Wood, C. (2003): Technology Sourcing and Output of Established Firms in a Regime of Encompassing Technological Change, *Strategic Management Journal*, vol. 24, pp. 651-666.

Northstream (2002): *Den Norska SMS-Marknaden*, Analyst Report, Northstream AB, Stockholm, Sweden. (In Swedish).

NPT (2006). *Regulering avd bredbåndstelefoni etter lov om elektronisk kommunikasjon*. Rapport av 14. juni, Post og teletilsynet, Oslo, Norway.

Nysveen, H., Pedersen, P. E., and Thorbjørnsen, H. (2005): Intentions to Use Mobile Services: Antecedents and Cross-Service Comparisons, *Journal of the Academy of Marketing science*, vol. 33, no. 3, pp. 330-346.

Ofcom (2006). The International Communications Market. Ofcom Research Report, November, Ofcom, London, UK.

Okamoto, Y. and Reynolds, T. (2006). *Multiple Play: Pricing and Policy Trends.* Report JT03207142 of the Directorate for Science, Technology and Industry, OECD.

Osterwalder, A., Pigneur, Y., Ondrus, J. and Lathoud, B. 2005a. *Skype's disruptive potential in the telecom market: a systematic comparison of business models*. Working paper, University of Lousanne, Switzerland.

Osterwalder, A, Pigneur, Y. and Tucci, C.L. 2005b. Clarifying business models: origins, present, and future of the concept. *Comm. AIS*, 16(1).

Papacharissi, Z. and Rubin, A. M. (2000): Predictors of Internet Use, *Journal of Broadcasting and Electronic Media*, vol. 44, pp. 175-196.

Parks Associate (2006): *Mobile Broad Wireless: Path towards 4G*, Preliminary Table of Contents, Parks Associates, Dallas, TX.

Päivärinta, R. and Koikkalainen, L. (2003): Put a Lid on Your Telephone System Expenses by Using VoIP-Technology, *HINKU*, pp. 22-23, March 31, 2003, Helsinki.

Pedersen, P.E. 2001. An adoption framework for mobile commerce. In Schmid, B., Stanoevska-Slabeva, K. and Tschammer, V. (eds.). *Towards the E-Society*. pp. 643-656. Kluwer Academic Publishers, Ma.

Pedersen, P. E., Methlie, L. B., Gressgård, L. J., Nysveen, H., and Thorbjørnsen, H. (2005): *An Exploratory Study of the Relationships Between Mobile Data Services Business Models and Customer Value*, Institute for Research in Economics and Business Administration, Report 13/05, Bergen, Norway.

Purdy, J. G. (2005): *Vocera Communications: Bringing Mobile VoIP to In-Building Mobile Workers*, Vocera Communication, 20600 Lazaneo Drive, Cupertino, CA.

Rajendran, Raj Kumar, Samrat Ganguly, Rauf Izmailov, and Dan Rubenstein (2006). *Performance Optimization of VoIP using an Overlay Network*, Technical Report, Columbia University, NY.

Ralph, D. T. (2002): 3G and Beyond – The Applications Generation, *BT Technology Journal*, vol. 20, pp. 22-28.

Ransom, M. (2006): *Don't Forget Voice – Content Isn't Everything*, Advisory Report – Europe, CurrentAnalysis, Paris, France.

Rao and Parikh (2003) Wireless Broadband Networks: The U.S. Experience, *International Journal of Electronic Commerce,* Fall, 8(1), 37 – 53.

Reding, V. (2006). *From Service Competition to Infrastructure Competition: the Policy Options Now on the Table*. ECTA Conference, Brussels, November, 16.

Richards, Foster, and Kiedrowski (2006). *Communications - The next decade: A collection of essays prepared for the UK Office of Communications*. Ofcom, London, UK.

Rietkerk, O. (2006). Business Role Models. Report D8-A.3 from the Ambient Networks project. [http://www.ambient-networks.org/Files/deliverables/D8-A3_PU.pdf].

Robinson & Yedwab (2004). Understanding Vendor Strategies for VOIP, *Business Communication Review*, August, 28-32.

Rogers, E. M. (1995): *Diffusion of Innovations* (4th Edition), The Free Press, New York. s64

Rubin, A. (1983). Television uses and gratifications: the interactions of viewing patterns and motivations. *Journal of Broadcasting* 27, 37-51.

Sathish, P. (2006). *VoIP - The Future of Telecommunications*. VoIP Lowdown. http://www.voiplowdown.com/2006/03/voip_the_future.html

Schilling, M. A. (2003): Technological Leapfrogging: Lessons from the US Video Game Console Industry, *California Management Review*, vol. 45, pp. 6-32.

Schwartz, B. (2004). *The Paradox of Choice: Why More is Less*. Harper Collins, NY.

Sekino, H., Pecorari, M., Douglas, G., and Gates, D. (2006): *Convergence: One Size Doesn't Fit All*, Diamond Management & Technology Consultants, Chicago, IL.

Sengupta, S. (1998): Some Approaches to Complementary Product Strategy, *Journal of Product Innovation Management*, vol. 15, pp. 352-367.

Siemens (2006): *Bridging the Gap in the broadband Access Market*, Siemens Communications Mobile Network, Munich, Germany.

Simon, M. (2005): *Overview of the Current Situation of Voice over Internet Protocol*, Computing Research Methods Report, Semester 2, 2005 (3

November), School of Computer and Information Science, University of South Australia.

Smith, B. (2006). IMS: All Talk and No Walk?, *Wireless Week*, March, 8-9.

Solem, A., Fauske, M.F., Gaarder,K., Carbonell, J. Guarneri M.R., Eskedal, T.R. and Gjerde, I.G. (2006). Business Models for the ePerSpace Products. Report D1.4 from the ePerSpace Project. [http://www.ist-eperspace.org/deliverables/D1.4_R2.pdf].

Sony Ericsson (2006). *Sony Ericsson M2M Brochure.* http://www.sonyericsson .com/spg.jsp?cc=us&lc=en&ver=4002&template=ph1&zone=ph

Sprint Nextel (2006): *Sprint Nextel Announces 4G Wireles Broadband Initiative with Intel, Motorola, and Samsung*, Note, August 8, New York.

Stuart, T. E. (2000): Interorganizational Alliances and the Performance of Firms: A Study of Growth and Innovation Rates in a High-Technology Industry, *Strategic Management Journal*, vol. 21, pp. 791-811.

Tachikawa K. (2003). A perspective on the evoulition of mobile communications. IEEE *IEEE Communications Magazine*, 41 (10): 66-73.

Telechoice (2002): *Unwire Me: The User Perspective on Mobile Broadband*, Telechoice, Colorado Office, Denver, CO.

Teo, T. S. H. and Pok, S. H. (2003): Adoption of WAP-Enabled Mobile Phones among Internet Users, *Omega*, vol. 31, pp. 483-498.

TietoEnator (2006): *Digital Trends 2006*, Arabianranta 6, Helsinki, Finland.

Timmers, P. (1998): Business Models for E-Commerce, *Electronic Markets*, vol. 8, pp. 3-7.

TMNG (2005): *Mobile Broadband Content and Applications*, The Management Network Group, Overland Park, KS.

Tobin, P. K. J. and Bidoli, M. (2006): Factors affecting the adoption of voice over internet protocol (VoIP) and other converged IP services in South Africa, *South Africa Journal of Business Management*, vol. 37, no. 1, pp. 31-40.

Todd, P. M., & Gigerenzer, G. (2000). Simple heuristics that make us smart. *Behavioral and Brain Sciences*, 23(5), 727–741

Ure, J. (2003). Deconstructing 3G and reconstructing telecoms. *Telecommunications Policy*, 27, 187-206.

Varshney, U., Snow, A., McGivern, M. and Howard, C. (2002): Voice over IP, *Communication of the ACM*, vol. 45, no. 1, pp. 89-96.

Verkasalo, H. (2006*), Emerging Trends in the Mobile VoIP Business*. Working Paper, Helsinki University of Technology, Finland.

Vesa, J. (2003): The Impact of Industry Structure, Product Architecture, and Ecosystems on the Success of Mobile Data Services: A Comparison Between European and Japanese Markets, Presented at *the ITS 14th European Regional Conference*, Helsinki, Finland, August 23-24.

Wang, C.-C., Hsu, Y. H., and Fang, W. (2004): Acceptance of Technology with Network Externalities: An Empirical Study of Internet Instant Messaging Services, *Journal of Information Technology Theory and Application*, vol. 6, no. 4, pp. 15-28.

Wang, N., M. H. Wang, and N. Q. Zhang, (2006). Wireless sensors in agriculture and food industry: Recent development and future perspective," *Computers and Electronics in Agriculture*, 50(1), 1-14.

Watson, R. T., Pitt, L. F., Berthon, P., and Zinkhan, G. M. (2002): U-Commerce: Expanding the Universe of Marketing, *Journal of the Academy of Marketing Science*, vol. 30, pp.333-347.

W-CDMA (Accessed 13.01.2007): A Call to Action – HSPA Deployment, pp. 10-11. [http://www.nttdocomo.com/binary /about/mobile_issue 07_02.pdf]

Weill, P. and Vitale, M. R. (2001): *Place to Space. Migrating to e-business Models*, Harvard Business School Press, Boston, MA.

Weinrib, A. (2006). *International Roaming Access Protocols: Taking WLAN Mainstream*, Intel, IRAP web, visited Dec. 2006, http://www.irap.nl/pres.htm.

Zahra, S. A. and Nielsen, A. P. (2002): Sources of Capabilities, Integration and Technology Commercialization, *Strategic Management Journal*, vol. 23, pp. 377-398. s14

Zhang, J., Chan, S., and Fang, X. (????): *Enterprise User Adoption of VoIP,* working paper, DePaul University, School of Computer Science, Telecommunications and Information Systems, Chicago, IL.

APPENDIX A. Deliverable requirement specification

Pre-study deliverable - 176757/S10 Designing business models for customer value in heterogeneous network services

Requirements and deliverables

1. Introduction

As proposed in the project proposal for the above mentioned project and as agreed upon in the kick-of meeting of September 20, a pre-study will be conducted this autumn. It was agreed that we should conduct literature reviews, industry reviews and service area updates on 5-6 potential service areas. These service areas will be among the ones analyzed in our service selection workshop in Q1/07. The main idea is that the pre-study should provide the necessary background material for us to make an optimal choice of our first three service areas that we will conduct full service analysis for in 2007 and partly in 2008.

Responses for potential service areas of the pre-study have been collected and aggregated. The criteria for identifying and aggregating service areas are that they are relevant to partners, are sufficiently commercialized in the form that they are open to empirical investigation and also show some variation in relevant determinants of optimal structural conditions, business models and in relevant service attributes.

It has also been decided that the pre-study should be organized by reviews of issues relevant to structural conditions, business models and customer value. Furthermore, it has been decided that the contents of each pre-study deliverable should be specified by requirements issued by the project owner. In this document, these requirements are specified. First, the chosen service areas are briefly described. Next, the organization of research groups is described. Finally, the assignments given to each group are presented and requirements for deliverables are specified.

2. Service areas

The following service areas have been chosen for elaboration and analysis in this pre-study:

Service area	Partner	Commercial.	Example technologies	Example problems/research topics
Corporate VoIP	Teleca	High	SIP/IMS H323 IAX (Skype) IMS and propr. technologies for non-voice functionality	Value of non-voice services. Efficiency based customer values. Blurring boundaries of professional/domestic life. Interoperability of non-voice and business models. The influence of enterprise network infrastructure vendors.
Mobile VoIP	Teleca/ Res.	Moderate	SIP UMA Femtocell	Value of domestic mobile VoIP and mobile VoIP roaming. Cross-access network revenue

			Bluetooth CTP Skype/IPdrum VoiceRoaming	stimulation. Business models in path to IMS. Changes in relevant market definitions.
Mobile broad-band	NPT	High	UMTS WiFi WiMAX SmartRoaming	Roaming value. Enterprise VPN value and security. Business model comparisons between licensed/unlicensed band players
Multi play (access indep.)	NPT /AE	High (Triple) - Low (Quad)	FTTH ADSL2 Cable	Value of bundled versus unbundled service offerings (open network value). Content provider business models in open network multi play. Regulatory interplay between media and telecom reg.
M2M Cellular and heterog.	Teleca /NPT	Moderate for cell, low for heterog.	GSM/GPRS Bluetooth Zigbee RFID	Measurement of indirect and aggregate value. Open business models for M2M-sevice development. Unlicensed regulation.

The table above identifies the five potential service areas of Corporate VoIP, MobileVoIP, Mobile broadband, Multi play and M2M Cellular and heterogeneous. The table also illustrates *examples* of technologies representing heterogeneity of technologies and *examples* of potential problems and research topics that may be investigated in the service analyses in 2007/2008.

By Corporate VoIP we refer to solutions for implementing VoIP and corresponding non-voice services by corporate customers. Mainly current implementations are found in enterprises and larger public sector organizations. One of the issues that makes this service area interesting is how the functionality of these services extends into operator provided VoIP implementations and infrastructures. Correspondingly interesting is how providers of public VoIP services should adapt to the service functionalities offered in corporate VoIP implementations that are already widely adopted.

By Mobile VoIP we refer to solutions for both corporate and domestic customers as well as solutions for public Mobile VoIP services over open hotspots. Several business models for such service offerings are currently commercialized ranging from the use of dual mode handsets applying SIP clients and IMS solutions to different types of "smart" services utilizing characteristics of currently offered cellular service plans (e.g. IPdrum). For this service area, we are mainly interested in voice services, but non-voice services should also be briefly discussed.

By Mobile broadband we mean broadband access services, mainly to provide broadband access for data when using the mobile as "modem" for another terminal. The most widely implemented service is general Internet access, and through this, VPN-services. Currently, solutions for roaming across WiFi and different cellular networks exists, but as the number of access networks increase, the complexity of roaming agreements is also likely to increase.

By Multi play we mean bundled services of fixed TV, Internet access and telephony with or without bundled mobile telephony services (QuadPlay). The service offerings may be business strategic bundles with integration at the bill level or they may be provided with a more technical integration utilizing the variety of infrastructure controlled by integrated and full service providers. In particular we focus the provision of Multi play as an open access service where the customer is offered a variety of service providers for each of the individual services of the service bundle and where the customer is free to compose the bundle of services to her preferences.

By M2M Cellular and heterogeneous we mean the offering of services providing communication between machines using either a) cellular networks or b)combinations of cellular and other networks, such as sensor and actuator networks or ad hoc networks. The main challenges of heterogeneity are found in the services of category b) above, and will be focused.

3. Organization

The organization of the pre-study reflects differences in the expertise of consortium members and is the project owner's suggestion. Partners are encouraged to engage in cross-partner collaborative activities. Thus, the suggested organization is indicative. The responsibility for deliverables, however, is based on this proposed organization. The person responsible for the deliverable is indicated with the letter (D). The organization is as follows:

1. Structure – conduct investigation of regulatory and market conditions:
Helge Godø (NIFU STEP) (D) and Anders Henten (CICT/DTU)

2. Structure – conduct investigation of technological development, security and standardization:
Frank Reichert (HiA) (D) and Vladimir Oleshchuk (HiA)

3. Investigation of current business model practices and challenges:
Leif B. Methlie (NHH) (D) and Irena Gjerde (Telenor)

4. Investigations of customer behaviour and customer value drivers:
Rich S. Ling (Telenor) (D) and Herbjørn Nysveen (NHH)

5. General literature review
Herbjørn Nysveen (NHH) (D), Leif B. Methlie and Per E. Pedersen (HiA)

Researchers should encourage relevant industry partners to be included in their reviews. For example, NPT is likely to have a special interest in the review of group no 1 and AE seems likely to have a special interest in the review of group no 4. Industry partners are also encouraged to supply problems that they feel should be reviewed by individual groups. People responsible for the deliverables are asked to initiate cooperation and organize the work of the group.

4. Assignments, deliverables and requirements

Researchers are free to interpret the specified assignments and also to focus other topics and issues that they feel relevant as well as to focus some of the service areas, but as a minimum requirement all service areas must be covered on the topics specified as follows:

1. Structure – conduct investigation of regulatory and market conditions:
   - Status of relevant regulation
   - Status of market situation, such as market power and fragmentation
   - Important characteristics of value chain configurations
   - Characteristics of innovation processes
   - Inputs from innovation research of particular relevance to service areas

2. Structure – conduct investigation of technological development, security and standardization:
   - Status of standardization efforts in order to overcome heterogeneity problems
   - Technological disruptiveness
   - Technological barriers and challenges of relevance to commercialization, including security and privacy issues
   - Recent technological industry efforts besides standardization to overcome heterogeneity problems, including industry investments

3. Investigation of current business model practices and challenges:

   - Status of industry business model practices including:
   - Revenue model alternatives
   - Cooperative arrangements and governance forms
   - Value proposition details and differences
   - Market strategy details and differences
   - Inputs from business model research of particular relevance to service areas

4. Investigations of customer behaviour and customer value drivers:
   - Description of inherent service characteristics, including two-sidedness
   - Categorization of customers
   - Categorization of service attributes of relevance to customer value
   - Inputs from domestication, adoption, acceptance and gratification research of particular relevance to service areas

5. General literature review:
   - Status of customer behaviour research in service areas
   - Status of business model research of relevance to SCP-framework
   - Inputs from innovation and technology management research of relevance to SCP-framework
   - Discussion of SCP-framework adjustments due to recently published research results

Each of the reviews should be written with the framework of the project (the SCP-framework) in mind and should provide a firm basis for identifying problems of particular relevance to each service area that need particular attention in a full service analysis.

Each review should be reported in a working paper of approximately 10-15 pages covering the topics described above for each of the service areas. The working papers should easily be integrated into a full report published as an SNF-report that will be used as the basic material for identifying service areas and relevant research topics for further investigation in Q1/07. To enable such integration, the papers should be organized by *service area*. Thus, each paper should cover the relevant topics indicated above, but organized by service area. The deadline for submitting the working papers is Friday, December 15, 2006. Please submit in Microsoft Word format by email to per.pedersen@hia.no. There are no other formal requirements with respect to formatting etc. Please use a standard form of citation.

Persons responsible for submitting the deliverables should also be prepared to give a presentation of the work at the service selection workshop scheduled for Q1/07. Please note that the person hour costs of the working paper deliverable, the presentation, travel and person hour costs for participating in the service selection workshop should be covered by the 2006 funding of each partner, so please dimension your efforts accordingly. Responsibility for the deliverables does not necessarily indicate how efforts should be distributed in each group. Distribution of efforts should reflect the available resources given to each researcher/partner. For external partners this is indicated in the project budget. For SNF-internal researchers, the internal SNF-budget reflects allocated resources for the pre-study. Again, please dimension your efforts accordingly.