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Unfolding the Convergence Paradox:

The Case of Mobile Voice-over-IP in the UK

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Abstract

The notion of digital and in particular Information and Communication Technology (ICT) convergence has, over the past 40 years, been in the centre of many technological discourses in different functional systems of society: from the economic and mass media to the legal and political systems. Recently, a new convergence discourse has emerged around next-generation wireless infrastructures and services. One manifestation can be seen in discussion of the mobile Internet, and in particular of new converging services connecting mobile telephony networks to the Internet. Contrary to the prominence of the topic in other domains, the Information Systems community has relegated the notion of ICT convergence to the sidelines. Only recently have there been calls to include convergence as one of the drivers for the design of new mobile infrastructures and services. However, a systematic analysis of the idea of ICT convergence is still missing. Thus, based on an extensive literature review, this dissertation aims firstly to understand if there is space for a more theoretical development of this concept in the information infrastructure literature. Secondly, it provides an initial conceptual clarification of the ICT convergence discourse. Thirdly, it suggests a systems-theoretical unfolding of the identified core distinction between convergence and divergence, namely the convergence paradox. Finally, the role of technology in these discourses is examined.

This dissertation analyses the notion of convergence and provides a systems-theoretical understanding of its dynamics from a second-order cybernetics perspective. The theoretical framework of this study is based on Niklas Luhmann's Theory of Social Systems. More specifically, it uses analytical strategies based on the work by Nils A. Andersen to understand the characteristics of convergence, eventually to unfold the convergence paradox.

The empirical study investigates the convergence discourses around mobile Voice-over-IP in the UK from 2000-2009. The corpus of data encompasses 39 semi-structured interviews with telecommunications experts in the field of mobile VoIP, a wide range of documents, and direct observations from practitioners' conferences. The empirical study has been part of the EPSRC / Mobile VCE Core-5 Flexible Networks Project.

This dissertation contributes to the broad multi-disciplinary literature of studies dealing with the phenomenon of ICT convergence, more specifically to that on information infrastructures. It develops a conceptual clarification of the notion of convergence. The findings of this dissertation suggest seeing convergence as a difference-reduction programme. This conceptualisation has the following consequences. Firstly, it suggests that convergence is observer-dependent. Secondly, it suggests that its counter-concept is not divergence or fragmentation but rather the maintenance of difference, i.e. control. Thirdly, it suggests that convergence has to deal with the typical unintended consequences inherent in difference-reduction programmes. Furthermore, while ICT convergence treated as difference-reduction programme challenges the existing identity of the infrastructure, the primary role of control is to maintain this difference. The dynamics between these two operations seem to lead to the emergence of further fragmentation.

This dissertation is dedicated to my beloved wife Priyanca

Acknowledgements

List of Acronyms

3G	Third Generation
3GPP	3rd Generation Partnership Project
CMI	Convergent Mobile Infrastructure
EBITDA	Earnings before Interest, Tax, Depreciation and Amortisation
EPSRC	Engineering and Physical Sciences Research Council
GSMA	Global System for Mobile Communication Association
ICT	Information and Communication Technology
IMS	Internet Protocol Multimedia Subsystem
IP	Internet Protocol
IPTV	Internet Protocol Television
IS	Information Systems
ISOR	Information Systems and Organisational Research
MNO	Mobile Network Operator
MVNO	Mobile Virtual Network Operator
Ofcom	Office of Communications
PDA	Personal Digital Assistant
PSTN	Public Switched Telephone Network
SIP	Session Initiation Protocol
SMS	Short Messaging Service
UMTS	Universal Mobile Telecommunication System
VoIP	Voice over IP
WAP	Wireless Application Protocol
WiFi	Wireless Fidelity
XMPP	Extensible Messaging and Presence Protocol

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Prologue

How can convergence be represented in an image? Images of convergence that immediately come to mind are of two rivers merging into one big stream or two pathways uniting into one. The leftmost picture in Figure 1 below shows a Google Earth satellite image of the Rhine and the Mosel merging into each other in Koblenz, Germany. The picture to the right in Figure 0-1 is the famous converging path in the Japanese Tea Garden in San Francisco.
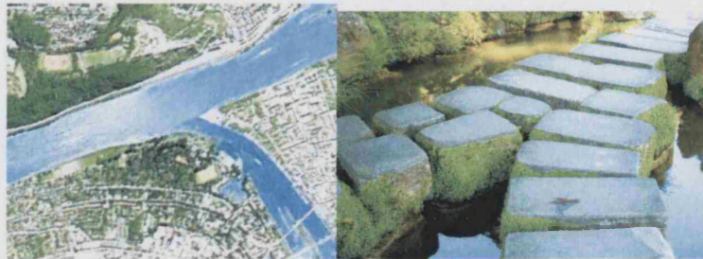
Figure 0-1 Converging Rivers (Google Earth, 2009) and Pathways
(with the explicit permission of Miquel Martin)

A slightly different depiction of convergence is the inclination of a line towards an axis as shown in the fitness curve of a genetic algorithm below (Figure 0-2). What is interesting here is that the convergence of the line with the axis sets a limit. The line will never actually reach the axis, in contrast to the two previous examples.
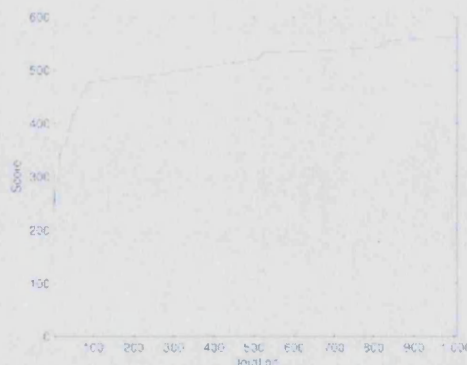
Figure 0-2 Converging Genetic Algorithm (Example)

The next figure (Figure 0-3) is a very different graphical representation of convergence. It is one of the artist Jackson Pollock's most famous paintings: Convergence No. 10 (1952). Jackson Pollock pioneered action painting, a technique where the process of painting is in the foreground. The artist "drips" or "pours" paint on a horizontal surface without touching the actual painting.

Figure 0-3 Jackson Pollock's Convergence No. 10 (Albright-Knox Art Gallery)

One characteristic of Convergence No. 10 highlighted by art experts is that the observer cannot see a *Gestalt* or form, instead it projects the "Immer-Anders-Moegliche" (Böhme and Olschanski 2004), the possibility of being always different. The colours and shapes seem to be contrary to any order and therefore convey both ambivalence and ambiguity to the observer. These characteristics of the painting as compared to the traditional depictions of convergence showing in figure 0-1 and 0-2 above sketch out the research journey described in this PhD dissertation and highlight some of its main themes: hyperbole, differences, and contradictions. It is this change in perspective that this dissertation advocates, and which it argues will be helpful in a rather different context, the context of technological convergence.

However, coming back to Jackson Pollock's painting, it became famous for a very different reason. In 1964, the US-based puzzle company Springbok released a jigsaw puzzle based on "Convergence No. 10", marketing it as the "world's most difficult

jigsaw puzzle". Hundreds of thousands of Americans bought the puzzle. The first 'hype' of convergence in the history of mankind was born.

One year before Springbok marketed the convergence puzzle, Rosenberg (1963) coined the term technological convergence. Technological convergence as a phenomenon has been around as long as mankind has existed. However, only in the past 30 years, has the idea of convergence started to play an influential role. This happened with the emergence of digitalisation, and in particularly the coming together of information and communication technologies.

1. Introduction

This chapter introduces the PhD dissertation through presenting the relevance of the topic of digital and in particular ICT convergence discourses for both the private and public sectors. The argument presented here suggests considering convergence not just as a short-lived management fad, but to take it seriously as both practitioners and their observers do. The central research themes framed in this introduction are threefold: first, convergence in the context of mobility; second, convergence as an idea and not as a phenomenon; and third, the contradictory nature of convergence. Based on the identified shortcomings of the existing literature on convergence, a systematic second-order cybernetic analysis of the notion of convergence in the context of mobile information infrastructures is proposed. Finally, the research approach is outlined and the overall structure of the dissertation is presented.

1.1 BACKGROUND AND MOTIVATION

The digitalisation of the world has taken on a new momentum (Yoo 2010). Physical artefacts in everyday life are becoming increasingly digitalised, that is they all start speaking in the same binary language of 0's and 1's (Kallinikos 2006; Murray 2010). One of the promises of digitalisation is that unlimited interoperability between digitalised artefacts becomes theoretically possible. One consequence of this process is that system designers, managers, and regulators face an increasingly non-transparent web of interconnected applications and networks (Marton 2010).

These artefacts are embedded in specific discourses and are shaped through an ongoing socio-economic process (Orlikowski and Iacono 2001). One discourse that has accompanied this process of digitalisation since its infancy is the discourse of convergence (Herzhoff 2009; Tilson, Lyytinen et al. 2010a). The phenomenon of ICT convergence has been intensively discussed in the academic literature. However, despite the apparent maturity of this research area (Farber and Baran 1977; Lind 2004); there is no generally accepted definition of convergence (Nyström 2008). In addition, there is relatively little understanding of its dynamics, and that focuses

primarily on technical and economic aspects (Kaerrberg and Liebenau 2006) while neglecting equally important social aspects (Jenkins 2006).

One recent manifestation can be seen in discussions of the mobile Internet, and in particular of new converging services connecting mobile telephony networks to the Internet (Minges 2005). The converging information infrastructures not only enable new services, but also they impose design and regulatory challenges (Lyytinen and Yoo 2002; Shin 2006). The diffusion of new converged services like IPTV (the convergence of TV and the Internet) or mobile Internet (the convergence of mobile telephony networks and the Internet) has only increased in pace recently. It is therefore crucial to provide a more robust theoretical underpinning of this phenomenon, so that it can inform future innovation and regulatory recommendations. Tilson et al. (2010) argue that understanding this phenomenon of digital convergence and in particularly the underlying digital infrastructures, is a significant opportunity for IS research. This dissertation follows this call and is therefore situated at the intersection between the literature on the design of information infrastructures, mobility, and convergence studies. The following paragraphs show the relevance of convergence discourses in the public and private sectors.

In 2002, the New York Times (Landler and Fabrikant 2002) credited David Geffen, one of the co-founders of the film production company DreamWorks SKG with Stephen Spielberg and Jeffrey Katzenberg, with the following statement: "Convergence may be the most expensive word in history. It has cost people billions." He was referring to the numerous business strategies, initial public offerings and mergers & acquisitions, which have been rationalised through the idea of digital and ICT convergence during the 1990s. Technological convergence has been particularly accorded tremendous importance in the ICT industry, and especially in the telecommunication sector. It has been used to justify large investments (Lind 2004) or to solicit funds for entrepreneurial endeavours (Knox 2003). In the economic system, the notion of convergence has also been used to shape the structure of many organisations as in the case of the Time Warner AOL merger in 2000 (Kolodzy 2006).

However, these discourses on convergence are not only situated at an industry or organisational level, but also at an individual level. Telecommunications specialists still carry the notion of convergence in their job title (e.g. "Convergence Specialist at BT plc" or "Manager of Convergence Products at Vodafone Group"), and they highlight specific knowledge on convergence in their profiles on professional social networking websites such as LinkedIn (linkedin.com).

In the political and regulatory system, the idea of convergence has significantly shaped the technology policy agenda. The first regulatory report influencing the UK regulatory framework was the green paper on Convergence by the European Commission (European Commission 1997).

The most recent case is related to the *Convergence Think Tank*, which provided the groundwork for Lord Carter's Digital Britain Report (Carter 2009). On 21st December 2007, the Department of Culture, Media and Sport and the Department for Business Enterprise & Regulatory Reforms announced the establishment of a so-called Convergence Think Tank to discuss the future of communications in the UK. It consisted of five seminars and consultation rounds with key industry players from the telecommunications and media sector. In October 2008, the Convergence Think Tank was superseded by the Digital Britain initiative.

Furthermore, discourses on convergence play an important role for government regulators. In the UK, the regulatory body Ofcom was founded in 2002, and enacted through the Communications Act 2003 based on the idea of ICT convergence. Shin (2006) argues that in particular "the focus of the Communications Act has been placed on interoperability and access-related aspects in the regulation of gateways in convergent service" (p. 47). Convergence still plays an important role for the regulator. For example, according to a Google search, 2,420 pages of Ofcom's 86,200 indexed web pages contain the notion of convergence related to ICT.

Finally, the idea of convergence is increasingly embedded in the design of mobile devices, services, and networks (Lyytinen and Yoo 2002). Devices like Apple's iPhone are called "converged devices"; applications like mobile VoIP are called "converged services"; and next-generation networks like BT's 21st century network

are called "converged networks". Yoo, Boland et al. (2009) argue that the notion of digital convergence needs to be expanded to "all forms of artefact design, process change, and experience creation to theorize about these kinds of 'radical' digital innovations" (p. 278).

The notion of convergence seems to touch many parts of our social lives (Steinmüller 2000). This overview has shown that convergence discourses have become quite prominent in society, and have had major influences in both the public and private sectors. It is therefore relevant from both the public and private sectors' perspectives to understand the underlying dynamics of these discourses. In particular the challenges through new mobile information infrastructures and services suggest that it is necessary to study these discourses in the particular context of mobility. The emergence of new convergence discourses around mobility indicates that a new chapter of convergence is currently being written.

1.2 RESEARCH PROBLEM

Despite the importance assigned to the notion of convergence in non-academic discourses, and its impact on organisations and society, the academic discourses around ICT convergence in particular in the IS literature have been very superficial, taking the notion either for granted or relegating it to the sidelines (Herzhoff 2009; Tilson, Lyytinen et al. 2010a). While the literature review shows that the broader management, computer science, and new media literature have studied convergence extensively, the literature on Information Systems where the notion of digital convergence shows high relevance, has only recently discovered the notion as a concept in the context of mobile networks and services.

According to Lyytinen and Yoo (2002), convergence is seen along with mobility and mass scale as one of the three main drivers that designers have to consider in the development of these new information infrastructures and services. However, a critical review of the IS literature has shown that even seven years after Lyytinen and Yoo (2002) published their research agenda in the Journal of Information Systems Research, the understanding of the notion of convergence in particular in the IS literature is still rather poor, and a systematic analysis is missing (Herzhoff 2009).

Relatively few researchers have attempted to provide the kind of theoretical insight needed on convergence to tackle new design and regulatory challenges (Knox 2003; Jansen and Nielsen 2005; Nyström 2008; Tilson, Lyytinen et al. 2010b). In general convergence has been treated merely as a descriptor for technological change in the 1980s and 1990s (Lind 2004). Therefore, a systematic analysis of the notion of convergence is necessary. This kind of analysis contributes not only to the information infrastructure literature but also to the wider context of convergence studies. These studies focus primarily on the phenomenon and less on the notion of convergence and how it is enacted in reality.

The following section shows the main shortcomings of previous studies on ICT convergence.

1.2.1 Previous Research

As part of this dissertation, an extensive literature review on convergence in the IS literature and adjacent fields has been carried out, and this has been supplemented by a review on studies around information infrastructures and mobility. Four main shortcomings of the existing literature have been identified.

1. Previous studies have primarily focused on the drivers and the consequences of convergence, neglecting to study convergence as an idea constructed by a multi-disciplinary discourse (Knox 2003). In particularly, they do not take into account the observer.
2. Most of the previous studies focused on convergence in the general ICT domain, neglecting the recently emerged discourse around mobility (Wareham, Busquets et al. 2009).
3. Studies on ICT convergence focus either on the social-economic or on the technology, but do not consider a socio-technical perspective on convergence (Jenkins 2006). Therefore, the role of technology shaping these discourses is rather unclear.
4. Finally, the literature on convergence is loaded with contradictions. Firstly, although the notion of convergence has taken a very prominent position in the non-academic discourses, it is regarded by some observers as a buzzword

(Lind 2004), and by others as an important concept (Lyytinen and Yoo 2002). Secondly, it is unclear if convergence is a process (Hacklin 2007) or an endpoint (Storsul and Stuedahl 2007). Is it a vision or already there? Thirdly, the notion of convergence is often taken for granted, and few studies question this assumption (Knox 2003).

Some scholars have attempted to deal with this contradictory nature of ICT convergence. Ludes (2008) suggests that convergence under pressure leads to fragmentation and therefore to divergence. This suggests that a convergence programme facing resistance might move in a different direction, leading eventually to divergence. Appelgren (2004) takes a different view. She sees convergence and divergence as the two opposite sides of the same coin. They both happen simultaneously. Finally, Nyström (2008) sees divergence as one of the elements of the overall convergence process.

In particular, it is unclear what the role of technology is in this paradox. Henry Jenkins (2006) calls this the "fallacy" of convergence. He uses this argument to reject the idea of technological convergence and proposes instead a social dimension: "convergence culture". Jenkins (2006) argues that the convergence paradox is a fallacy since it firstly presupposes that following convergence all functionality will be embedded in one converged entity; secondly, it assumes that convergence is solely a technical matter. There are some problems with this view however. Technological convergence is often used with the assumption of technological determinism, namely that technology is the primary cause for social change. However, the argument by Jenkins to disregard technological forces and focus on the social forces in the convergence process might lead to the other extreme, social determinism (Hughes 1994).

In the literature on information infrastructures, some scholars have also pointed towards this paradox. Kallinikos argues that in the past, most ICT artefacts were developed either uncoupled or loosely connected through gateways (Kallinikos 2006). Path-dependencies further increased the fragmentation of different technologies through backward and sideways compatibilities (Bowker and Star 2000). Besides these technological aspects, Kallinikos points out additional social

and institutional segmentations, resulting in a highly fragmented terrain of information infrastructures. An opposing trend is what he calls functional unification. The binary character of digitalisation opens up in theory the possibility for making all software mutually compatible (Kallinikos 2006).

In conclusion, some scholars have briefly addressed the contradiction between convergence and divergence. Based on those previous studies, several propositions have been sketched out. However, this PhD dissertation aims to move beyond the previous literature through conducting an empirically grounded systematic analysis guiding the unfolding of this paradox.

1.2.2 Problem Statement and Research Question

This PhD dissertation began out of an interest in the idea of convergence. The literature review showed that one school of thought regards convergence as an important factor for mobile services and infrastructure design. However, it is still quite unclear what is meant by convergence. Previous studies show that the idea of convergence has not been systematically analysed from an IS perspective. Hence an extensive literature review on the use of convergence in the IS literature was conducted (see chapter two), and five archetypes of convergence were identified. The distinction between convergence and divergence was the main guiding distinction. However, a study exploring this contradiction between convergence and divergence systematically is still missing, in particularly in the IS field.

The convergence paradox poses further questions. If system designers should focus more on convergence, what if there is divergence rather than convergence? What if convergence is just a rhetorical device, as has been suggested by some scholars (Appelgren 2004; Lind 2004)? The findings from the literature review frame the research problem and the research question this study aims to answer. This lays out the ground for the problem this PhD dissertation aims to address and the specific research questions to be answered.

In the academic debate around new mobile information infrastructures, ICT convergence is seen as one of the key drivers. However, the literature review of the

IS literature has shown that the notion of convergence is under-researched and loaded with contradictions. Is convergence just another fad or an important concept? Is convergence an endpoint or a process? Is convergence, divergence? These contradictions reveal the practical problems with the notion of convergence as descriptor for technological change, and in particularly for the design of information infrastructures. It also poses theoretical problems of how to address convergence. How can a taxonomy of convergence be built? Does it make sense to design for convergence, if designers are faced not with convergence but an increasing fragmentation?

The role of the research question is to focus the research and set boundaries, enabling the researcher to create a sound research design and answer the question with the available resources (Flick 2002). As pointed out by Flick (2002), research questions must be dealt with at different stages of the research process; they develop over time. Multiple interactions have been observed between research questions and aspects of this dissertation, necessitating a continual refinement of the over-arching research question throughout the course of the study.

Based on the problem statement above, an initial starting point for a research question was set to understand better why convergence is so prevalent in practice, but is not reflected upon in the academic literature. Is the notion of convergence just a fashion, or is there more to it? Furthermore, what are characteristics of the convergence discourse, and what is the function of convergence? Finally, is convergence inevitable, what are the limits of convergence? Another proposition identified in the literature is that convergence and divergence of information infrastructures might happen in parallel. Furthermore, some observers see convergence as a future utopian end-point; others argue convergence is already there. A third group argues that convergence is a process.

There seem to be many contradictions around the notion of convergence and this dissertation aims to analyse them systematically to provide a conceptual clarification of convergence for the information infrastructure literature. The following question has been identified as the over-arching research question for this PhD dissertation:

Table 1-1 Overarching Research Question

How can we conceptualise the notion of ICT convergence using second-order observation to understand the contradictory discourses around convergence in the case of mobile VoIP in the UK?

The overarching research question consists of two parts. It assumes that it can provide a better understanding of the contradictory discourse between convergence and fragmentation through a second-order conceptualisation. This second-order conceptualisation requires an understanding of the existing convergence discourses, their characteristics, and their limits. Furthermore, since focus of this study is technological convergence, the role of technology in these discourses needs to be examined. Based on the overarching research question, the following five sub-questions emerged:

- Is ICT convergence in the context of mobile telecommunications just another fad or fashion?
- How has the idea of convergence been used in the discourse around mobile VoIP applications? What are special forms of convergence communication; what distinctions are made?
- What are the characteristics of the ICT convergence discourses around mobile VoIP?
- What are the limits of ICT convergence?
- What is the role of technology in the ICT convergence discourses?

As Schütz (1962) suggests, we can build first-level and second-level constructs. First-level constructs are theories on the phenomenon itself, whereas second-level constructs are theories on how an observer observes the phenomenon. We can build a theory explaining whether an observed phenomenon is a "war dance, a bartender trade, or the reception of a friendly ambassador"; or we can investigate how the observed persons understand the dance. In Luhmann's terms (Luhmann 2002), focusing less on the constructs than on the process of observation, we can observe either the dancers (first-order observation), or how the dancers themselves understand the dance (second-order observation).

The literature review will show that research not only in Information Systems but also in such related fields as management and new media has yet to provide a substantial theoretical conceptualisation of ICT convergence – despite its thirty-year history and wide impact on practice, regulation, and society. Furthermore, most studies offer only a first-order analysis, neglecting equally important second-order analysis (Lee and Sarker 2008). Therefore, it is not the phenomenon of ICT convergence in the context of the mobile Internet that this PhD dissertation wants to understand, but the idea of it, and how participants in the discourse on convergence have shaped this idea.

1.2.3 Significance of the Study

This research belongs to an emerging body of literature, which aims to make sense of the phenomenon of ICT convergence. In particular, several recent PhD dissertations build the background for this dissertation (Nielsen 2006; Tilson 2006; Hacklin 2007; Müller 2008; Nyström 2008). Furthermore, it aims to contribute to an emerging branch in the literature on information infrastructures represented by the work of Lyytinen, Yoo, and Tilson. In the context of this previous work, this research distinguishes itself through four main contributions:

- First, it focuses exclusively on the idea of convergence, and not on the phenomenon.
- Second, it provides an initial conceptual clarification of ICT convergence from a second-order observation.
- Third, it uses systems-theoretical concepts to provide a new understanding of the convergence paradox.
- Fourth, the case study of mobile VoIP as well as the theoretical lens of Luhmann's Theory of Social Systems is new to this field.

1.3 OVERVIEW OF THE RESEARCH APPROACH

This section presents an overview of the research approach taken. First, the conceptual framework will be briefly presented. Second, the research design will be outlined; and thirdly, the analytical strategy will be discussed.

1.3.1 Theoretical Framework

The data analysis is based on the previously mentioned analytical strategies derived from Niklas Luhmann's Theory of Social Systems. Since the focus of the research question is not the phenomenon of convergence itself but rather the understanding of convergence, an analytical approach is needed that supports this particular type of investigation (Andersen 2003). A good way to access social systems is the observation of communication. Luhmann's Theory of Social Systems has been chosen as the most appropriate to guide the data analysis for the following reasons:

- It assumes that communication is the main operation in society.
- It offers a set of analytical strategies to deal particularly with contradictions.
- It has been successfully applied in the past in the field of Information Systems.

The operationalization of Luhmann's "grand theory" (Lee 2000) has been conducted through Andersen's (2003) concept of analytical strategies. Andersen suggests that besides systems analysis there are five more types of analytical strategies, which he derived from Luhmann's Theory of Social Systems. These will be presented and discussed in detail in chapter four.

1.3.2 Research Design: The Case of Mobile VoIP

Flick (2002) sees the role of a research design as "the means of achieving the goals of the research" (p. 152). The over-arching research design is based on an empirical study of the convergence discourses in the UK mobile telecommunications sector, and in particular the case of the introduction of mobile VoIP in the UK. Mobile VoIP may be defined as (Verkasalo 2006) "voice-oriented services, in which voice is transmitted over IP networks, and the service is used with a mobile handset" (p. 1); it is usually accompanied by instant messaging capabilities and presence functionality. Some observers see it as potentially one of the most disruptive forces in the mobile telecommunications industry, insofar as it targets the core business of mobile operators, namely mobile voice calls and messaging (Christensen, Johnson et al. 2002).

Mobile VoIP is a very recent example of converging information infrastructures, so scholars have been studying it for only a few years. The literature is driven mainly by technical (Bányász and Iváncsy 2005; Algell 2006) and economic questions (Nyström and Hacklin 2005; Mellberg 2006), with no consideration of underlying dynamics. Mobile VoIP is a particularly interesting instance of convergence because it exemplifies both ICT convergence and mobility. In the 1990s, the concept of ICT convergence was used primarily to describe the integration of phone and computer (Yoffie 1996; Hacklin 2007). Mobile VoIP application may be regarded as the cutting edge of the next generation of ICT convergence, the convergence of mobile-telephony networks and the Internet.

1.3.3 Fieldwork Strategy

The empirical study has been conducted in the UK over a time span of 1½ years between June 2008 and December 2009. However, the overall investigation in this research project started already in June 2007. The primary data collection methods encompassed three forms. First, 39 semi-structured interviews were conducted with experts in the field of mobile VoIP. The interview data collected resulted in more than 40 hours of recorded material. Second, document inspection encompassing over 1,300 business press articles from Reuters Factiva from 2000 to 2009, company presentations, annual reports, patents, white-papers, and court proceedings was conducted. The third method was direct observations of two practitioner's conferences in 2009 (Open Mobile Summit and Westminster eForum) dealing with developments around the mobile Internet, and in particular with mobile VoIP.

Corpus construction was used as the sampling strategy (Bauer and Aarts 2000). Since the convergence discourse is the unit of analysis, every data including the interviews has been examined as text, i.e. in their written form through the transformation of interview recordings into transcripts. The primary data was supplemented by experiments with mobile VoIP applications, data from the wider convergence discourses in the telecommunications industry (e.g. the transcripts from the Convergence Think Tank of the UK government, and observational data on meeting recordings, presentations, observations, whitepapers, and reports from the EPSRC/Mobile VCE project on 'Flexible Networks'. Mobile VCE is a consortium of

leading UK universities and private organisations engaged in the mobile telecommunications sector. Material was collected while participating during one year of this project, where together with electrical engineers a methodology was developed for a socio-economic analysis that can inform the design of flexible networks.

1.4 OBJECTIVE, LIMITATIONS, AND OUTLINE OF THE DISSERTATION

The main aim of this study is to deliver a rigorous, coherent, well-argued research document that is worthy of a PhD. To achieve this objective, this study aims to provide an argument on how discourses around convergence of mobile VoIP in the UK are constructed, and how they can be used to understand the convergence paradox. Therefore, to summarise, the objectives of this study are threefold: first, to provide a systematic analysis of convergence discourses in the context of mobile VoIP, second to construct from this systematic analysis a theorization of convergence, and third to answer the stated research questions.

Gregor (2006) suggests five different types of theoretical contributions for IS research: theory for analysing, theory for explaining, theory for predicting, theory for explaining and predicting, and theory for design and action. This dissertation aims for a theoretical contribution primarily in the form of theory for analysing. Hence, this dissertation aims to develop a conceptual framework to describe convergence discourses, and to understand better the paradoxical relationship between ICT convergence and fragmentation in the context of information infrastructures. This study contributes to the literature on information infrastructures and also to the wider field of technological convergence studies.

The forms of convergence within the scope of this dissertation focus primarily on technical convergence in the mobile telecommunications industry, and in particular on the convergence of mobile telephony networks with the Internet. Furthermore, the analytical focus is not on the phenomenon itself, but on the discourse of convergence, and how practitioners in the telecommunications industry are making sense of convergence. The focus is on mobile VoIP in the UK as one instance of convergence in the mobile space, however, the whole "stack" from the infrastructure to the service

layer is part of the analysis.

VoIP has a long history, however, the main focus of this study is the time period between 2007 and 2009, supplemented by contextual data between 2000-2009. Furthermore, only a single case study has been conducted. These limitations restrict the possibilities of generalization. However, it is argued that through theoretical generalization (Mitchell 1983; Seale 1999; Lee and Baskerville 2003) the conceptual framework of ICT convergence that is developed may also be useful for other studies related to information infrastructures.

This dissertation consists of seven chapters. The *second chapter* will present a critical review of the literature on first- and second-order research on ICT convergence, locate the position of this dissertation within the literature, and set the stage for its contributions in the information infrastructure literature. *Chapter three* outlines the research design for the field study. *Chapter four* discusses different approaches for second-order observations, and introduces Niklas Luhmann's Theory of Distinction and Systems Theory as the primary analytical strategies informing the collection and analysis of empirical data. The findings and analysis from the case study are presented in the following two *chapters five and six*. *Chapter six* will also discuss the findings and their implications for the wider debates around convergence. Finally, *chapter seven* assesses the contributions and limitations of this study, and offers suggestions for further research.

Chapter 1: Introduction
(Frames Central Research Themes)

1.1 Background and Motivation
1.2 Research Problem
1.3 Overview Research Approach
1.4 Objective, Limitations and Outline of Dissertation

Chapter 2: Literature Review
(Construct Literature Domain for Contribution)

2.1 Initial Conceptual Clarification of Convergence in IS
2.2 Convergence Studies – Blazing the Trail
2.3 Revisiting Mobile Information Infrastructures
2.4 Problematizing for Contributions

Chapter 3: Research Design
(Choices of Research Design)

3.1 Philosophical Assumptions
3.2 Research Design Strategy
3.3 Fieldwork Strategy, Data Analysis
3.4 Coherence and Limitations

Chapter 4: Theoretical Framework
(Key Concepts for Analysis)

4.1 Theories for Second-Order Observation
4.2 Rationality for Choosing Luhmann
4.3 Analytical Strategies in Systems Theory
4.4 Theoretical Implications, Contributions

Chapter 5: Findings from Fieldwork
(Data Description)

5.1 Context: UK Mobile Telecoms Sector
5.2 Case Description: Mobile VoIP in UK
5.3 Convergence Discourses
5.4 Initial Findings

Chapter 6: Analysis and Discussion
(Brings together Chapter 4 and Chapter 5)

6.1 Analysis of the Empirical Findings
6.2 Conceptualization of ICT Convergence
6.3 A New Guiding Distinction
6.4 Chapter Summary

Chapter 7: Conclusion, Limitations, and Future Research
(Ties together the loose ends of the Dissertation)

7.1 Research Questions Revisited
7.2 Contributions Revisited
7.3 Third-Order Observations: Limitations and Reflections
7.4 Suggestion for Future Research

Figure 1-1 Outline of the Dissertation (Own Figure)

2. Literature Review

> "Convergence is by definition a process crossing boundaries and therefore raises the need for multiple units of investigations."
>
> Hacklin (2007 : 15)

This chapter brings together three different research domains, namely ICT convergence studies, information infrastructures, and mobility. The literature on information infrastructures suggests considering ICT and digital convergence as an important factor in the design of next-generation information infrastructures and services, in particular, in the context of mobility (Lyytinen and Yoo 2002; Wareham, Busquets et al. 2009; Yoo, Boland et al. 2009; Tilson, Lyytinen et al. 2010a; Lyytinen 2011). However, a systematic conceptualisation of convergence in this body of literature is missing (Herzhoff 2009). Instead, convergence appears rather ambiguous and ambivalent to the observer (Storsul and Stuedahl 2007).

The approach taken in this review aims for an initial conceptual clarification of ICT convergence. The first section (2.1) of this literature review deals with the question how ICT convergence can be conceptualised from an IS perspective. Three initial dimensions of convergence discourses are identified. These dimensions are further examined in the wider multidisciplinary discourse of convergence studies. Here, this dissertation makes the important distinction between the phenomenon and the idea of ICT convergence. The distinction is, as outlined above, based on the differentiation between first and second order observations.

The second section (2.2) presents, in particular, the key debates and perspectives developed in the adjacent fields to information systems, such as management science, computer science, and new media. In the following section (2.3), the review revisits the intersection of the information infrastructures and mobility literature, and contrasts it with the findings from the previous two sections.

The final section (2.4) pulls all the components together, and marks the specific body of literature this dissertation aims to contribute to. The aim of this chapter within the overall context of this PhD dissertation is therefore threefold:

- Provide an overview on the key debates and perspectives on ICT convergence,
- identify shortcomings of the existing literature, and
- construct the literature domain for the contribution intended by this study.

2.1 INITIAL CONCEPTUAL CLARIFICATION OF CONVERGENCE IN INFORMATION SYSTEMS

Information systems are, according to Angell and Smithson (1991), "social systems whose behaviour is heavily influenced by the goals, values and beliefs of individuals and groups, as well as the performance of the technology" (p. 12). Hence, within the information systems discipline technology is studied as an element of a social system (Avgerou 2000). As Orlikowski and Iacono (2001) point out, technological artefacts are always embedded in a specific social setting, i.e. specific time, place, and discourse. The designer of a technology operates within the context of a discourse that shapes that designer's contribution (Kallinikos 2005). Hence, a systematic analysis of the role of the discourses concerned with convergence within the overall IS literature is suggested.

Summarised, this section has three aims. First, to examine the role of convergence discourses in the IS literature. Second, to understand in particular, how the idea of ICT convergence can be conceptualised from an IS perspective. Third, using the identified dimensions of convergence to provide the input for a review of the wider convergence literature. As this section is interested in how IS scholars describe convergence, the primary focus is not the phenomenon of convergence itself. At this point this dissertation does not commit to a specific definition of ICT convergence. Instead, this definition will emerge from the following analysis.

2.1.1 Studying Convergence Discourses in IS

The methodology of this literature review on the convergence discourses within IS is primarily influenced by the Grounded Theory approach, which has been used successfully in previous studies (Orlikowski and Iacono 2001; Jones 2004). This

approach to analysing IS journal papers uses a form of content analysis in which categories are developed solely on the basis of the findings from the data, and not imposed from any preconceived position (Agar 1980). This study follows the Corbin and Strauss (1990) version of Grounded Theory, although it differs from that approach in two distinct ways. First, the data selection is based on corpus construction (Bauer and Aarts 2000) instead of theoretical sampling. Second, the focus is not only on the core category, but also on the core distinction using Luhmann's Theory of Distinction as additional analytical strategy.

The approach of informing Grounded Theory with the Theory of Distinction is new, especially in the IS field, although it has already proven valuable in other domains of social sciences (Gibson, Gregory et al. 2005). Luhmann's Theory of Distinction has been used as an analytical strategy to sharpen the perception of differences in the data analysis (Andersen 2003). It is consistent with Grounded Theory in several ways. Firstly, both approaches are interested in the emergence of meaning, and focus on what has been communicated and how it has been organized. However, they differ in one distinct aspect: traditional Grounded Theory searches for the core category, whereas the Theory of Distinction is concerned with the "guiding distinction" (Gibson, Gregory et al. 2005). The guiding distinction is particularly important in a second-order study since, similar to Koselleck's (1985) notion of a counter-concept it keeps the concept in place and defines its restrictions (Andersen 2008).

Corpus construction (Bauer and Aarts 2000) has the advantage of offering a vocabulary that is independent of the sampling logic, and so overcomes the shortcomings of theoretical sampling, such as multiplication of sampling methods (Corbin and Strauss 1990). The goal is to select "incidents" of a phenomenon, not to sample a population (Bauer and Aarts 2000). Barthes (1967) suggests selecting a data corpus based on relevance, homogeneity, and synchronicity. By keeping the focus on information systems, relevance was ensured, whereas homogeneity of the corpus was achieved by taking only journal articles into consideration. Finally, synchronicity has been maintained by focusing on journal articles that were published between 1998 and 2008.

This study focuses only on the leading academic IS journals. The decision to focus on this body of literature and to exclude other journals, conference papers, etc., is driven by relevance and resource constraints. The primary aim here is to see how the notion of convergence is treated and used in the mainstream IS journals. Ten IS journals have been drawn upon based on the ranking from Louisiana State University, since it distinguishes among management, practitioners', and "pure" IS journals. The selected journals (MIS Quarterly, Journal of Information Systems Research, Journal of MIS, Journal of the AIS, Information & Organisation, European Journal of Information Systems, Journal of Strategic Information Systems, Information Systems Journal, Information & Management, and Decision Support Systems) also appear frequently in the top ten rankings (Peffers and Tang 2003; Rainer and Miller 2005).

A full text search has been conducted on the term "convergence" using Business Source Premier, Sweetwise, and ScienceDirect. The search has not been limited to "ICT convergence" to achieve a broad understanding of the convergence discourses within IS, and to increase the variety of the findings. The only exception for the analysis period between 1998 and 2008 is the *Journal of the AIS* since it was first published in 1999. This timeframe has been selected to cover an extended period, but at the same time it benefits from the easy data access to conduct a full-text search. Another relevant factor is that no electronic versions are available for most of the journals before 1998. Based on the search results, a corpus of 341 journal articles has been constructed and imported into the software package Atlas.ti. Twenty-four articles that used the term "convergence" only in their bibliographies were excluded. The final corpus contains 317 articles.

2.1.2 Contexts of Convergence Discourses in IS

Each article has been searched for the term "convergence," and the relevant paragraphs have been coded by repeatedly asking what the term means in the particular instance, in what context it is used, and what distinctions the author(s) of the article make. Based on the context codes, six categories have been identified in which authors use convergence. Three contexts are closely related to the general research process, and three were related to the phenomenon presently under study.

The findings suggest that the IS community uses the concept of convergence to describe (I) research streams and theoretical concepts coming together; (II) quality criteria in methodology sections; and (III) the processing of quantitative and qualitative data analysis. The contexts can be broadly separated into (IV) decision-making; (V) technological change; and (VI) other contexts.

Context	Freq.	%	Freq.	%
I. Research focus			*36*	*11*
Interdisciplinary	8	22		
Research Streams	12	33		
Theories	10	28		
Findings	6	17		
II. Quality criteria			*37*	*12*
Triangulation	12	32		
Validity	25	68		
III. Data analysis			*65*	*21*
Saturation	2	3		
Neural Networks	20	30		
Genetic Algorithms	16	25		
Other Algorithms	27	42		
IV. Decision-making			*119*	*38*
Groupwork	52	44		
Alignment	22	18		
Decision-support	8	7		
Agent systems	37	31		
V. Techn. Change			*46*	*14*
Infrastructure	9	19		
Network Organisation	21	44		
Mobility	10	21		
Web service	6	13		
VI. Other contexts			*14*	*4*
Globalisation	11	79		
Activities	2	14		
Telemedicine	1	7		
Total	**317**	**-**	**317**	**100**

Table 2-1 Convergence Contexts in IS

Table 2-1 illustrates the different sub-themes and the number of occurrences in the data corpus. One interesting aspect of this data is that convergence in the context of technological change has only 46 occurrences, which account for less than 15% of the articles (total = 317). In the next step, some initial concepts were identified along with their properties and their dimensions, and the data coded accordingly. These insights and the method of constant comparison (Corbin and Strauss 1990) have been used to construct a first set of categories. Based on the analysis, the five identified categories or conceptualizations of convergence are: *alignment, recombination, optimization, interoperability* and *correspondence*. The category labels are rooted in the data. The five different forms of convergence are used in different contexts (Table

2-2). It becomes clear from this analysis that convergence in the context of technological change focuses primarily on interoperability and alignment, and to some extent on recombination. In the following paragraphs, all five views on convergence identified in the course of the analysis of the data corpus are presented in more detail.

Table 2-2: Convergence Archetypes in Context

Context	Types									
	Inter-operability		Re-combination		Optimization		Alignment		Corres-pondence	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Research Focus	-	-	11	65	-	-	16	15	9	31
Quality Criteria	-	-	-	-	25	18	-	-	12	41
Data Analysis	-	-	-	-	65	47	-	-	-	-
Decision-Making	-	-	-	-	45	33	74	69	-	-
Techn. Change	27	100	6	35	-	-	13	12	-	-
Other Contexts	-	-	-	-	2	1	4	4	8	28
Total Freq. / %	*27*	*9*	*17*	*5*	*137*	*43*	*107*	*34*	*29*	*9*

2.1.3 The Five Convergence Discourses in IS

A. Convergence as Alignment

In the IS literature, the concept of alignment is primarily used in the context of decision-making (Table 2-3). Two sub-forms are identified in the data corpus: one based on building up shared models between social systems, and the other on finalising the decision-making process. ICT has more of a support role in the form of group or decision-support systems. Both sub-forms convey an understanding of convergence not as a vision but rather as an iterative process. Convergence as decision-making is intended to increase focus and efficiency, whereas convergence as building up shared mental models aims towards incremental change in mutual understanding.

Table 2-3 Convergence as Alignment

Sub-forms	Change in elements	Process	Distinction	Role of IT	Example
Build up shared mental models between social systems	Change in both elements anticipated	Clear process view, each iteration results in incremental change in individual accuracy	Might either lead to more intense mutual understanding or reveal biases and generate conflict	Proxy or support but not focus	"Rogers and Kincaid's convergence model described communication as a cyclical process, which involved the repetitive exchange and sharing of information between (...) individuals in order to reach a mutual understanding." (Johnson and Lederer 2005)
Finalise decision-making process	Change in both elements anticipated	Process to increase focus and efficiency	It clearly distinguishes itself from the brain-storming phase which seeks for creativity and to open up the option space	Support role in form of DSS	"Convergence represents the coming together of differing opinions and often involves resolving conflict and reaching consensus (...). Divergence is considered a characteristic of brainstorming where no evaluative filters are placed on ideas, and results in disparate views being expressed by members about problems and issues facing a group." (Chidambaran and Tung 2005)

B. Convergence as Correspondence

Convergence as correspondence focuses on similarities among concepts, and highlights correlations or equality between them. It is used in the context of aligning research findings with existing research or in the process of triangulation. The converging elements are not anticipated to change, but are conceptualised in a stable state. Therefore, convergence is not seen as a process, but as an end stage. The process is folded into one dimension, and is not iterative (table 2-4):

Table 2-4 Convergence as Correspondence

Sub-forms	Change in elements	Process	Distinction	Role of IT	Example
-	No change within the converging elements, they are in a stable state.	Convergence is not seen as a process but as an end stage, the process is folded into one single dimension and thus not iterative.	Differences	No role of IT	"As mentioned, we applied thematic analysis (...) to analyse the data (...) in order to evaluate the extent of convergence or triangulation among conversational information and supplementary observations." (Lim and Tan 2005). "This striking convergence in management and IS research should encourage scholars to explore these capabilities (...)." (Zahra and George 2002)

C. Convergence as Recombination

Convergence as recombination deals with the mixing of elements, often resulting in innovation. It is used in the context of bringing together different concepts, for example, in the form of research streams, different functionalities, or media in the context of technological change. This view focuses on the mix and the outcome, and does not account for an iterative process. It assumes no change in the converging elements themselves, as observed in the case of alignment, but instead results in the creation of a new element (Table 2-5):

Table 2-5 Convergence as Recombination

Subforms	Change in elements	Process	Distinction	Role of IT	Example
Con-ceptual	No change in the existing elements. However, emergence of a new element	No iterative character and focuses instead on the mix and the outcome.	Divergence	No role	"Overall, the convergence of marketing and MIS views was assumed to form a better understanding of SMS usage drivers by identifying important value dimensions in its adoption."(Turel, Serenko et al. 2006)
Func-tional				Main focus	"The industry has experienced the introduction of nearly twenty competing products (...) convergence of functionality of hand-held devices, palm devices, small phones, and car communication systems within a short time span of about 2 years."(Ramesh and Tiwana 1999)
Digi-tisation				Main focus	"Electronic commerce helps the convergence of text, data, hologram, images, graphics, audio, full-motion video, and animation in an easy way [28]." (Yen and Ng 2003)

D. Convergence as Optimization

Convergence as optimization has been found mainly in the data analysis sections of the articles. The articles focus on an optimization problem. This optimization problem is analysed in different ways (e.g., genetic algorithms) to achieve a convergence to the optimal solution. This special form of convergence assumes that there is only one element that moves to a predefined ideal state. Convergence as optimization assumes a strong process view, and number of iterations and rate of convergence are important properties (Table 2-6):

Table 2-6 Convergence as Optimization

Subform	Change in elements	Process	Distinction	Role of IT	Example
N/A	One element exists, it changes but it does not converge to something else but to its own optimal solution.	Process and the number of iterations and rate of convergence are important properties	Sometimes only a local optimum can be reached.	Not in focus	"The repeated use of these operators results in a series of populations of individuals with successively higher levels of fitness until some level of convergence around a single optimum or multiple optima is achieved. A detailed and comprehensive discussion of GA is given in [3]." (Mirrazavi, Jones et al. 2003)

E. Convergence as Interoperability

The interoperability view on convergence is mainly found in the context of technological change, particularly in relationship to system integration and the

network organisation. Both deal with the detailed technical links between two or more elements moving together. While the integration form sees convergence more as a driver for efficiency, the network organisational form points out that it is set up through standards, which are again a result of a negotiation or alignment process among players (table 2-7):

Table 2-7 Convergence as Interoperability

Subforms	Change in elements	Process	Distinction	Role of IT	Example
Integration	Deals with the detailed links between two or more elements moving together. It builds up the bridge between them.	Convergence is seen as a driver for efficiency, highly technical.	Dis-integration, divergence	Technology is the focus. It deals with the integration of systems, networks, and infra-structures.	"Convergence suggests the need to think formally about integration. In many of the above examples, the key element is integration, i.e., combining existing tools and techniques to solve problems" (Mandviwalla and Khan 1999).
Network Orga-nization	Elements change to incorporate the other side	This inter-operability is set up through standards, which are again a result of a negotiation or alignment process between different players.	Closed system, divergence	Technology is the focus	"The convergence of IT and telecom-munications, (...) are all supported or enabled by modern IT." (Mirrazavi, Jones et al. 2003)

2.1.4 Initial Dimensions of Convergence

Three points can be highlighted from the literature review thus far. Firstly, the concept of convergence as technological change is relegated to the sidelines in the leading IS journals. It has a very small number of occurrences, and is primarily considered only within the themes of mobility and network organisation. Secondly, convergence can be conceptualised based on the IS literature in five archetypes:

convergence as alignment, correspondence, recombination, optimization, and interoperability. Thirdly, convergence discourses in the context of technological change have been described primarily through convergence as interoperability and alignment and, on some occasions, through recombination.
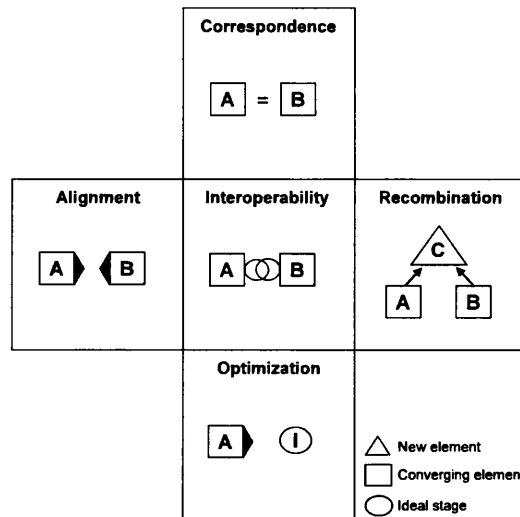
Figure 2-1 Forms of Convergence Communication
(Own Figure)

If the differences among the five categories are analysed, it can be observed that the categories mainly differ in the relations of the converging elements (see figure 2-1). The key distinction between alignment and recombination is that alignment is not about "mixing" media or functionalities. Instead, it deals with streamlining existing ideas, interests and opinions, e.g. agreement on standards. At the same time, the main distinction between alignment and interoperability is that interoperability builds detailed technical bridges or gateways among the converging elements, e.g. web services. Correspondence is a special case, assuming that the converging elements are the same, while optimization differs from the other four conceptualizations because it assumes that there is only one element, which moves towards an ideal state or optimum.

Based on the literature review thus far, in the context of technological change researchers observe convergence as a socio-technical process, where both elements

are mutually constituted. A good example of this can be found in a definition quoted by Pawlowski & Robey (2004) from Susan Leigh Star et al. (1997): "Star et al. defined convergence as 'the double process by which information artifacts and social worlds are fitted to each other and come together...a process of mutual constitution'":

> *Working definition of ICT convergence:* the double process by which information artifacts and social worlds are fitted to each other and come together in a process of mutual constitution.

While the focus of ICT convergence within IS seems to revolve around this double process of alignment and interoperability, the other three forms cannot be ruled out. In fact, from a design perspective it might be very useful to examine the other three forms closely and, in particular, their distinctions. For example, alignment and interoperability cover both extremes of the socio-technological dimension well, but neither can distinguish between process and vision, nor between differentiation/unification dimensions (see Table 2-8).

The detailed analysis of these five forms of convergence, however, already reveals three dimensions inherent to the notion of convergence: (1) a socio-technological dimension, (2) a process-vision dimension, and (3) a differentiation vs. unification dimension.

The *social-technical dimension* is best illustrated between alignment and interoperability. The social dimension can be further distinguished in collaboration and conflict. The technological dimension differs between interoperability and integration. The second dimension of convergence distilled from the analysis is the one between *process and vision*. While convergence as alignment, recombination, and interoperability is primarily based on the assumption of convergence as a process, convergence as correspondence and to a lesser extent convergence as optimization puts the emphasis on an ideal state or vision. The third dimension distinguishes between *differentiation and unification*. Here, convergence as recombination plays a special role since it is the only form of convergence that

explicitly covers differentiation. Convergence as correspondence or optimization focuses instead on unification.

Table 2-8 Three Dimensions of Convergence identified in the IS Literature

	Dimensions		
Forms of Convergence	Social/ Technical	Process/ Vision	Differentiation/ Unification
Alignment	Social	Process	Unification
Correspondence	Both	Vision	Unification
Optimization	Technical	Both	Unification
Recombination	Technical	Process	Differentiation
Interoperability	Technical	Process	Unification

All three dimensions indicate properties of the notion of convergence. However, they also point towards contradictions: Is ICT convergence a process or an endpoint, a vision? Is ICT convergence a social or a technical phenomenon? Does ICT convergence deal with differentiation and fragmentation or unification? Before these themes will be discussed in detail in the following section, the guiding or core distinction has still to be identified.

What is the guiding distinction that indicates ICT convergence? While the concept of distinctions will be explained in detail in chapter four, a short introduction will be given at this point. In a nutshell, whenever we observe something, a distinction is made; the scene is indicated by one side of the distinction, but the remainder is left unobserved (Luhmann, 2002) – the "residual category". Added to this is the fallacy that the scene and the residual category make up the whole (Demetis & Angell, 2007): structural couplings between the two parts are lost in the observation and disappear into paradoxes. Furthermore, more observations will introduce yet new distinctions, new scenes, and new residual categories.

According to Luhmann (1991), there are three ways to make distinctions. Firstly, a distinction can be made without specifying the other side of the distinction (e.g. convergence/no convergence). Secondly, a distinction can be made to restrict the other side of the distinction (e.g. convergence/divergence). Luhmann refers to the

first category as objects and to the second category as concepts. Finally, there is a special kind of concept in which a distinction is made by copying it to the inside or outside of the concept itself. Luhmann (1995) calls these concepts, which can re-enter themselves, as second-order concepts (he gives an example of government and opposition, where government can itself have a ruling party and an opposition). The guiding distinction is a distinction that is at the core of the concept (Gibson, Gregory et al. 2005). It divides the world into observer and the observed observations. This distinction is contingent. One of the consequences of a guiding distinction is that the world becomes poly-contextual. Furthermore, it controls the second-order observation since it determines who can be observed and how, and who and what cannot be observed (Andersen, 2009). In the following section the forms of all five types of convergence are analysed to identify the prevailing guiding distinction.

Convergence as alignment: Many authors make the distinction between convergence as a concept, and divergence as its counter-concept (Table 2-3). While the other side of the distinction of convergence through building shared models is the revelation of biases and conflict, divergence is seen in decision-making as part of the brain-storming phase that seeks creativity and opens up the option space. In the case of the double process of alignment and interoperability, convergence is observed as alignment becoming a second-order concept, which re-enters itself in convergence as interoperability.

Convergence as interoperability: Most authors do not make any explicit distinction except in the context of network organisation, where the other side of the distinction indicates the traditional form of closed systems (Table 2-7).

Convergence as recombination: Similar to interoperability, most authors use convergence as recombination as an object without any clear distinction (Table 2-5). Interestingly, recombination has a strong relationship with innovation and therefore seems to be closer to the counter-concept of alignment. On the other hand, convergence as recombination leads to new forms, which may question the existing beliefs, bringing in diversity and may result in divergence. The other side of the

distinction is, in this case, a form of separation, that is a concentration on a specific concept, functionality, or medium (see for example the original Blackberry or iPod).

Convergence as optimization: Here, many authors see any divergence from the optimum or ideal stage as the main difference (Table 2-6). Although this type of convergence communication has not been used explicitly in the context of technological change in the data corpus, some convergence rhetoric is based upon the belief of convergence as an ideal (for example the discussion around ubiquitous computing).

Convergence as correspondence: The opposite form of convergence as correspondence is difference (Table 2-4). Hence, convergence as correspondence blends out differences, and constructs an artificial sameness between two different elements. However, from a systems design perspective it may become problematic if the other side of the distinction is forgotten, namely that there are other alternatives as well. It might be helpful from a design perspective to remain sensitive to these differences.

In most cases, the IS researchers in the data corpus (see e.g. Mandviwalla and Khan 1999) use convergence as an object without any clear distinction from its environment. Some other researchers (see e.g. Chidambaran and Tung 2005) set it explicitly against a counter-concept (being primarily divergence), and therefore fulfil the criterion of a concept according to Luhmann. The first type of distinction is not very helpful; it is a distinction between convergence and everything else. It therefore offers a form, but not a conceptualization of convergence.

So what does making the distinction between convergence and divergence tell us? The unity of the distinction between convergence and divergence could be described as "mutual dependencies between elements." Jansen and Nielsen's (2005) theory of convergence is based on a similar distinction. They call the unity "co-evolution." This indicates that convergence itself is not inevitable, and that there might be other trajectories to follow. The first finding from this present analysis is that convergence itself is taken for granted, and that the possibility of divergence is mostly ignored or

seen as undesirable. Therefore, the relationship between convergence and divergence seems to be used asymmetrical in the IS literature. Observations focus on convergence neglecting the other side of the distinction – divergence. In the following section, the identified contradictions and core distinction are further examined in the wider multidisciplinary discourse of convergence studies. The aim is to present the key debates around the conceptualisation of convergence.

2.2 CONVERGENCE STUDIES – BLAZING THE TRAIL

If we go beyond the IS literature, ICT convergence reveals itself as a multi-disciplinary discourse. Based on the previous identified themes, this section will conduct some preliminary "trail blazing" through the "convergence jungle". The marks left on the trail indicate the relevant debates and perspectives dealing with ICT convergence.

2.2.1 The Idea vs. the Phenomenon of ICT Convergence

Many academic papers suggest that convergence as a *phenomenon* has had a wide influence on technology, businesses, and society as a whole (Messerschmitt 1996; Steinmüller 2000). This PhD dissertation takes a different route, starting with the proposition that the *idea* of convergence has had a profound impact on society. However, since researchers themselves use the notion of convergence when they study the phenomenon it is helpful to provide a brief overview about the multidisciplinary academic discourse studying the ICT convergence *phenomenon*. Hence, the following paragraphs move to a 'higher order', observing the construction of the idea of ICT convergence in the academic literature by looking at the etymological origins of convergence, the different perspectives on convergence, the construction of typologies, and the primary observers constructed by the literature.

A. Etymology of Convergence

According to the Oxford English Dictionary, the term "convergence" is derived from the Latin word *convergere*, from *con* ("together") and *vergere* ("to bend, turn, incline"). The first recorded instance of the word in English is found in the work of William Derham, an English scientist and theologian, who in 1713 described the "convergences and divergences of the rays". The word would later be adopted by

investigators in the fields of physics (Arnott), biology (Darwin), mathematics (Todhunter), and eventually the social sciences. In the middle of the 20th century it was primarily applied in the political science to describe the phenomenon of the convergence of the US and Soviet system, and in economics to describe the convergence of national into a world economy (Gordon 2003). H. E. Vaughan of Bell Labs has already envisioned the meaning of ICT convergence in the context of digitalisation, when in 1959 he treated it as integrated communications that can provide flexibility for new services. Evidence from a literature review on technological convergence (Herzhoff 2009) shows that the notion has been used in the technological context in academia since the 1960s (Rosenberg 1963), and in practice since the 1970s, when Nippon Electric Company (NEC) developed its "convergence" vision in 1977 (Yoffie 1996).

However, convergence has hardly been the only term proposed to describe this form of technological change. Competing terms offered in the 1970s included "compunications" (Oettinger 1976) and "telematique" (Nora and Minc 1978). But "convergence" eventually triumphed as the dominant label for this form of technological change, and was the term that came to be deployed in both the management literature and popular media. For example, according to a 1978 issue of Time: "Convergence [of computing, telecommunications, and office products technologies] and vertical integration are going to create utter chaos in the market for information systems"). This usage echoes that of a journal article published the previous year: "The Convergence of Computing and Telecommunications Systems" (Farber and Baran 1977).

The term was further popularised by Nicolas Negroponte's famous Venn diagram of three overlapping circles, a highly static conceptualization that assumes that convergence is an end-stage. This diagram was adopted by practitioners like John Sculley (CEO of Apple from 1983 onwards), who used it to illustrate Apple's vision of the future (Gordon 2003). Since then, the notion of convergence has been widely adopted and used in both theory and practice to address technological change emerging from the process of digitalisation. During this process, convergence started to take many different shapes from technological convergence to media convergence and ICT convergence.

B. Different Perspectives on ICT Convergence

ICT convergence as a phenomenon has been studied from many different perspectives. This review focuses besides IS on the key works in the fields of computer science, management, legal, journalism, and media.
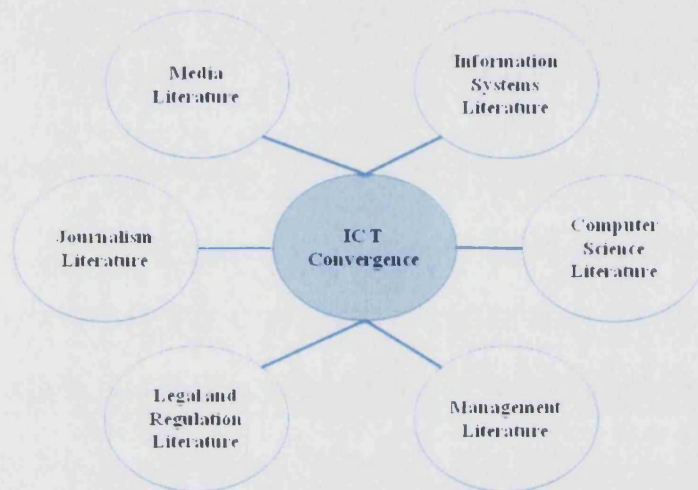
Figure 2-2 Different Perspectives on ICT Convergence in the Literature

(Own Figure)

One of the most comprehensive summaries of the *computer science* perspective on ICT convergence can be found in Messerschmitt's (1996) paper on the "convergence of telecommunications and computing". He describes the history of the phenomenon of ICT convergence in nine stages as illustrated in table 2-10. He sees the final stage of "complete convergence" when there are no longer "any technological or intellectual differences that distinguish telecommunications from computing" (p. 1176).

Table 2-9 The nine stages of ICT convergence based on Messerschmitt (1996)

Stage	Points of Convergence of Information and Communication Technologies
1. Common Technology	Stored-program control for telephony switches and digital representation of telephony signals
2. Networked Computers	Networked applications as well as computerized control and configuration of the telephony network
3. Programmability and Adaptability	Telecommunications hardware is increasingly becoming a software-defined solution and is therefore gaining programmability. Building upon this trend is the capability of adaptability, i.e. to adjust to the environment.
4. Horizontal Integration	In the past, vertical integration has been the norm: A dedicated infrastructure is used to realise a single application or even single content (application-aware/content-ware). Horizontal integration is built on open interfaces and usually comes along with modularity.
5. Untethered, Nomadic, and Mobile Services	Both require mobile computing and mobile telephony require dynamic migration of resources and raise high demands to Quality of Service
6. Network Deployment	User-to-user applications
7. Dynamic Deployment and Transportable Computation	Virtual machines
8. Intelligent Agents	Transportable programs
9. Complete Convergence	Dynamic deployment of interwoven user-to-user and user-to-information-server multimedia applications in a horizontally-integrated terminal and network environment

There are manifold debates on convergence from the perspective of *computer science*. Messerschmitt (1996) identifies nine key debates related to the phenomenon of ICT convergence in the Computer Science literature: (1) best effort versus Quality of Service (QoS), (2) scalability, (3) terminal and network coordination, (4) connection versus wireless, (5) control architecture, (6) interconnection versus interoperability, (7) embedded computing versus general-purpose computing, (8) heterogeneity, and (9) architecture and complexity management. In particular, the design issues pertaining to increased conflicts or "tussles" through convergence and how to control networks better, are of primary concern (Clark, Wroclawski et al. 2005). Messerschmitt (1999) argues that mobility provides another point for ICT convergence: namely, that issues raised by mobile telecommunications and by mobile networked computing are very similar when viewed from a technological perspective. Both mobile telecommunications and mobile networked computing

require a dynamic migration of resources like connections, reserved memory and bandwidth, and have high demands on issues related to Quality of Service.

In the *management literature*, the convergence phenomenon is seen rather differently. The management literature, drawing upon Rosenberg (1964), began to incorporate the concept of convergence into the study of strategic management, building analytical tools and offering recommendations on how companies should react to technical convergence (Pennings and Puranam 2001). According to Hacklin (2007), the key debates revolve around how an organisation should respond to convergence, which may be viewed in the larger context of how organisations respond to innovations or market disruptions not originated by them. The debates have proceeded on two levels of analysis: at the firm level and at the industry-level. Recently, work has been published to understand better the convergence phenomenon from an innovation management perspective applying evolutionary theory (Hacklin 2007; Hacklin, Marxt et al. 2009; Hacklin, Marxt et al. 2010; Lyytinen 2011).

The *economic perspective* on ICT convergence deals primarily with the question of how ICT convergence affects productivity growth (Katz 1996; Fagerberg and Verspagen 2002). Cameron, Proudman, and Redding (2005) analysed how technological convergence, in particularly through technological transfer, affects productivity growth.

The *media and journalism literature* has traditionally been a very vibrant community of scholars studying the convergence phenomenon. One of the first media scholars studying it was Ithiel de Sola Pool. In his book *Technologies of Freedom* (Pool 1983) he describes the convergence of different modes of communication and claims that the "one to one relationship between a medium and its use is eroding" (p. 23). Jenkins (2006) builds upon the work by de Sola Pool and argues for a shift towards the social implications of convergence, which he conceptualises under the form of convergence culture. Recently, there has been much work in media on how convergence of technologies affects newsroom work. Dupagne and Garrison (2006) argues based on findings from a qualitative case study that technical, economic, and regulatory convergence processes are the three main forms of media convergence.

According to their study, these forms have effects on content diversity, curriculum structure, media use, and newsroom practice.

The *regulatory and legal perspective* has shifted over time from how to encourage convergence over the development of appropriate regulatory frameworks, to the consequences of convergence. Although the convergence phenomenon was already in the regulatory agenda in the early 1990s through an OECD report, the most widely influential and cited document in regulatory circles during this time was the Green Paper on ICT Convergence issued by the European Commission in 1997. It defines convergence as "the ability of different network platforms to carry essentially similar kinds of services, or the coming together of consumer devices such as the telephone, television and personal computer" (European Commission 1997). However, the academic literature on regulation has been investigating issues of convergence since the 1970s. The first article on convergence in the Telecommunications Policy Journal was by Nyborg (1977) who argued that the issue of ICT convergence already raised important regulatory questions in the US as early as 1966, "primarily with respect to the potential offering of data processing services by common carriers, and the provision of communications services as part of the overall offering of a non-regulated data processing company (p. 374)". At the beginning of the 1990s, the academic discussion was primarily around deregulation and how to reduce barriers for convergence. Since the early 1990s the Telecommunications Policy Journal states in its objectives that

> "It provides a focus for research and debate amongst academics and professionals studying such issues as competition and regulation in the telecommunications industry, telecommunications and economic development, and the convergence of new technologies and services." (Telecommunications Policy Journal, 1994).

Yochai Benkler (Benkler 2000) suggests that the appropriate regulatory frameworks in a convergence context should orient themselves towards democratic values, and he proposes an approach to develop descriptive models how law concentrates or distributes control over production and exchange of information in society. Shin (2006) studied the regulatory frameworks in South Korea and the UK. He argues that technological convergence of ICT has taken place, however, the remaining regulatory conflicts between the two industry sectors (the information technology sector and the communication technology sector) are still significant barriers. He argues for a clear

regulatory distinction between transport and content to facilitate further convergence. He points out the problems of separate regulation for different sectors and instead proposes a multi-sector regulatory approach.

Latzer (2009) studies the regulatory and governance implications of the convergence phenomenon. He argues that one key implication is the emergence of a common regulatory framework in many countries based on four components: (1) integrated strategies, control structures and legal frameworks for the convergent communications sector, (2) a technology-neutral functional taxonomy, (3) a subdivision into transmission and content regulation, (4) and a growing reliance on alternative modes of regulation such as self- and co-regulation.

C. Construction of Convergence Typologies

This PhD dissertation agrees with Tilson, Lyytinen et al. (2010b) that a destabilisation of academic boundaries can be observed in regards to digital convergence. However, despite the large number of studies dealing with the phenomenon of convergence, only a few attempted to describe convergence, and to craft a theory. One of the first serious attempts to do so from a management perspective was undertaken by Greenstein and Khanna, who distinguish between convergence of substitutes and complements (Greenstein and Khanna 1997). Convergence as substitutes entails one domain competing with another, and complementary convergence, which involves two different fields coming together. Stieglitz (2003) refines the model by introducing a second dimension, that of product orientation versus technology orientation. However, each of these conceptualisations focuses only on industry convergence, taking technological aspects for granted.

Converging studies have primarily focused on organisations and the regulator. According to Hacklin (2007), the key debates in the management literature revolve around how an organisation should respond to convergence, which may be viewed in the larger context of how organisations respond to innovations or market disruptions not originated by them. The legal literature in the context of convergence primarily focuses on the regulator's point of view (Shin 2006), whereas the media looks primarily from the perspective of newsrooms, journalists and media organisations (Gordon 2003).

Several studies over the last five years discuss convergence from a second-order perspective, i.e. analysing or reflecting on the idea of convergence instead of describing the underlying phenomenon. Knox (2003) analyses the idea from an anthropological perspective, considering how it has been mobilized in the development of new media in Manchester. She points out that both observers of new media (economists, academics, politicians, civil servants) and its practitioners used the notion of convergence (2003). Further, Knox argues that the articulation of the term often manifests a "calculated performance" in which *"the lack of experience by these companies is self-replicated in as much as they are required to seek out novelty and new ways of working"* (p. 47). Furthermore, she suggests seeing convergence not only as a singular description of a process but rather as a descriptor of change "which has gained its predominance from the fact that it cannot be pinned down to a single process, a single model, from the fact therefore of its own reproduction" (p. 120).

In a study of the usage of the term convergence in published newspaper articles between 1990 and 2004, Lind (2004) finds that the idea of convergence is often used to justify mergers and acquisitions, and also to flag impending change early in the redefinition of a market. Furthermore, he argues that convergence may be rather seen as a hype or management fashion instead of a serious concept. However, the main shortcoming of the existing body of second-order literature on ICT convergence is, with the exception of the work by Knox (2003) and Nyström (2008), that it has not moved further below the surface to enrich the understanding of the idea of convergence. Since the most prominent meaning of convergence has emerged in information and communication technologies (Hacklin 2007), it is fruitful to engage in this discussion, particularly in relation to information systems.

In light of this literature review, the PhD dissertation in its entirety sees ICT convergence as a socio-technical complex (Bauer and Gaskell 2002) that has been observed by a heterogeneous set of observers, and that has developed in parallel to the other established systems that constitute its environment. Depending on the observer and his/her research question, any particular observing system might be in focus, relegating other systems to the background.

As the literature review has shown so far, ICT convergence has primarily been studied as a phenomenon. However, most of the previously presented studies take the notion of convergence either for granted or relegate it to the sidelines, and focus instead on the drivers and consequences of convergence relevant to the specific discipline.

A few scholars have conducted second-order studies focusing on the idea of convergence like Knox, Lind, and Nyström. The review of the IS literature suggested three dimensions of convergence, namely social/technology, process/vision, and differentiation/ unification, as well as convergence/divergence as the guiding distinction drawing the boundary of convergence. In addition, one more theme has been identified, namely convergence as fad or fashion (Appelgren 2004; Lind 2004). There is a strong debate between scholars but also practitioners if convergence is just a fad or fashion. One of the key aims of this dissertation is to understand if there is space for a more theoretical development of the concept of ICT convergence. Hence, the following sub-section provides an extensive discussion of convergence as fad or fashion.

2.2.2 Convergence a Fad or Fashion?

There has been a longstanding debate between those scholars who are dismissive of management fashions, referring to them as costly distractions (Cole 1999) and those who acknowledge that it is important to study fashion in its own right (Abrahamson 1996; Carson, Lanier et al. 2000). Collins (2000) argues that hot topics of management should not be dismissed just as buzzwords. Instead, a critical analysis is needed that looks beneath the term to understand its function. Abrahamson (1996) argues that theorists should not be dismissive of fashion because it is hardly limited to aesthetics. He points out two main differences between fashion in aesthetics and in management: Firstly, fashion in aesthetics needs to be only beautiful and modern, whereas fashion in management needs to be both rational and progressive. Secondly, he sees socio-psychological forces alone shaping demand for aesthetic fashion, whereas in management fashion, technical and economic forces join these forces.

Recently, Baskerville and Myers (2009) initiated a debate in the MISQ about the relevance of fashions for IS and suggested that IS academics should engage more proactively in the evaluation of IS fashions. For more than a century social scientists have been fascinated by fad and fashions (Simmel 1904; Sapir 1937; Meyerson and Katz 1957). However, only recently a body of literature studying fad and fashions in the management context has emerged, represented primarily by the seminal work of Abrahamson (1991; 1996), Kieser (1997), Newell (2001), and Swan (1999). These studies address the hyperbole around management tools and concepts such as Quality Circles, Business Process Reengineering, and Knowledge Management. Three key debates have been identified relevant to this study, listed here and further detailed below: (1) Distinction between fad and fashion, (2) Why fashions disappear, and (3) Fad and Fashions and Technology.

A. Distinction between Fad and Fashion

This study makes an important distinction between fad and fashion; this distinction can be traced back to Sapir (1937), who distinguishes fads from fashion in terms of scale, duration, and social acceptance. According to Sapir, fads involve fewer people, are more personal, have shorter durations, and are socially less accepted than fashions. For Abrahamson (1991), both fad and fashion deal with imitation. The difference between fad and fashion, according to him, is based on the scope of the imitation process. If an idea stays just within one's own group, it can be regarded as a fad; if the imitation goes *beyond* one's own group, it can be regarded as fashion. Dale et al. (2001) argue that this distinction is still unclear. They suggest a distinction between fad, fashion, and fit based on a process perspective. According to their model, *fads* are the first phase of a multi-stage model and have the purpose to bring an idea to the attention of a larger audience of people. *Fashions* are the second phase where the idea gets implemented and adopted. *Fit* is the final phase where the idea finally leads to performance improvements and is implemented in everyday work practices. In a nutshell, not every fad becomes a fashion, not every fashion becomes a fit. Wasson (1978) emphasises the temporal dimension that fads emerge quickly, accelerate to reach a peak, and fall low at the same pace. Fashions, however, stabilize for some time before they decline.

B. Why do Fashions disappear?

Fashions have an ephemeral character (Esposito 2004). They disappear after some time, and there are different stances in the literature on how this happens. Abrahamson (1996) sees the main reason being when more and more organisations apply this fashion, they can no longer distinguish themselves from the other organisations and therefore have to look for new topics. Kiesler (1997) bases his management fashions view on a more rhetorical stance. He points out that fashions are reinterpreted over time and become meaningless. He explains the decline of a fashion through dysfunctional effects leading to a counter-fashion and the replacement of the fashion through the critique of other fashion designers. A similar view is suggested by Benders and van Veen (2001). They argue that "fashions wear out through use" (p. 44). Often, management fashions are not clearly defined and can be interpreted by different observers in different ways. This characteristic, which they call *interpretative viability* (Ortmann 1995) is maybe the key to success for a concept but also the reason for its decline. The concept diversifies in different forms and is linked to perceived failures. Finally, in this respect, Benders and van Veen (2001) argue that the distinction between mass media and practitioners (including both private and public sector) is important. The mass media might lose interest in a concept even though practitioners still use it.

C. Fad and Fashions and Technology

The discussion of fad and fashion has also found its way into technology studies. Abrahamson (1991) analysed the diffusion of technology and another example is the Gardner Hype Cycle (Drobik 1999), which is based mainly on studying the hyperbole around new technologies. In the IS literature, a few fad and fashion studies have been conducted. The primary focus here has been around the notion of BPR (Newell, Swan et al. 1998) and knowledge management (Swan, Scarbrough et al. 1999). Westrup (2005) argues for a critical engagement with management fashions in relation to technology and, in particular, to specific technologies such as ERP systems. He sees one key difference between technology and management techniques: Technologies are more durable and can be seen as a mechanism to provide more continuity for a fashion "besides vendors, consultants, and the trade press" (Westrup 2002). He argues through the notion of articulation that ERP systems

might be observed as declining management fashions in the literature but, in fact, are still widely used in organisational settings.

D. Convergence as a Fashion

The prologue introduced the jigsaw puzzle of Jackson Pollock's famous painting "Convergence: No. 10" as the first convergence hyperbole in history, which had nothing to do with technology. It is therefore even more surprising that in the following decades, most convergence discourses in the business press were related to technology ((Herzhoff 2010). The continuous differentiation of the notion of ICT convergence has subsequently thrown up numerous different forms of the term - the literature review in this dissertation shows 24 different forms of convergence related to technological change alone!

Global Convergence   Economic Convergence
Cultural Convergence   Market Convergence
Regulatory convergence   Industry Convergence
Organic convergence   Product Convergence
Technological Convergence   Price Convergence
Network Convergence   Computer and Communication Convergence
Digital Convergence   Convergence   ICT Convergence
Device Convergence   Convergence of Computers and Television
IP Convergence   Mobile Internet Convergence
Service Convergence   Media Convergence
Wireless Convergence   Fixed-Mobile Convergence
Messaging Convergence   Terminal Convergence

Figure 2-3 Forms of Convergence identified in the Literature Review

(Own Figure)

The loose usage of the convergence metaphor in both practice and academia has led to a situation where no one is quite sure what it means. In fact, scholars argue that "there seem to be as many definitions of convergence as there are authors discussing the topic" (Appelgren 2004). They argue that the large amount of studies on convergence lead to an inflation in meaning of the concept. Some scholars tend to see it instead of being the description of one of the key driving forces for technological change (Katz 1996) as just another buzz word (Lind 2004).

Noll (2003) even argues that "the very term 'convergence' is so all encompassing of a large number of concepts that by attempting to be everything, convergence is nothing more than an over hyped illusion". The conceptual value is further criticised by Garnham (1996) who points out that an all-including term like convergence covers up important distinctions, which need to stay visible.

The perception that convergence is neither just a buzzword nor a clear concept and, therefore, needs to be analysed more thoroughly has only recently been picked up (Nyström 2008). Lind (2004) conducted the only systematic analysis of convergence as a fad and fashion. He studied the use of the term *convergence* in the business press between 1990 and 2003 and analysed the pattern of the articles with the Gardner Hype Cycle model. The most influential application had been Drobik's (1999), analysis of the E-Business Hype Cycle in November 1999 that predicted the dotcom crash in the spring of 2000. Lind (2004) suggests that convergence follows the "Hype Cycle" in the 1990s. He concludes that the notion of convergence has been used as a rhetoric device to motivate strategic moves and as an alert for strategists about impending changes. However, the study covers only a limited period focusing on the US and excludes mobile convergence. Although the Gardner Hype Cycle model is an established framework in the industry, it is not based on a well-grounded theory and does not distinguish between shorter-lived fads and longer fashions. More importantly, it does not answer which characteristics of convergence make it appear as hyperbole. Storsul and Syvertsen (2007) argue that the main reason for the strong perception on convergence discourses is its merits as a rhetorical tool. It is very effective in encouraging investments and legitimizing political and regulatory change. Furthermore, it simplifies the communication of complexity through a metaphor (Fagerjord and Storsul 2007).

Nyström (2008) on the other hand conducted an empirical study interviewing business and IT managers in the Finnish telecommunications and media sector about their perception on convergence. She points out the necessity of a better description of what convergence is and more importantly to distinguish what it is not. Hacklin (2007) argues for the need to better understand the usage of the term convergence particularly in the academic literature. Another school of thought sees ICT convergence instead as a description of one of the driving forces for technological

change (Katz 1996; Lyytinen and Yoo 2002). Although we do not go as far as to see convergence, ontologically, as one of the driving forces for technological change, we have to acknowledge that the notion of convergence has been the cornerstone of several technological discourses for over 30 years in different functional systems of society − from the economic and mass media systems, to the legal and political systems. Therefore, this dissertation considers convergence not just as a short living management fad, but instead as a concept that needs to be taken seriously because it is being taken seriously.

Since the most prominent meaning of convergence is attached to information and communication technologies (Hacklin 2007), this dissertation sees it as being fruitful to engage in this discussion and specifically focus on the information systems field. The following sub-section will delve deeper into the dimensions of ICT convergence identified in section 2.1.

2.2.3 Dimensions of ICT Convergence

ICT convergence is a complex with many different dimensions. The most important ones identified in section 2.1 are discussed in the following paragraphs. Based on the review so far, three analytical distinctions emerged besides the core distinction of convergence/divergence:

- the social/technical dimension
- the process/vision view dimension
- the differentiation/unification dimension

A. The Social-Technology Dimension of ICT Convergence

Two main strands have developed over time, which emphasise either the technological or the social side of ICT convergence. Fagerjord and Storsul (2007) point out that convergence in policy documents, business plans, and many academic articles is primarily seen as pre-determined. Digitalisation will cause convergence of technologies and industries and therefore, has been taken for granted by many observers. The findings from a review of the literature suggest that media and management literature primarily "blackboxes" the technology, and rather focus on

the social dimension of convergence, e.g. cultural convergence (Jenkins 2006) or industry convergence (Pennings and Puranam 2001). Similar to the management literature, most authors in new media "blackbox" the technological side of convergence. Ithiel de Sola Pool's book Technologies of Freedom (1983) uses the term to describe the convergence of different modes of communication. Jenkins (2001) argues in particular for a wider understanding of convergence from cultural to organic convergence. The computer science perspective has focused on the technological side of convergence. The distinction between social and technology might suggest that the IS discipline would be a viable candidate to bridge this gap. However, as pointed out above [2.1], only a few articles in the core IS literature deal explicitly with the concept of convergence – all, without exception, on mobile computing and information infrastructures. However, a specific strand in the information infrastructure literature regards information infrastructures not only from a technological (McGarty 1992) or social perspective (Star and Ruhleder 1996), but regard them as an assemblage of both social and technological aspects (Ciborra 2000). Sørensen and Gibson (2004) regard the vision of ubiquitous computing, outlined by Mark Weiser (1991), as "the ultimate convergence of the social and the technical. Here, there is no longer any distinction between the two" (Sørensen and Gibson 2004).

B. ICT Convergence – A Process or a Vision?

There has been a debate in the literature if convergence is a process or an endpoint (Nyström 2008). Most scholars see convergence as a process. If it is a process, how can this process be described? Hacklin (2007) interprets convergence as a species of technological change. He suggests analysing it as a process that originates in convergences of knowledge, technology, and applications, leading eventually to industrial convergence. Henry Jenkins (2001) disagrees with conceptualising convergence as a single process. He builds upon de Sola Pool's work and systematises the concept of convergence by splitting it into five different processes, namely technical and economic convergence, which together lead to global, cultural, and organic convergence. Knox (2003) suggests seeing convergence not only as a singular description of a process but rather as a descriptor of change "which has gained its predominance from the fact that it cannot be pinned down to a single process, a single model, from the fact therefore of its own reproduction" (p. 120).

A very different approach is conceptualizing convergence not as a process but rather as a vision. Storsul and Stuehdal (2007) argue that one of the main reasons why the idea of ICT convergence became so influential was that it conveyed a long-term vision. How does this vision look like? In a recent practitioner's book on convergence, Shneyderman and Casati (2008) formulate this vision this way:

> "imagine now a seamlessly connected world – like in a science-fiction novel – a world in which telecommunications is replaced with communications and the 'tele' no longer has any significance. A world in which services are converged, the access network type no longer matters, and your communications experience is simplified with a single "any-media" service and devices with intuitive user-centric UI and functions. Now mix in some never-before-possible solutions such as unified presence and messaging or location and content-aware applications, and the outcome becomes very predictable" (p. xiv).

Swanson and Ramiller (1997) have studied visions in information systems innovations. They argue that visions play an important role in organisations. First, they reduce uncertainty during planning and increase efficiency in the decision-making process through their ambiguity. Visions change over time to ensure legitimacy and to provide the resources necessary to realise the vision.

C. Between Differentiation and Unification

The idea of convergence as differentiation has a strong position in media and technology studies while convergence as unification is often the focus of business and technology studies. While on the macro-level, most authors follow the unification idea of one single industry for ICT and Media, on the micro-level differentiation is observed. Kallinikos (2006) argues that one of the main consequences of digitalisation is the possibility to recombine text, images, and sound. This recombination creates new hybrids like the famous mash-ups produced by teenagers (Lessig 2008). Bassett et al. (2006) bring it to the point:

> "Everything that arises does not converge (...) It is increasingly obvious that there is no digital behemoth, no single form, no single function, no New World Order. Rather a series of reconfigurations, reformulations, new functions, new contents, new spaces, new grounds, new uses, have emerged and are emerging within global media networks" (p. 1).

Furthermore, they argue that it is less about unification, rather "what connects them together as many" (Bassett, Hartman et al. 2006). Storsul and Stuehdal (2007) call this the ambivalence of convergence. The term ambivalence signifies according to the

dictionary Merriam-Webster (2010) contradictions, ambiguity, and a fluctuation between something and its opposite. Storsul and Stuehdal (2007) see these contractions in particularly related to "what is converging (networks, terminals, social practices) and with what happens if something converges (merging, new complexities etc)" (p. 13). Finally, they argue that convergence might have been a good description of what happened in the 1990s, and less of what we are observing (differentiation and complexity), and would we are going to observe (more complexity). The following paragraphs will discuss this convergence paradox in more detail.

D. The Convergence Paradox

One debate that has only been a sub-question in the convergence literature is the distinction between convergence and divergence. As pointed out above, this issue is in particularly important in a second-order study since a counter-concept keeps the concept in place and defines its restrictions (Koselleck 1985; Andersen 2008). The review of the IS literature suggest that the distinction between convergence and divergence is the core distinction. Returning to the literature, a few scholars have gone beyond the taken-for-granted assumptions of convergence. However, different positions have emerged in the literature. Nyström (2008) sees divergence as a part of the convergence process besides technological, market and individual role and position seeking. Based on a case study of the Finnish telecommunications sector she argues that convergence and divergence both co-exist and co-evolve (Nyström 2008). Appelgren (2004) takes a different position and argues that both convergence and divergence are separate processes, which can run after another or in parallel. Gomez (2007) sees convergence and divergence as two processes, which constitute each other and are based on digitalisation.

Liestøl (2007) analyses the dynamics of convergence and divergence based on historical cases, distinguishing between hardware (i.e. CPUs or screens), software (i.e. applications or protocols), and meaningware (i.e. individual texts, genres, or conventions). He describes this process through the metaphor of the vortex in Edgar Allan Poe's short story from 1841 'A Descent into the Maelstroem'. The narrator is on a fishing boat approaching a dangerous vortex. He realises that smaller objects slow down in their speed so he decides to vacate the boat and attaches himself on a

floating object. This strategy helps him to survive. Liestøl's (2006) convergence/divergence framework suggests that initial conceptual aggregates disintegrate and attributes are detached before a recombination takes place. This recombination constitutes new composite objects.

Information systems are fragmented (Hanseth and Braa 2000). Ludes (2008) argues that convergence under pressure leads to fragmentation. Nyström (2008) points out that some of her interviewees mentioned that there might be resistance to convergence. Furthermore, an increasing number of non-digital artefacts are becoming digitised. Through digitisation these artefacts gain the potentiality to be linked and recombined. In particular the on-going convergence of large-scale infrastructures like mobile telephony networks, fixed-line networks, and the Internet provide opportunities for further linkages. Digitisation has to be distinguished from digitalisation (Tilson, Lyytinen et al. 2010a). While digitisation describes the technical process of digitizing an artefact, digitalisation describes the "socio-technical process of applying digitizing techniques to broader social and institutional contexts that render digital technologies infrastructural" (Tilson, Lyytinen et al. 2010a).

The promises of digital convergence are manifold. However, an increasing number of blocks to convergence emerge. Why? From an information infrastructure perspective, reasons for this might be risk-reduction (e.g. parallel infrastructures to provide high quality of service in emergency situations or security risks like worms and viruses on mobile phones), economic justification (the perceived costs of network convergence are too high compared to the benefits), and finally power-relations (e.g. loss of control over the infrastructure).

This section has presented, along the identified perspectives and themes in the initial literature review, an initial trail-blazing of the convergence literature. The following section will revisit the literature on mobile information infrastructures to contrast the findings gained so far with this specific body of literature.

2.3 REVISITING MOBILE INFORMATION INFRASTRUCTURES

Information infrastructure literature has recently, as outlined in the introduction [1.2.1], developed an interest in the notion of ICT convergence. However, a systematic conceptualisation is missing. A similar conclusion may be drawn if the researcher moves one level "higher". The extensive review of the broader IS literature conducted in the first section of this chapter [2.1] has shown that the notion has in fact only been used in the domain of information infrastructures and here in particular related to mobility. Three themes (social/technical, process vs. vision, and differentiation vs. unification) have been identified in an initial conceptual clarification of ICT convergence in the IS literature [2.2]. In the convergence literature, two additional themes (fashion and convergence paradox) were identified. Based on the findings from the previous ones, this section revisits the literature on mobile information infrastructures. It analyses how far these themes have been discussed in the context of information infrastructures and locates the specific body of knowledge to which this PhD dissertation aims to contribute.

2.3.1 Foundations

Mobile information infrastructures are at the intersection of two distinct bodies of literature – information infrastructures and mobility. Both notions are also important for the description of the case study in chapter five and its analysis in chapter six. This sub-section will provide a brief overview of both concepts.

The notion of information infrastructures has been politically promoted in the US through the Clinton/Al Gore vision of the information superhighway and in the EU through the Bangemann commission in 1994 (Hanseth and Monteiro, 1998). The roots of the concept of information infrastructure lie in the studies of large-scale technological infrastructures in the 1980s (see e.g. Hughes, 1983; Hughes, 1987). Since then, information infrastructures have been studied from different perspectives (see e.g. McGarty, 1992; Star and Ruhleder, 1996, Ciborra et al., 2000). McGarty (1992) takes a primarily technological perspective whereas Star and Ruhleder (1996) see information infrastructure from a social perspective. Ciborra et al. (2000) distinguish themselves through taking a socio-technical perspective. According to Hanseth and Lyytinen (2009: 9), information infrastructures can be defined as

"shared, evolving, heterogeneous installed bases of IT capabilities among a set of user communities based on open and/or standardized interfaces". They suggest two distinctions for information infrastructures; one based on scope (universal, business sector, and corporate information infrastructure) and the other based on function (service, application, and transport information infrastructure).

Tilson et al. (2010a) suggest a slightly different taxonomy. Referring to Benkler (Benkler 2000), Tilson et al. (2010a) propose differentiating between three types of layers within an information infrastructure: The physical layer, the logical layer, and the content layer. The physical layer consists of the cables, any form of hardware, and radio spectrum in the context of wireless infrastructures. The logical layer on the other hand provides the logic for the physical layer. It consists of data protocols and the service logic. The content layer finally consists of the texts, images, and speech, which are running over the infrastructure. They analyse all three layers based on the distinction open/closed and social/technical. These multi-layer models have been the dominant depiction of information infrastructures (Ciborra, 2000). Most of the literature on information infrastructure focuses on universal and corporate infrastructures, neglecting business sector infrastructures.

Tilson et al. (2010b) introduce the notion of digital infrastructures. Digital infrastructures have, in addition to traditional information infrastructures, some distinct characteristics. Firstly, they are *recursive* in nature, i.e. they can easily recombine and establish new infrastructures. Secondly, digital infrastructures are very *scalable*, since they can be easily upgraded with relative ease and low cost. Thirdly, they possess *downward and upward flexibility* - upward flexibility for the development of new services as well as downward flexibility to work on top of different types of networks. Finally, digital infrastructures are essentially *bit pipes*. In contrast to traditional infrastructures, the meaning of the bits has to be constantly negotiated and re-arranged (Tilson et al. 2010).

Mobile information infrastructures are a specific form of digital infrastructures. The term mobility has condensed multiple meanings over time. According to Urry (2007), four different forms of mobility can be distinguished from each other. The first one is to describe something that moves or has the capability to move. This can be a person

or any type of artefact. The second form is mobility as a mob, a disordered crowd. The third form is upward or downward social mobility within society. The fourth form is mobility in the form of migration, a geographical movement (Wiredu 2005). The focus of this dissertation is on the first form. It agrees with Elaluf-Calderwood (2009) that mobility can only be understood in the context of what we call mobile. This can be the mobile user, the mobile device, the mobile application, or a mobile infrastructure. Further development of the idea of mobile information infrastructures has resulted in the ideas of ubiquitous networks (Weiser 1991) or pervasive computing (Lyytinen and Yoo 2002). As information infrastructures become more and more interconnected, there is a lack of knowledge about the development process of these ubiquitous and pervasive structures. There is therefore a clear need to increase the understandings not only of the processes but also of the discourses influencing these processes (Orlikowski and Iacono 2001). The following section discusses some of the contexts of convergence discourses in the mobile information infrastructure literature.

2.3.2 Convergence Discourses in Context of Mobile Information Infrastructures

As pointed out in the introduction, the notions of ICT and digital convergence have recently been discovered in the IS literature on mobile information infrastructures. This section juxtaposes the themes identified in the previous sections with the understanding of convergence in this particular body of literature.

Wareham et al. (2009) see convergence as one important characteristic of the mobile telecommunications industry system designers have to consider besides market saturation and commoditization. They make the distinction between upstream and downstream convergence and highlight how this convergence can have implications for the social in mobile services. Tilson et al. (2010) argue similarly. They point out that network convergence has been facilitated through increasing usage of Internet Protocol providing *upward flexibility* for the development of new services as well as *downward flexibility* to work on top of different types of networks.

The information infrastructure literature has developed two concepts, which are semantically closely related to the general understanding of ICT convergence (see

also chapter 2.1). The first one is *integration.* According to Monteiro & Hepso (2000), information systems can be integrated in two ways. The first one assumes that one system is in control, and the other has to follow. The second one assumes that both systems are considered equal and neither is in control. *Interoperability* is the second. Bowker (2005) points out that the interoperability of information infrastructures is primarily based on protocols and standards. Hanseth (2000) sees gateways as a kind of converter, translating between two otherwise incompatible protocols. Gateways support modularization (Hanseth 2000). Design of information infrastructures is often based on modularization (Baldwin & K. B. Clark 2000). Gateways support modularization in the way that they need only tight coupling at the extremities (Hanseth 2000). Furthermore, a large body of literature deals with different aspects of *boundary-management,* and several useful theoretical concepts like trading zones (Gorman 2004) or boundary objects (Star and Griesemer 1989) have been developed.

Is there a conceptual place for the notion of ICT convergence in the mobile information infrastructure literature between these notions of interoperability, integration or boundary-management? This dissertation argues that based on the findings so far, the notion of convergence has sometimes been used in the literature interchangeable with these concepts. However, the notion of ICT convergence does have distinct characteristics and utility that make it worthwhile to include it as a concept in the information infrastructure literature. The following paragraphs focus on the identified dimensions of ICT convergence as developed from the literature and how they have been studied in the information infrastructure literature: The social and technological, the process and vision, the unification and differentiation dimension as well as the convergence paradox.

As pointed out above, information infrastructures are regarded in Information Systems research as assemblages of both social and technological aspects. Tilson et al. (2010) see that the essence of digital convergence as the co-evolution of social and technological infrastructures. Based on Benkler (1998) they argue that each of the three layers of an information infrastructure (physical, code, and content) rests on a technological and a social infrastructure. They see it in particular digital convergence

represented by the dynamics of the interconnection, overlapping, contention, and reconfiguration of the social and the technical infrastructures.

Nielsen (2004) sees convergence as a "process bringing together different and heterogeneous actors as well as markets and technologies, a process not only bringing synergies but also challenges." He argues that in particular conflicting interests might emerge from these convergence processes. Stavem et al. (2002) and Jansen and Nielsen (2005) investigated the converging processes between UMTS and WiFi infrastructures in Norway. While Stavem et al. focused more on "convergence strategies", Jansen and Nielsen suggest to conceptualise convergence as one form of co-evolution pointing out that convergence between these two infrastructures is by no-means inevitable. Mueller (2008) studied convergence processes in the context of mobile TV using structuration theory (Giddens 1986). However, convergence as vision has not been well-studied in the information infrastructure literature. Olla (2004) develops the concept of convergent mobile infrastructure (CMI) on the idea of "ubiquitous computing" by Weiser (1992). He suggests a business model approach based on four new business models to aid policy makers and network operators in the development of new converging services. Ellingsen and Monteiro (2008) have studied the closely related concept of integration from a vision perspective in the healthcare sector. Their findings suggest that the inherent ambiguity of integration is an important requirement for mobilizing political support among stakeholders for integrated health information systems. They further argue that the vision of integration developed career dynamics influencing not only the discursive but also the material realizations of the IS implementation.

The distinction between convergence and divergence is also the core distinction used in the IS literature. However, Wareham et al. (2009) also hint towards the observation that claims of convergence in the mobile space might be overstated. They observe a very heterogeneous landscape on all layers of the mobile industry stack from operator, device, operating system, application, and content. They conclude that convergence might happen on the macro-level, however, on the micro-level the different stacks remain constrained by lock-ins, proprietary standards, and lock-in.

The convergence paradox has been observed primarily in the context of standardisation. Nielsen (2006) studied the convergence processes around the Content Provider Access (CPA) standard in Norway. He observes that "when we study processes where technologies, markets, actors etc. that were previously independent and distinct, that now become integrated and mutually dependent, standardization reveals a process based on convergence through fragmentation" (p. 116). Tilson (2008) addresses several convergence instances in the mobile and television industry. He uses actor-network-theory to "explain convergence, the explosion in the number of interfaces requiring standardization, and other industry and standardization changes observed in the case studies" (p. 17). Tilson et al. (2010) observe three waves of digitalisation. In the current third wave they see "as a result a rapid divergence is emerging in how service creation, distribution, and use occurs, which, paradoxically, is built upon the convergence around the bit." (p. 2). Furthermore, they put forward a set of criteria that any framework to explain convergence/divergence has to satisfy (p. 6):

1. Account for the expansion and complexity of technological infrastructures.
2. Account for the dynamic mutual dependencies among social and technical infrastructures.
3. Provide some way of breaking up an increasingly interconnected socio-technological world into separate domains that allow meaningful study.
4. Use the domains outlined in (3) to explain at least some of the most important dynamic mutual dependencies referred to in (2).

In other words, a framework to analyse convergence and divergence should provide meaningful distinctions explaining the observed dynamic mutual dependencies between social and technical infrastructures. They suggest the three-layer model suggested by Benkler (1998) as a starting point for this kind of framework. However, what is missing in this suggestion is that convergence is observed through an observer. It also ignores the temporal dimension of convergence as elaborated above. Furthermore, the dynamics of the process of convergence and divergence have to be elaborated further. Finally, the unity of the distinction convergence/divergence is ignored. Hence, it is argued that the presented framework is a good start but needs to be extended through a systematic second-order analysis.

2.3.3 The Example of Mobile VoIP

Within the nomadic information environment (Lyytinen and Yoo, 2002), mobile Voice-over-IP (VoIP) is a very recent example of ICT convergence. While VoIP has been studied for many years, very little research has so far been done on mobile VoIP. This is not surprising given its relatively recent character. Mobile VoIP has only gradually shifted into the academic debate in the past five years. The following literature review provides an overview about the current perspectives and academic debates on mobile VoIP. It also provides the argumentation why mobile VoIP provides an excellent case for studying ICT convergence.

Mobile VoIP has been defined as "voice-oriented services, in which voice is transmitted over IP networks, and the service is used with a mobile handset" (Verkasalo 2006); it is usually accompanied by instant messaging capabilities and presence functionality. Furthermore, Verkasalo (2008) distinguishes between deployment scenarios, namely proprietary clients (e.g. Skype), operator-controlled (e.g. IMS) or virtual VoIP services. Mobile VoIP applications started as simple voice services. However, since 2006, many mobile VoIP applications have become information infrastructures in their own right. In effect, it is an information infrastructure on top of existing mobile telephony networks.

Technical studies have focused over the past years primarily on quality of service and the handover of VoIP calls between different networks (Bányász and Iváncsy 2005; Algell 2006). Analogue to the technical convergence studies, one of the key technical issues for mobile VoIP are around Quality of Service (Hossfeld et al. 2005). Varela (2007) studied the Quality of Service of mobile VoIP in a convergent network setting. His findings suggest that mobile VoIP is not yet on par in quality with circuit-switched voice services.

Maeda et al. (2006) study mobile VoIP in the US, Europe and Japan from a technical and economical perspective and developed a couple of recommendations for the regulatory bodies in these countries. A different perspective was taken by Chetty et al. who investigate the diffusion of mobile VoIP in terms of bridging the digital

divide between rural and city areas in South Africa by conducting a rich exploratory case study in a remote village (Chetty et al. 2006). Although this research gives some interesting perspectives about the tensions between regulation and innovators and some insights on the diffusion of the technology they avoid using a specific theoretical lens.

Only a few studies look at mobile VoIP from an economic perspective. These studies focus in particular on the diffusion of mobile VoIP (Verkasalo 2008) and its disruptive potential for the mobile market (Lindqvist 2007). Nyström and Hacklin (2005) look at mobile VoIP from a value-creation perspective. Some observers see mobile VoIP as potentially one of the most disruptive forces in the mobile industry insofar as it targets the core business of mobile operators, i.e. mobile voice calls and messaging (Christensen et al. 2002; Greenemeyer 2007).

Summarised, mobile VoIP has some characteristics, which make it an excellent context to study ICT convergence discourses. First, mobile VoIP can be seen as the latest example of ICT convergence and is located in the context of mobility. Second, mobile VoIP offers interesting insights into the dynamics between mobile services and information infrastructures, since it questions as an extreme case the basic business model of the mobile network operators (Arjona 2009). Third, due to its recent character, it is less studied than other converging services like mobile TV (see e.g. Nyström 2008; Mueller 2008).

2.4 SUMMARY AND PROBLEMATISING FOR CONTRIBUTIONS

> "When we construct and write up our discussion of the extant literature, then, we are doing much more than generating a summary of previous studies and theorizing on a topic (...) we shape it so that it invites the contribution our work can make."
>
> Golden-Biddle and Locke (1997: 27)

The aim of this section is to pull all the strings developed in this chapter together to construct a clear space in the literature for the contribution of this PhD dissertation. First, the limitations of the literature are briefly addressed before the findings from the literature review are presented and the implications for the research question are drawn.

2.4.1 Limitations of the Literature Review

As Golden-Biddle and Locke (1997) rightly point out, a literature review is always selective. Therefore, the decisions for the selection need to be made transparent. Multiple databases were used to find relevant literature. The literature search was conducted both manually and through electronic catalogues to identify relevant books, academic journals, and conference papers. The focus was primarily on literature between the 1970s and 2009 since this has been the period of ICT convergence discourses. The focus has rather been on themes and debates and not to include every paper of single authors. Some parts of the literature review were strongly keyword driven, in particular the IS literature review (2.1). In cases, where authors presented the same idea in different papers, papers were excluded selectively for better readability.

2.4.2 Shortcomings of Previous Research

The main shortcoming of the existing body of second-order literature on ICT convergence is, with the exception of the work by Knox (2003) and Nyström (2008), that it has not moved further below the surface to enrich the understanding of the idea of ICT convergence. With the exception of Knox (2003), none of the previous studies used a theoretical grounded analytical strategy for second-order observation.

Drawing on the broader convergence literature in other research fields, four key shortcomings of the existing literature were identified. *First*, previous studies have primarily focused on the drivers and the consequences of convergence, neglecting studying convergence as an idea constructed by a multi-disciplinary discourse. What is missing is that convergence is observed through an observer. *Second*, most of the previous studies focused on convergence in the general ICT domain, neglecting the recently emerged discourse around mobility. *Third*, studies on ICT convergence focus either on the socio-economic or on the technology, but do not consider socio-technical perspective on convergence. *Finally*, the literature on convergence is loaded with contradictions, making it difficult to operationalise the notion of convergence as a concept for systems design.

However, previous studies only provide limited discussion on these contradictions. Firstly, although the notion of convergence has taken a very prominent position in the non-academic discourses, it is by some observers regarded as a buzzword and by others as an important concept. Secondly, it is unclear if convergence is a process or an endpoint. Is it a vision or already there? Third, studies on convergence focus either on the social-economic or on the technology but do not consider a socio-technical perspective on convergence. Therefore, the role of technology shaping these discourses is rather unclear. Finally, there is evidence that the concept has been diluted, which makes an analysis of the distinctions of what constitutes convergence and what does not necessary. The literature suggests as core distinction convergence/divergence. However, based on the literature review it is argued that this ambiguous relationship between convergence and divergence, which we may well call *convergence paradox*, is essential to understand the limits of convergence and to provide a useful conceptualisation of convergence for the information infrastructure literature. Furthermore, the dynamics of the process of convergence and divergence have to be elaborated further. Therefore, there is a clear need for a systematic analysis of convergence discourses from a second-order observation in the context of mobility.

2.4.3 Key Differentiators of This Research compared to Previous Research

One of the key differentiators of this dissertation compared to previous research projects studying convergence is the focus on the idea of ICT convergence rather then on the phenomenon. This change in perspective results from the philosophical assumptions this study is based upon which will be presented in the following chapter [3.1]. This shift from first- to second-order observation is accompanied with an interest in discourses. However, discourses are difficult to grasp. Chapter 4 will therefore present a couple of discursive analytical strategies and present a justification why Luhmann's Theory of Social Systems has been chosen as primary theoretical basis. This is followed by an introduction to some of Luhmann's key concepts and discursive analytical strategies. The following two chapters will present the relevant theory and methodology as an attempt to overcome the shortcomings of previous research presented in this chapter.

3. Research Design

"Which analytical difficulties do we encounter when the innocence of the empirical collapses, when we can no longer pretend that "the object out there" discloses how it wants to be observed, when we know that it is our "eye" that makes the object appear in a particular way?" (Andersen, 2009)

As elucidated in the introductory chapter, the aim of this doctoral dissertation is to investigate how we can conceptualise the notion of ICT convergence using second-order observation to understand the contradictory discourses around convergence of mobile telephony networks with the Internet. Therefore, the primary objective of the empirical study is to explore the discursive ways in which convergence is referred to and enacted in practice (Knox 2003).

In the following sections the choices related to the research design are presented together with their justifications. The structure of this chapter is similar to Crotty's (1998) depiction of the research design process. The first section introduces the ontological and epistemological assumptions underpinning this PhD dissertation. The second section outlines the interpretive research approach through introducing second-order observation and the notion of analytical strategy (Andersen 2003). The third section, presents the method used in this PhD dissertation for the empirical study, namely a single case study on mobile VoIP. The final section, discusses the applied data collection techniques and data analysis.

3.1 PHILOSOPHICAL ASSUMPTIONS

At the beginning of a new research endeavour it is important to ask the question about the most appropriate epistemological approach (Zuboff 1988). Why do researchers collect empirical data, and what claims can be made from it, and more importantly what cannot be made? Of course, this depends on the adapted methods and methodology, but even more importantly on the underlying ontological and epistemological assumptions (Crotty 1998). These assumptions are the link between the empirical findings and the theoretical constructions. If these assumptions are not made explicit, inconsistencies between theory and practice may emerge, which has

often happened in the past, especially in the field of information systems (Smith 2006).

3.1.1 Ontological and Epistemological Framing

The assumptions made in this dissertation on the phenomenon of the study *(ontological framing)* are discussed here, along with the beliefs about the notion of knowledge and how it can be acquired *(epistemological framing)*. This dissertation therefore remains in the prevailing subject-object paradigm, in contrast to the more radical approaches that will be referred to later in the theory section (Luhmann 2002). These ontological and epistemological assumptions are also the basis for judgment about which claims this dissertation can make from the empirical data collected (Searle 1995). In addition, they serve as a compass to show where this dissertation stands in relation to other scholars. However, a note of caution needs to be placed at this point. This section deals with highly complex philosophical issues and can only skim over the surface since a full appreciation of these issues is out of scope of this dissertation.

Every academic position depends on an ontology and on an epistemology (Andersen 2003), it mainly depends on the sequence and the emphasis. Why does this section not begin with epistemology? This dissertation does not follow Crotty (1998) who sees no need for a separate discussion of ontology and argues that it can be dealt with in the epistemology discussion. However, the intention is not to build up the Bhaskar (1998) argument ("how has the world to be like to make science possible?"). Instead, the ontological discussion is seen as the first step to reject the two extremes of both naïve realism and idealism for this dissertation. There are three different ways of answering the ontological question of "what is," with many shades of grey in between:

- Reality is everything that is observable (naïve *realism*) or observable reality is only one part of reality (*critical realism*).
- Reality is real but constructed (*mild constructivism*) or nothing can exist unless it is socially constructed (*radical constructivism*).
- Many different realities exist (*postmodernism*) or only what is part of communication exists (*linguistic idealism*)

Reality is too complex to be experienced through five senses alone, as suggested by naïve realism (Sayer 2000). For example, many first-order studies on ICT convergence take a stance of naïve realism or critical realism (see, in particular, the studies from a management perspective in the literature review in chapter 2).

Therefore, reality must be "deeper". The idea of a stratified ontology has been the centrepiece of critical realism. Roy Bhaskar (1998) suggests in his critical realism a three-layered structure of reality that he labels as the "real", the "actual" and the "empirical". While the "empirical" deals with our perceptions and experiences, the "actual" conceptualises the underlying events that may lead to our perceptions. The "real" finally deals with the fundamental mechanisms and structures that have causal powers to influence events. This dissertation agrees with critical realism that one problem of naïve realism is that it conflates these ontological levels into one. As Mingers (2004) put it: "It reduces underlying laws or mechanisms to actual events, and then events in general to experience". (p. 382).

However, although this dissertation rejects the ontology of naïve realism, it does not go so far as to state that reality does not exist at all. People can - as many constructivists would agree - observe some parts of the real with their senses or with the help of technological artifacts. John Searle (1995) makes this point very clear:

> "We live in a world made up entirely of physical particles in fields of force. Some of these are organized into systems. Some of these systems are living systems and some of these living systems have evolved consciousness. With consciousness comes intentionality, the capacity of the organism to represent objects and states of affairs in the world to itself". (p. 7).

Hence, if there is a reality out there independent of us human-beings, these physical particles might have some properties that are inherent to them. But these are not the properties we identify through our perceptions and experiences. How we name this "worldstuff", how we relate to it and more importantly the process through which we make sense of the phenomenon is socially constructed (Goodman 1978). Here we enter the social realm of reality. We cannot neglect that certain structures may have effects on us, at least in the short term. We could potentially "free" ourselves from

the structural constraints, but it is highly likely that some properties of social structures may influence our behaviour.

The key question is whether this world is accessible so that we can discover it; and if not we can only interpret it. How successful is intentionality in making representation of the world? Here we reach the invisible boundary between critical realism and social constructivism. It is this particular space between critical realism and social constructivism that is the focus of this section. Of course, only a brief sketch can be provided in this dissertation, although it should be sufficient to present a robust philosophical foundation for a doctoral dissertation.

Epistemology is the theory of how to acquire knowledge about the "real". What is "knowledge"? How do we acquire it, and when is it valid (Hirschheim 1985)? To some extent, critical realism sees knowledge about reality as possible, and defends this view through the fallibility argument — knowledge is fallible, and that is why knowledge about reality is possible (Bhaskar 1998). Nonetheless, the metaphor of layers of reality may still suggest a certain kind of accessibility to this reality; we just need to "dig" deep enough to identify the hidden mechanisms of the world. This position can be found, for example, in Hacklin's study on convergence in which he focused on "revealing" the hidden properties of the convergence process (Hacklin 2007).

But this dissertation also agrees with Smith (2006) that one of the key problems with this rejection is the risk of inconsistency between believing in no-causality, and using causality as the basis of cognition to describe the findings. On the other hand, human beings have to think in the way of causality. This is, as human beings, our way of dealing with experiences. One of the key problems in any realist epistemology is the problem of conceptual relativity (Putnam 1988), which is that we describe everything relative to our existing categories (e.g. John Searle's "klurg", see Searle 1995). The key solution is the understanding that we do not make explanations of reality, rather, and contrary to Goodman (1978), we do not make "worlds" but descriptions of the world. While the objective of critical realism is still to discover, constructivism suggests making sense of the world.

It is here where this dissertation departs from realism, and crosses the line towards constructivism. We cannot have knowledge about truth; we can only assert knowledge (Hirschheim 1985). This study therefore rejects the correspondence theory of truth, and joins Thomas Kuhn in his argument that "truth" is rather an accepted convention by a community at a certain point in time (Mingers and Willcocks 2004). Latour (1987) would put it like "fact construction is so much a collective process that an isolated person builds only dreams, claims and feelings, not facts" (p. 41).

From a constructivist perspective, reality exists to some extent independent of the observer, but it is not accessible (Walsham 1993). Therefore, some descriptions developed in the course of this dissertation might be more useful than others, but they do not correspond with reality. But how is it possible that as human beings we cannot grasp reality but still are able to develop knowledge?

One of the key epistemological assumptions this dissertation is based upon can be described through the metaphor of seeing reality as a horizon, which is used by Luhmann drawing upon Husserl (Luhmann 1997). While it does not deny the existence of reality, it does take into account its inaccessibility. Hence, the "reality" as human beings we observe on a daily basis is constructed within our own psychic systems by constant tests for consistencies, or, in other words, by sense-making (Luhmann 2000). It is the process of sense-making that generates knowledge.

But does not this argument lead to radical constructivism? Radical constructivists argue that outside stimulus is only relevant for our nerve system in relation to its intensity (v. Foerster, 1985). The brain itself makes sense of it, and therefore constructs reality; from here "anything goes" is just next door (Feyerabend 1993). But even if this study joins the radical constructivists on their home turf of biology, it can be quickly realised that this argument is too superficial (Saalmann 2007). According to current scientific knowledge (Roth 1995), the brain receives not only information about the intensity but also the duration of the stimulus, its decrease and increase and its locality. Therefore, the brain receives not only single stimuli, but also patterns and structured information (Roth, 1995). Although we as human beings

don't have access to the environment, it has influence on us. Sense-making is therefore not only a closed internal process but also it takes into consideration structured information from the outside. Which information our psychological system finally selects through complexity reduction is on the other hand a "closed process" (Luhmann 1992).

Since this dissertation is situated in the social part of reality, some implications for research on social reality need to be addressed. As Hacking (1999) pointed it out, social science is different from natural science in what he called "the looping effect of human kinds" (p. 34). Whenever a researcher undertakes social research he/she also influences his "object" of study, e.g. when asking interviewees about their perception of convergence. What implication does this have for studying ICT convergence? It means that it is impossible to study the phenomenon of convergence and make claims about an objective truth. Instead, this study examines how communication constructs the idea of ICT convergence.

Practitioners have constructed the idea of ICT convergence to make sense of this phenomenon. As a social science researcher, the task is not to explain the phenomenon of ICT convergence itself, rather to explain the processes that are producing the phenomenon (Cordella and Shaikh 2006). Hence, this study aims to understand how the idea of ICT convergence is shaped and how the convergence discourse is constituted. Therefore, this dissertation is based on a mildly constructivist epistemology.

3.1.2 Research Approach: Second-Order Observation

Methodological and epistemological assumptions are highly interrelated because the epistemological assumptions not only determine what constitutes valid knowledge but also how this knowledge may be obtained. The hinge between epistemological assumptions and the adopted methodology is the underlying research approach. According to Crotty (1998) any research design has to be based on a research approach that is informed by an epistemological stance. This research approach informs the research design and provides a context for its logic and criteria (Crotty 1998). Several scholars have in the past attempted to provide a categorisation of research approaches. This section will provide a brief overview about these

classifications and show where some of the previous ICT convergence studies can be located.

One of the most influential approaches has been the classification by Burrell and Morgan (1979). They structure social theories based on two sets of assumptions. The first is the subjective/objective dimension, including dichotomies based on ontology (realism / nominalism), epistemology (positivism / anti-positivism), human nature (determinism / voluntarism), and methodology (nomothetic / ideographic). The second assumption concerns the state of society, which can either be in order or in conflict. Based on these two dimensions, four paradigms are suggested: functionalist, interpretive, radical structuralist, and radical humanist. This categorisation has on the one hand been highly influential because of its simplicity, but on the other received much criticism (Chua 1986; Deetz 1996). Other scholars have resisted the rigid categorisation, and instead suggested focusing on the assumptions (Chua, 1986). Orlikowski & Baroudi (1991) observe the emergence of three main traditions in the field of Information Systems: Positivist, Critical, and Interpretative approaches. Previous studies have adopted a variety of approaches to the study of ICT convergence (see Table 3-1). The following table shows the theoretical perspectives used in the key empirical studies on ICT convergence.

Table 3-1: Epistemological Assumptions of Previous Studies on Convergence

Convergence Studies (*no empirical data)	Theoretical Perspective
Silverstone (1995)*	Critical
Hedley (2000)*	Critical
Knox (2003)	Interpretative
Lind (2003)	Positivism
Bally (2005)	Positivism
Nielsen (2005)	Interpretative
Tilson (2006)	Interpretative
Delgado Gomez (2007)	Positivism
Hacklin (2007)	Positivism
Nyström (2008)	Interpretative
Mueller (2008)	Interpretative

Most of the previous studies on ICT convergence use either positivism or interpretivism. Two studies have taken a critical stance (Silverstone 1995; Hedley

2000), however, they are purely conceptual papers without any empirical data. One identified shortcoming of these previous studies (with the exception of Hannah Knox's approach) is the lack of any analytical strategy as a guide for data collection and analysis.

As described in the previous section, this dissertation is based on the belief in the existence of a world with objective properties, but it still acknowledges that meaning can only emerge through interactions between human beings. Based on these premises, it is closer related to the interpretative research tradition then to positivism or the critical research tradition. However, it is primarily a second-order approach. The key difference between interpretivism and second-order observation is that observations are not interpreted; they are to be described (Andersen 2008). According to Lee et al. (1997), interpretivism refers to an approach that uses ethnography, hermeneutics, phenomenology, and case studies. Although constructivism is more inclined toward relativism, we do not propose an "anything goes" attitude such as Feyerabend's (1993) and various other postmodernists' (Caputo 1997). Every description must be consistent and must "fight" resistance (Luhmann 1996:158).

This dissertation requires a research approach that does not focus on the phenomenon of convergence, but instead provides a lens through observing how the idea of ICT convergence is formed and shaped. This analysis, therefore, requires an approach that is sensitive to different observers. The risk of a different approach would be that the dissertation becomes too insensitive to different observers and might not acknowledge that different observers shape the discourse on ICT convergence simultaneously.

Luhmann traced second-order observation back to the novels in the 18th century where the reader could observe some things that the hero of the novel was unable to observe (Luhmann 2002). It became more widespread in the 19th century in academia through the critique of ideology from Marx and from Freud's psychoanalysis. Rasch (2002) sees the purpose of second-order observation in these early studies primarily to "locate 'latencies' (class interest, traumatic experience) that account for error (ideology, pathological behaviour)" (p. 3). However, as Rasch (2002) argues further, these studies were primarily driven by morally normative rationalities to correct

wrong observations through rational or normative observations. In the mid 20th century, different approaches were developed to overcome these shortcomings. Niklas Luhmann suggests one radicalisation of this idea. He proposed putting latency in all observations; even in the researcher's own (Rasch 2002). The implication for this is a high degree of reflexivity inherent in this approach.

3.1.3 Second-Order Observation through Analytical Strategies

The following section presents the general approach of second-order observation, and analytical strategy as its operationalisation. This dissertation will use analytical strategies based on Niklas Luhmann's Theory of Social Systems and Theory of Distinction (Andersen 2003; Andersen 2008). This section also provides a brief account of why Luhmann's Systems Theory is seen here as the most appropriate for studying the ICT convergence discourse. A detailed presentation of Luhmann's Theory of Social Systems and the relevant key concepts for this study will be presented in *chapter four*.

Andersen (2003) studied different approaches of second-order observation (e.g. Koselleck, Laclau, Foucault, and Luhmann). Based on his findings he created the notion of an analytical strategy to operationalise second-order observation:

> "Analytical strategy does not consist in methodical rules but rather in a strategy that addresses how the epistemologist will construct the observations of others – organisations or systems - to be the object of his own observations in order to describe the space from which he describes. From an epistemological point of view the perspective constructs both the observer and the observed". (Andersen, 2009: 99)

An analytical strategy assumes society as communication. An analytical strategy (Andersen 2003) needs to give first, an account of the *choice of guiding distinction*, second an account of the *conditioning* of the chosen guiding distinction, and finally it must point out, substantiate, and account for the implications of the exact *observation point*.

The *guiding distinction* divides the world into observer and the observed observations. This distinction is contingent. One of the consequences of a guiding distinction is that the world becomes poly-contextual. Furthermore, it controls the

second-order observation since it determines who can be observed and how, and who and what cannot be observed (Andersen 2009).

For a rigorous analysis *conditioning* the guiding distinction is important. The analyst has to set upfront the conditions for what is accepted as indication, i.e. what is in focus. In the case of systems analysis, where the guiding distinction is system/environment, it becomes vital for quality of analysis to state clearly the criteria for when something can be regarded as a system and when not. The important role of the observer in second-order studies is accompanied by the importance of the point of observation. Within systems theory, the *point of observation* is the systems reference. It may be very different to observe ICT convergence from the perspective of the media system compared to that of a mobile telephony operator.

Andersen (2003) conceptualises this as a machine of analytical strategies, which is illustrated in figure 3-2.
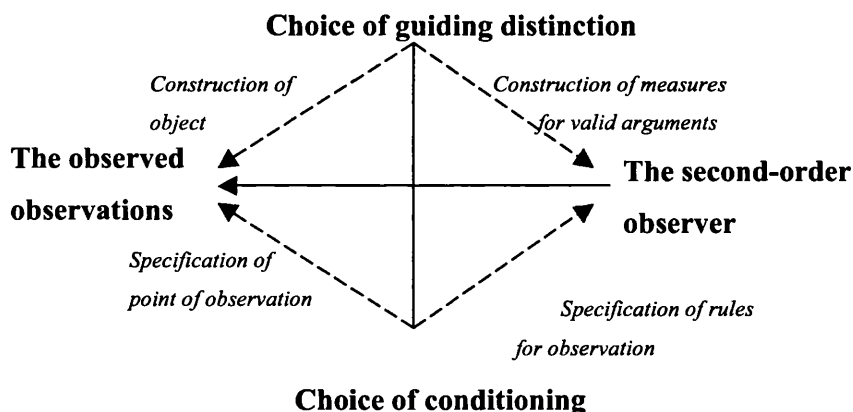
Figure 3-1 Machine of Analytical Strategies

(after Andersen, 2003: 117)

However, as Andersen (2009) points out: "There is no fixed answer to the choice of guiding distinction, and on the other hand, the choice determines everything". Furthermore, analytical strategy offers flexibility (Andersen, 2003). First, the second-order observer can always question the choice of guiding distinction. Second, he can question the conditioning of the guiding distinction and replace it with ones that are more useful. Finally, the point of observation can be changed.

Andersen (2003) draws a clear distinction between analytical strategy and method. However, he does not deny the compatibility of methods working inside an analytical strategy. He only points out that analytical strategy drives the methodology, and vice versa:

> "The distinction should not be understood as a normative regulation against the use of methods. The central question is whether a methodical or an analytical strategy perspective is primary in the research design. Naturally, within one analytical strategy different methods can be reintroduced which the analytical strategy then has to question."(Andersen, 2009: 100)

Summarised, this section has introduced the basic philosophical premises this dissertation is based upon. This PhD dissertation takes the stance of a mildly constructivist epistemology. It applies second-order observation through analytical strategies. The following section describes in detail the research design adopted in this dissertation based on these premises.

3.2 RESEARCH DESIGN STRATEGY: CASE STUDY METHOD

According to Yin (2009), every research design strategy needs to account for five components: the research question, propositions, a logic to link the data to the propositions, the unit of analysis, and quality criteria for interpreting the findings. In this section, the first three have been grouped together since they all are related to the research question. The unit of analysis and the quality criteria will be discussed separately. However, before delving into these components, the decision for taking a case study approach will be discussed.

3.2.1 Case Study as Research Design Strategy

Previous studies investigating the idea of ICT convergence have used a wide range of research strategies, spanning from archival design over ethnographic study to the case study approach. For example, Lind's (2004) study on the use of convergence in newspaper articles employs an archival design. Although this approach is helpful in identifying patterns in the convergence communication over a long period of time (e.g., a "convergence hype cycle"), it does not provide detailed insights on its specific form and is limited to the perspective of the mass media. Mass media, as mentioned earlier, selects news based on the distinction information/non-information (Luhmann, 2000), and therefore ignores anything that does not make a difference.

On the contrary, Knox (2003) conducted an ethnographic study in Manchester to explore the idea of convergence in the new media industry. An ethnographic study has the advantage of being the most 'in-depth' research method possible, and can therefore challenge much taken-for-granted knowledge (Myers 1999). However, Myers (2008) points out that ethnographic research, like any other design strategy, also has its disadvantages. First, ethnographic studies take a very long time, the data collection alone requires according to Sanday (1979) at least a year. Furthermore, ethnographic research focuses predominantly on one specific organisation or context. Although initially utilizing an ethnographic study has been considered by the researcher, an ethnographic study has primarily been rejected since this dissertation aimed to capture how very different observers describe ICT convergence.

An alternative to ethnographic research is the case study approach. (Yin 2009). Nyström (2008) used a case study design in her research on the Finnish telecommunications industry. She conducted 38 interviews with Finnish managers in the industry, primarily focusing on employees involved in the design and development of mobile services. The case study design allows the researcher to focus on the rich interactions between the actors, which can neither be separated from the context nor controlled in an experiment. As an interpretivist case study, it is also consistent with this dissertation's epistemological position (Walsham 1993). However, the study falls short of accounting for the role of the observer. ICT convergence in the context of the mobile Internet is a highly contemporary event, and this rules out a historical study of the phenomenon. Furthermore, such a study requires no behavioural control. Finally, the focus of this dissertation is on how convergence discourses are constructed, thereby ruling out survey design or archival analysis as a primary research strategy.

Hence, a case study approach seems to be most appropriate research strategy. However, it remains unclear what constitutes an appropriate "case" to study convergence discourses in the context of mobility (Ragin and Becker 1992)? To answer the question of "what is a case", Ragin and Becker (1992: 9) suggest a conceptual map based on the dichotomy between (1) specific vs. general case conception, and the dichotomy between (2) case as an empirical unit vs. theoretical construct (Table 3-2).

Table 3-2 What is a case (adapted from Ragin and Becker, 1992:9)

Understanding of cases	Case conceptions	
	Specific	General
As empirical units	1. Cases are found (Harper)	2. Cases are objects (Vaughan)
As theoretical constructs	3. Cases are made (Wieviorka)	4. Cases are conventions (Platt)

Based on the epistemological assumptions outlined above, this dissertation sees a case as a "theoretical construct". Cases are not 'out there', rather they are mainly theoretical constructs by the researcher. Luhmann addresses the question of what is a case in his farewell lecture at the University of Bielefeld (Luhmann 1994). According to him, cases can be seen as boundaries, in Luhmann (1984) words, distinctions drawn by the observer between the system and the environment. Furthermore, this dissertation considers a case study as the distinction between a specific case and its context. However, particularly because this distinction is seen as contingent, the researcher has to give a clear account for this distinction because it has a major impact on the scope of the study.

In the context of a second-order observation analysis, the question of where to draw the boundary becomes rather tricky, given that this dissertation aims to listen to the voices of different observers within the ICT convergence discourse. Another approach might be to limit the discourse to a specific organisation. However, as Hacklin (2007) mentions, "Convergence is by definition a process crossing boundaries and therefore raises the need for multiple units of investigations" (p. 15). Nyström (2008) follows a different approach by selecting the Finish Mobile Telecommunications Industry as her case study to study ICT convergence. However, similar to Hacklin's argument mentioned above, discourses around convergence cross not only organisational boundaries but also those of industry.

Methodologically, this dissertation argues that the use of an entire industry makes only limited sense as a case, particularly in the context of convergence. It is questionable how the boundary of this industry can be defined. Mueller (2008) chooses a different path by introducing mobile TV as his case to study ICT

convergence. He uses a "converging" technology as his distinction between case and context. This approach seems to be favourable.

Mobile VoIP in the UK has been selected as the case for this dissertation for the following reasons. First, mobile VoIP is regarded as a convergent ICT. In the past, the convergence of ICT was primarily depicted by VoIP (Hacklin 2007). Mobile VoIP as natural successor seems to be an appropriate candidate to study convergence discourses in the mobility context.

Second, it a very interesting case for studying convergence discourses around information infrastructures. Mobile VoIP challenges the very nature of mobile telephony networks and therefore can be regarded as a critical case. Therefore, this dissertation focuses on the technology, the mobile VoIP application. This choice would also not only allow capturing the voices from different observers but also to answer Orlikowski's (2001) call for IS researchers to take the IT artefact as seriously as the surrounding factors.

Third, the UK was selected since it became the first market for mobile VoIP with the first mobile VoIP application called Truphone, the first fixed-mobile converged solution by BT called Bluephone, and finally the first collaboration between a mobile operator and a mobile VoIP company, namely between Hutchinson Three UK and Skype.

The objective of a case study is "to understand the deeper structure of a phenomenon, which is believed can then be used to inform other settings" (Orlikowski and Baroudi, 1991: 5). Although this present study focuses on the case of mobile VoIP, there should be room for theoretical generalisation (Mitchell 1983; Seale 1999). The insights gained through studying the convergence discourses around the case of mobile VoIP could be considered in other areas of mobility and perhaps even broadened to other technological convergence discourses in the future. Hacklin (2007) refers to the convergence of nano, bio, information, and communication technologies (NBIC); other areas might be recent convergence discourses around ICT and power networks in the context of smart grids.

Although discourse analysis might be viewed as a research strategy in its own right (Crotty 1998), the typical strategy in IS research is to embed it as a method in a case study design (Hearacleous and Barrett 2001; Pantelli 2003). Finally, another important aspect to consider is if the study is based on a single or multiple cases. Multiple cases offer the advantage of a replication logic (Yin 2003). However, it is argued that mobile VoIP is not only a critical case but also a very rich case for studying convergence discourses since it draws several convergence discourses together.

3.2.2 Unit of Analysis

Another important question relates to the unit of analysis. Because this dissertation is interested in the convergence discourse around the mobile VoIP artefact, its unit of analysis is any spoken (interviews) word or written text that refers explicitly to views, beliefs, and convictions of observers in the convergence discourse. Of course, this demands a sophisticated sampling strategy, which will be addressed in the next section.

One problem associated with the restricted timeframe of the PhD dissertation is the timing of the research itself. This is especially true for conducting qualitative research in which the time dimension is important, and clear time boundaries for the units of analysis must be defined (Yin 2003). The time boundaries of this study are between 2000 and 2009. In 2000, the first mobile VoIP company Software Cellular Networks (SCN, later well-known under the tradename Truphone) was founded. The end date of 2009 was determined by the end of this PhD data collection. However, the main focus of this study was between 2007 and end 2009 since mobile VoIP over 3G emerged in the UK in 2007. For the overall context of the mobile VoIP scene, this dissertation will go back to the early 1970s when the first VoIP prototypes were developed.

3.2.3 Research Question and Propositions

The research design is primarily based on the chosen research question (Benbasat, 1984). The over-arching research question posed by this dissertation has been: how can we conceptualise the notion of ICT convergence using second-order observation

to understand the contradictory discourses around convergence in the case of mobile VoIP in the UK? The research design strategy captures the link between the research question and the way the research is going to address the question (Yin 2009). Therefore, the form of the research question is one condition for the choice of research design. The form of the research question is a "how" question. According to Yin (2009), a case study as research design strategy is particularly appropriate for this type of questions. The following table contrasts the research questions with propositions identified in the literature review in chapter 2 (table 3-3).

Table 3-3 Research Questions and Propositions

Research Questions	Propositions
How can we conceptualise the notion of ICT convergence using second-order observation to understand the contradictory discourses around convergence in the case of mobile VoIP in the UK?	• Divergence is a part of the convergence process, both co-exist and co-evolve (Nyström 2008) • Divergence and convergence are both separate processes, which can run after another or in parallel (Appelgren 2004) • Divergence and convergence are two processes, which constitute each other and are based on digitalisation (Delgado Gomez 2007) • Convergence under pressure leads to fragmentation (Ludes 2008)
What are the characteristics of the ICT convergence discourses around mobile VoIP?	• Convergence is a process (Hacklin, 2007) • Convergence is a vision (Lind 2004) • Convergence is an endpoint (Storsul and Stuehdahl 2007)
What are special forms of convergence communication; what distinctions are made?	• No propositions from the literature
How has the idea of convergence been used in the discourse around mobile VoIP applications?	• No propositions from the literature
Is ICT convergence in the context of mobile telecommunications just another fad or fashion?	• Convergence is a hype (Lind 2004) • Convergence is one of the main drivers for technological change (Katz 1996)
What are the limits of ICT convergence?	• Convergence will change at one point to divergence (Lind 2004)
What is the role of technology in the ICT convergence discourses?	• Technical convergence is a fallacy (Jenkins 2006) • Convergence is a technical process (Messerschmitt 1996)

3.2.4 Quality Criteria

There has been a long-standing debate in the literature concerning appropriate quality criteria for qualitative research (Steinke 2004). There are three different perspectives. The first holds that researchers should use quantitative criteria like reliability or internal/external validity to assess the quality of qualitative research. The second holds that researchers should establish independent criteria, whereas individuals subscribing to the third, a more post-modern position, reject the use of criteria for qualitative research completely (Steinke 2004). This dissertation rejects both the first (e.g. Yin 2003) and the third perspective (Denzin and Lincoln 2005). Instead it follows Gaskell and Bauer (2000) who recommend that researchers should search for criteria that have functional equivalence to quantitative research in order to establish public accountability. They suggested six criteria to establish a functional equivalent

in terms of confidence and relevance (Table 3-4). The following table lists criteria for theses and indicates how they were accounted for in this PhD dissertation.

Table 3-4 Quality Criteria adapted from Gaskell and Bauer (2000: 344)

Quality criteria in quantitative tradition	Public accountability in reference to confidence and relevance	Functional equivalent in qualitative tradition	In this PhD dissertation
Reliability of measures		Triangulation and reflexivity	Systems Theory institutionalises reflexivity
Internal validity	Confidence	Transparency and procedural clarity	Rigorous usage of Atlas.ti for data collection, coding, and analysis; clear accounting for analytical strategy
Sample size		-	
-	Both Confidence and relevance	Corpus Construction	Clear description of sampling decisions, evidence of saturation
-		Thick description	Verbatim reporting of sources
Representative sampling	Relevance	Local surprise	E.g. the convergence/ divergence paradox
External validity		Communicative validation	Validation through confronting interviewees with findings from other sources, some findings from interviewees were re-checked but not full transcripts were sent
Validity of measure		-	-

Yin (2003) suggests that a case study needs to pass four quality tests: construct validity, internal validity, external validity, and reliability. Multiple tactics were applied to strengthen the construct validity of the research design. The framework to analyse the findings, the propositions and finally the measurement how to assess the quality of the findings have been presented above. In addition, multiple sources of evidence have been acquired, mainly interview data from different perspectives on the convergence discourses around mobile VoIP and archival data.

One major advantage of using case studies is the possibility of using multiple types of evidence. Yin (2003) suggests the approach of triangulation of the data to increase the construct validity of the case. At first sight this can be seen as conflicting to this dissertation's epistemological assumptions, since "if you treat social reality as constructed in different ways in different contexts, then you cannot appeal to a single

'phenomenon' which all your data apparently represent" (Silverman 2000:99). On the other hand, not all interpretations are accepted equally since they are outcomes of social processes. Triangulation of different data sources is therefore a crucial aspect to improve the quality of the study and could also be a good source to reveal interesting conflicts.

The question of reliability has been addressed by building up a consistent corpus of data in Atlas.ti. This of course does not capture every choice made but can give some account to the decisions made in the course of this study. In addition, all interviews have been recorded either with a tape-recorder or if the interviewee did not permit this (this happened in two cases), with extensive notes.

3.3 FIELDWORK STRATEGY AND DATA ANALYSIS

A fieldwork strategy encompasses site selection and sampling, an account on how access has been gained, and applied data collection methods. This section will finish with a reflection on data and how it will be analysed. The following table (3-5) provides an overview about the data collection methods applied in this study. The data was collected over a period of 15 months from June 2008 to December 2009.

Table 3-5 Overview This Dissertation's Primary Data Collection Methods

What?	How?
Expert interviews	39 semi-structured expert interviews, all related to mobile VoIP
Document inspection	Business press articles, presentations, annual reports, patents, whitepapers, court proceedings
Direct observations	Practitioner's conferences

3.3.1 Corpus Construction

The unit of analysis requires a sophisticated sampling strategy, which will be presented in this section. There are many ways to construct the sampling strategy, like theoretical sampling (Strauss and Corbin 1990) or corpus construction (Bauer and Aarts 2000). Corpus construction has the advantage in that it offers a vocabulary independent of sampling logic. The goal is to select "incidents" of a phenomenon, not to sample a population (Bauer and Aarts 2000).

This study follows Barthes's (1967) suggestion for corpus design by building up a selection based on relevance, homogeneity, and synchronicity. Each corpus should focus only on one relevant theme; it should contain only the same substance of data and should be chosen from one natural cycle (Bauer and Aarts 2000). Bauer and Aarts (2000) suggest to maximize the variety of the unknown phenomenon while selecting interviewees or documents. As Gaskell (2000) puts it, "the real purpose of qualitative research is not counting opinions or people but rather exploring the range of opinions, the different representations of the issue". It is important to consider the saturation of the process (Bauer and Aarts 2000). The number of interviews is limited, since the number of realities is limited through the outcome of social processes (Gaskell 2000).

First, this field study contains different corpora to account for different data. The data includes media articles, annual reports, white papers, presentations, and reports. This demands a separate treatment in different corpora to fulfil the criteria of homogeneity.

Second, the decision to include interviews in the corpus led to further selection decisions. The decision was made to record and transcribe the interviews when possible after consent was obtained from the interviewee. Because a one-to-one transcription is not needed to answer sociological questions (Flick 2002; Kvale 1996), the transcripts focused on the issues that help to address the research question. That is, they excluded the informal discussions that were not related to convergence.

Third, the mobile VoIP developers use videos on YouTube as a distinct way to communicate their ideas. These videos were not included in the data corpus as primary data. However, they were screened for "convergence communication" and only short sections where "convergence communication" was present were transcribed. These transcriptions were treated as contextual data.

The first step of the sampling process was to select a wide variety of different opinions for the discourse analysis. After an initial brainstorming session, which was primarily driven by thinking about potential stakeholder groups on an organisational level, a list of key targets had been identified for analysis, including potential fall-

back options should access be denied. Furthermore, a decision had to be made not only which organisations to approach, but also which individuals to contact. Individuals from different hierarchical levels or different functions might have a different perspective on ICT convergence. Therefore, during the empirical study the variety had been increased through including more engineers and system developers and also people who work in other areas of mobile VoIP, e.g. one interviewee has been in charge of the advertising campaign of a mobile VoIP player. The interviews were primarily used to confirm existing insights from other perspectives. Theoretical saturation has been reached in August 2009 when additional interviews did not produce further insights or new categories.

3.3.2 Gaining Access

Based on the sampling strategy outlined above, a detailed Web search helped to identify relevant stakeholders. Since a mobile VoIP start-up was the most crucial organisation to which access was needed, contact had to be established to the four market leaders Fring, Nimbuzz, Truphone, and Skype. Of these, Truphone is the most established mobile VoIP company, with headquarters in the U.K.; Fring is located in Israel; and Nimbuzz, in the Netherlands. Access was granted to all four companies.

Four tactics were developed and applied to gain access to the targets (Flick 2002). Three of the interviewees were reached through contacts from the author's previous employer. Furthermore, through visits of academic and commercial conferences, contacts had been established to other organisations. For example, the CEOs of Ofcom and Skype were approached during a conference and were instrumental in gaining access to relevant interviewees in both organisations. Another tactic was through participating in the Mobile VCE/EPSRC flexible networks project (see also mobilevce.com). Finally, a highly effective technique had been to use the contact lists on social network sites like XING and LinkedIn. Several mobile VoIP experts were contacted directly via these networks. In most cases this tactic was quite successful; for example, using LinkedIn, access to the business development director at one mobile VoIP company had been granted, who replied to confirm a telephone interview on the same day.

3.3.3 Primary Data and Secondary Data

Verkasalo (2009: 24) points out that one of the key challenges studying ICT convergence is the empirical data. Yin (2003) suggests using a variety of evidence to support a case study (i.e., documentation, archival records, interviews, direct observations, participant observation, and physical artifacts). The objective in interpretative research is to seek "multiple perspectives" and check for "conflicting interpretations" (Klein and Myers 1999:77). The use of a case study design demands a wide variety of data collection methods. One key distinction in the data collection process is the distinction between primary data and secondary data. Primary data is used for the data analysis, whereas secondary data provides further contextual sensitivity.

Creswell (1998) suggests that interviewees should be selected purposefully to answer best the research question. He also suggests that interviews are useful if the interviewee cannot be observed in the situations on which the study focuses. Furthermore, interviews can provide historical information, which is not available through observations. However, in particular, historical information within interviews is based on perceptions and selective memories. Therefore, documents were also an important method to provide a broad historical background.

To allow for in-depth interpretations on the idea of ICT convergence in the context of mobile VoIP, interviews are a helpful data collection method because participants provide rich interpretations (Walsham 1995). However, there are also several problems with interviews that need to be taken into consideration. Using constructivism in an empirical study poses the risk that the researcher might only see the subject and the subject's interpretation, which would lead to an empiricist epistemology. On the other hand, the researcher has to be careful not to impose his own perceptions on the subjects. Instead, the process of sense making to gain meaning from interviews resulted from an interaction between the interview partner and the researcher. Furthermore, the interview data had to be handled carefully due to the change of perceptions of the interviewees over time.

It was also found to be very helpful to send the interviewees a presentation with the key background material, the "rules of the game", as well as broad discussion topics. Although it needs to be acknowledged that there is a risk of providing too much structure for the discussion, the experience from the 39 interviews showed it worked quite well, particularly because the interviewees were more receptive to browsing through a PowerPoint presentation than they were to reading pages of plain text. This presentation also provided information about data protection and tape-recording. Informed consent (Mason 2002) was gained by sending the presentation beforehand as well as asking the interviewee before the interview if the permission of recording for purposes of this study would be granted. In all except two cases this permission was granted. The researcher also explained in detail before the interview again the purpose of the study and how the data will be used.

Table 3-6 Background of interviewees

Background Interviewees	Number of Interviews
Mobile VoIP Provider	13
Mobile Network Operator	8
Vendors (Handset/ Equipment/ Operating System)	4
Regulator	3
Context (Advertising, Investment Banking, GSMA)	3
Fixed-Line and WiFi Hotspot Players	4
Academia	2
Mobile VoIP Users	1
Total	**39**

Table 3-6 gives an overview of all the interviews. 39 interviews were conducted overall. The objective was not to maximize the number of interviews but to obtain a variety of perspectives (Gaskell 2000).

Overall, 39 interviews were conducted between June 2008 and December 2009. Most of the interviews were one-to-one, and 25 of the 39 interviews face-to-face. However, since interviewees were very busy and some located outside of London during the time of the interview, 13 interviews had to be conducted over the telephone. Such telephone interviews are different from face-to-face interviews but should by no means be judged as being inferior. In fact, even anthropologists consider telephone

interviews to be potentially as productive as those conducted in person (Sunderland 1999); e.g., the absence of visual cues and the "strangers passing in the night" phenomenon encourage people to talk more freely on the telephone.

The interviews usually started with a brief introduction and some background information about the research project. The interviewees were asked if they had further questions for clarification and if they had given their consent for tape-recording. The interviews lasted between 40 minutes and 2 hours, except one telephone interview with the director of a tier-1 investment bank, which lasted only 20 minutes. The interview was structured with the help of a topic guide (Gaskell 2000: 40), theoretical framework, and proposed research question. Since all of the respondents had their information on LinkedIn, the researcher did not ask details on their personal demographics, but focused on the topics at hand.

Table 3-7 Overview Interviewees

ID	Organisation	Designation	Type	Date	h.mm
1	Mobile Operator	Senior Engineer	Face	06/08	0.55
2	Regulator	Head of Convergence	Face	06/08	1.05
3	GSMA	Former Head of Strategy	Phone	06/08	0.55
4	Regulator	Former Chief Technologist	Phone	07/08	0.55
5	Mobile VoIP A	Marketing Director	Phone	08/08	0.50
6	Mobile VoIP B	Head of Communications	Phone	08/08	0.45
7	Mobile VoIP C	Director Business Development	Phone	08/08	1.00
8	Network Vendor	Director Business Development	Phone	08/08	0.40
9	Mobile Operator A	Senior Engineer	Face	08/08	1.30
10	Fixed Operator	Chief Researcher	Face	11/08	1.50
11	Academic	Reader	Face	02/09	1.40
12	Academic	Lecturer	Face	02/09	0.45
14	Fixed Operator	Chief Researcher	Face	02/09	1.50
15	Handset Vendor	Head of VoIP	Phone	02/09	0.55
16	Mobile VoIP D	Head of Business Development	Phone	02/09	0.45
17	Mobile VoIP B	VP Marketing	Face	03/09	2.15
18	Mobile VoIP B	Chief Architect	Phone	03/09	0.40
19	Mobile VoIP B	VoIP Product Developer	Face	03/09	0.45
20	User	Expert User	Face	03/09	0.40
21	Mobile Operator B	Senior Engineer	Face	05/09	1.20
22	Mobile Operator B	R&D	Face	05/09	1.50
23	Regulator	Strategy Principal	Face	06/09	0.55
24	Mobile VoIP A	Head of Business Development	Face	06/09	0.50
25	Mobile Operator B	Senior Engineer	Phone	06/09	0.40
26	Mobile Operator C	Senior Engineer	Face	06/09	1.45
27	Mobile Operator C	Chief Researcher	Face	06/09	1.50
28	Advertising	Project Manager	Face	06/09	0.55
29	OS Vendor	Research Manager	Face	07/09	0.40
30	OS Vendor	VoIP Technology Manager	Face	07/09	1.05
31	Investment Bank	Director Telecoms Research	Phone	07/09	0.20
32	OS Vendor	CEO	Face	08/09	1.00
33	Hotspot Operator	Former Strategy Director	Face	08/09	0.50
34	Mobile VoIP C	Network Solution Engineer	Phone	09/09	0.55
35	Mobile VoIP C	Business Development Director	Phone	09/09	0.45
36	Fixed Operator	Head of Mobile R&D	Face	09/09	0.40
37	Mobile VoIP D	Head of Regulation EMEA	Face	10/09	1.00
38	Mobile VoIP C	Developer	Phone	11/09	0.55
39	Mobile VoIP B	Developer	Phone	12/09	0.40

All quotations used in this dissertation have a number key. The ID indicates the number of the interviewee and further information can be retrieved from the table above (Table 3-7). In a very few cases the quotations had to be edited in order to keep the agreed confidentiality. This is however only limited to company names. These

edits do not change the meaning of the text but allow for ethical conformity. In accordance to the interpretive research approach, the number of quotations for a given topic is of less importance. Meaning is constructed through contrasting empirical data with theory (Yin 2003: 36).

The second primary data collection has been document inspection. The data collection started with a broad corpus of press articles between 2000 and 2009 concerning the mobile Internet and mobile VoIP, using the news database Reuters/Factiva and the Internet as primary data sources. This was supplemented through an extensive background research from press-clippings, white papers and organisational presentations. The website slideshare.net was very helpful for company presentations, in particular to access detailed information from the mobile VoIP companies prior to the interviews. Annual reports were also analysed since they provide a good source of how convergence is embedded in the communication of a corporate strategy to stakeholders (Nyström 2008). Furthermore, to capture the top-management perspective on "convergence" in the context of mobile Internet and mobile VoIP, interviews and speeches by the CEOs of the organisations involved were examined.

The findings from the literature review also suggested looking beyond the traditional expert interviews. Different sources beyond the expert interview like direct observations in organisations, projects, and practitioner's conferences were considered. Direct observations within the organisations were limited to the brief interview visits. However, the author also participated as a researcher in a project organised by the Mobile Virtual Centre of Excellence (Mobile VCE). The project had mobile VoIP as one of its scenarios and was a good source for interview contacts, in particular from the technical side. However, the decision was made against including observational data from the project since the author was an active member of the project and did not want to go the route of participant-observation. Knox (2003) used as one of her primary data collection source practitioner's conferences. Similarly, Mueller (2008) and Karhu (2007) used conference observations successfully. The researcher had the opportunity to go to two practitioner conferences with a major focus on mobile VoIP: First, the Open Mobile Summit, which was held in London in June 2009 and second, the eForum on the Future of the Internet in October 2009.

Extensive notes were taken at both events. Furthermore, direct recordings of the first conference are accessible from the website as well as full transcripts from the second.

Secondary data was not used in the main analysis but provided necessary background and contextual information. Secondary data included direct observations from encounters with the different mobile VoIP applications. The mobile VoIP applications were installed and used on different handsets on different networks to get a better understanding of the artefact. Furthermore, video data from mobile VoIP companies on YouTube was screened. These companies frequently use this medium to present themselves to the general public. Furthermore, user forums were screened for user perceptions on the mobile VoIP artefact.

Stahl (2003) raises a very interesting question for constructivist researchers: "Why do empirical research if it does not tell us what the world is really like?" (p. 2883). Stahl sees the answer in pragmatic considerations - it is publishable. However, this dissertation does not agree with Stahl (2003) that this is the sole reason. An independent world exists, but it is not accessible in that it is impossible to build a "true" representation of reality. Empirical data is needed to develop "survival strategies", however, there are the three limitations of this data: (1) it is always observer-dependent, (2) it depends on particular settings, and (3) it is not stable, especially in a social context.

Firstly, all the data gathered in the process of this PhD through interviews or archival analysis is socially constructed. Meaning emerges through the interactions with interviewees but also through our interaction with objects like presentations. The data provides different perspectives ("inter-views"), different cognitive systems we perceive through an openness of our mind and of which we make sense. This data is never value-free. As the researcher, one will always influence the research process and eventually influence the perception of his interviewees (Walsham 1995). Geertz (1973) formulated it this way: "What we call our data are really our own constructions of other people's constructions of what they and their compatriots are up to" (p. 9).

Secondly, the data gathered through out this PhD research is of course context-specific. Deeper understanding can only be obtained by analysing social constructions like e.g., language or documents and focusing on "the complexity of human sense-making as the situation emerges" (Klein and Myers 1999). The data gathered in the empirical investigation is the foundation to build up "an understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context" (Walsham 1993: 4-5). This information cannot be gathered from available secondary sources like market reports for example. This dissertation aims to understand the discursive ways in which convergence is referred to and enacted in practice. This contextual richness is not covered solely by "situated actions"; we also need to take into consideration the history of the notion as well as the macro-structures influencing it (Kallinikos 2004). Thirdly, the empirical data is not stable.

These insights have major consequences for what claims this dissertation can make based upon the empirical data. Hence, the objective of this study is to develop a more useful description of how the idea of ICT convergence is shaped. To draw upon Nietzsche, "it is description which distinguishes us from earlier stages of knowledge and science" (Nietzsche 2006), not explanation. This dissertation's contribution, therefore, lies in improving the descriptions of existing theoretical discourses on ICT convergence, and it is not about explaining this phenomenon. Hence, empirical data cannot lead us to the "truth", but it may lead us to a more useful description.

Another issue is that of generalisability of the findings. Walsham (1995) identifies four different types of generalisations that can be derived from using empirical data: (1) exploration and further development of concepts, (2) generating theory, (3) drawing specific implications in particular domains of action, and finally (4) developing rich insights. This dissertation aims in particular for generalisability according to types 1 and 2.

A final remark regarding the use of quantitative and qualitative data has to be made. There is no reason to reject – based on this dissertation's philosophical assumptions of a mild-constructivist epistemology – the use of quantitative methods and data. Quantitative data has been used throughout this dissertation. Quantitative data is one

way of making sense of the world, and it clearly does not conflict with a constructivist position.

3.3.4 Data Analysis

This section will briefly discuss the general analysis strategy and potential tools that have been applied in the course of this study. For case studies in general, Yin (2003) suggests three forms of analysis: (1) relying on theoretical propositions, (2) thinking about rival explanations, (3) developing a case description. This study uses theoretical propositions and rival explanations at the starting point as guidance in the initial data analysis. However, the principal strategy for data analysis has been based on the notion of analytical strategy (Andersen 2003). In particular, this study uses specific forms of analytical strategies derived from Luhmann's Theory of Social Systems, which will be presented in the next chapter.

Coding and Preliminary Analysis

The first step in the analysis was to process the large amount of data into a more manageable form. Here, the analysis followed Miles and Huberman (1994). The data analysis was conducted in an iterative rather than linear way by continuously analysing the collected data. A combination of "thematic coding" (Flick 2006: 307) and "cognitive mapping" (Miles and Huberman 1994: 134) was used in the initial analysis stage. Based on this approach, documents from the archival analysis and interviews (transcripts) were analysed. In the first step, based on the document or transcript, a cognitive map had been developed, focusing in particular on key concepts but using the author's or interviewee's own words. Due to the good experiences during the literature review, Atlas.ti was used to support the analysis. All data was imported into Atlas.ti and coded there based on our five archetypes, the dimensions identified in the literature review, and possible guiding distinctions as well as some contextual codes.

Systems Theoretical Analysis

As outlined in section 3.1.4, the decision for a systems-theoretical analysis requires, at a minimum, that the researcher accounts for his or her choice of guiding distinction, for the conditioning of this distinction, and for the observation point

(Andersen 2003: 69-70). All of the analyses conducted in the course of this study are, therefore, guided by these three conditions. Firstly, the researcher has to account for the choice of guiding distinction. Secondly, the researcher has to substantiate the choice for the conditioning of the chosen guiding distinction. Finally, the researcher must point out the implications of the choice of observation point. A detailed account of these analytical strategies will be given in the following chapter.

3.4 COHERENCE, LIMITATIONS, AND SUMMARY OF THE RESEARCH DESIGN

This chapter has described the research design used in the empirical study. Based on a critical discussion of the research design adapted in previous studies on ICT convergence and the research question at hand, a case study approach has been seen as appropriate. The empirical study focuses on the introduction of mobile VoIP in the UK and is based on expert interviews and observational data from practitioner conferences as well as a large data corpus of business press articles, company presentations, annual reports, patents, and court records. The analysis of the data is guided by analytical strategies based on Luhmann's Theory of Social Systems, which will be presented in the following chapter.

The objective of this section is to reflect on the overall coherence of the research model. Although many combinations are possible (Crotty 1998), some approaches are more appropriate for the research question in this study. This section will discuss the coherence of the research model, assessing in particular the links between our research design and the research question and the philosophical assumptions and the theoretical framework.

The research strategy is based on a case study embedded in a discourse analysis. The decision to take discourse analysis encompasses a clear epistemological shift (Gill 2000). It is a shift towards second-order observations. The theoretical background of discourse analysis is in social constructivism (Flick 2002) and therefore in line with the epistemological assumptions of this dissertation. It is also in line with the adopted theory since Luhmann's Theory of Social Systems provides a wide range of analytical discourse strategies (Andersen 2003). Luhmann's (2002) Theory of Distinction and

Systems Theory specifically address this kind of discursive question (as cited in Andersen 2003). The choice of discourse analysis to answer the research questions seems to be appropriate since the questions focus on how the making of social reality can be studied in discourses (Flick 2002). Finally, the choice of research design was primarily driven by the research question. Alternatives used in other studies in the literature were evaluated, but discarded.

The research design presented in this chapter for the fieldwork is equally compatible with the epistemological assumptions. This choice has several implications. First, all of the data gathered through interviews or archival analyses are socially constructed. Second, the data gathered is context-specific. Third, the empirical data is not stable. On the contrary, it is in flux and permanently reshaped.

4. Theoretical Framework

The objective of this chapter is to introduce some of the key concepts based on Niklas Luhmann's Theory of Social Systems with the intention of studying the idea of ICT convergence as a second-order observation. The first section provides a brief overview of different approaches to second-order observation and the rationale of why Systems Theory was selected as an appropriate theoretical framework. The second section discusses some of the key concepts of Systems Theory, which will subsequently be used to construct the required analytical strategies to answer the research questions. These concepts are used in chapter six to analyse the convergence discourses around mobile VoIP.

4.1 THEORIES FOR SECOND-ORDER OBSERVATION

The IS discipline is still relatively young and has therefore imported theories from many different fields. However, there are indications that their underlying epistemological assumptions are seldom questioned (Garcia and Quek 1997). Based on this study's interpretive approach, the main goal of theories is not testing validity, but the understanding (Verstehen) of meaning (Gregor 2006). Gregor (2006) points out that theories in IS may be distinguished from each other in four aspects: epistemological issues of causality, explanation, prediction, and generalization. The aim of this dissertation is not to explain, predict or design, but primarily to provide a theory for analysis. According to Gregor (2006), a theory for analysis provides "a description of the phenomenon, analysis of relationships among those constructs, the degree of generalisability in constructs and relationships and the boundaries within which relationships, and observations hold" (p. 619). This underpins both the theoretical contribution of this dissertation as well as the theory used to guide the data collection and the analysis.

In the context of this dissertation, different theories are seen as different types of "fishing nets", capturing fish of different sizes and shapes (Gregor 2006). However,

each theory has some flexibility in how it is interpreted, depending on underlying epistemological and ontological assumptions.[1]

The roots of second-order observation have already been discussed in the previous chapter. The present chapter deals with the different ways to operationalise this approach. The following section will outline some theories for studying from a second-order perspective. Similar to the fishing net metaphor, they offer different perspectives on the phenomenon, which in this case is the ICT convergence discourse.

4.1.1 Overview Discourse Analytical Strategies

The main focus of this PhD dissertation is how the idea of ICT convergence is constructed in a multi-disciplinary discourse and what constitutes its operational form. The main unit of analysis is therefore the convergence discourse. However, discourses are difficult to grasp. Several theories and methods have been developed to deal with this problem.

Phillips and Harvey (2002) speak of a "linguistic turn", which emerged over the past 30 years in the social sciences. One of the main premises of this "linguistic turn" is that language is not just the mirroring of social reality; rather it is constitutive of it. Parker (1992) sees discourses as a system of statements that construct an object. According to Parker, discourses have the power to bring the social world into being. This "linguistic turn" has been heavily influenced by philosophers like Ludwig Wittgenstein (1967) and further promoted through early work by sociologists like Berger and Luckmann (1967) and anthropologist Geertz (1973). Social sciences have increased their field of interest from just defining and measuring variables and their relationships, to also interpreting the meaning of concepts and their relationships (Phillips and Hardy 2002). One approach of studying these is through discourse analysis.

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[1] G. Walsham put it this way: "Your version of ANT is different from my version of ANT" (24.4.2008, 4th Social Sciences and Information Technology Open Research Forum, SSIT ORF, London School of Economics).

Phillips and Hardy (2002) categorise discourse theories based on two dimensions. The first dimension deals with the importance between text and context. Since discourse analysis has its roots in linguistics, some scholars focus primarily on the text as the sole unit of analysis, neglecting both the micro (e.g. the context of the moment in which the text was written) and the macro context of the text (e.g. broader social developments). The second dimension deals with the importance of power dynamics. Phillips and Hardy (2002) see here the primary difference between critical and constructivist discourse studies. Critical discourse studies focus primarily on the power relations, whereas constructivist studies focus on the 'how'. Based on the dichotomy of text/context and constructivist/critical, Phillips and Hardy (2002) develop four different theoretical perspectives on discourse analysis: Social Linguistic Analysis, Interpretive Structuralism, Critical Linguistic Analysis, and Critical Discourse Analysis (CDA). While Social Linguistic Analysis and Critical Linguistic Analysis focus primarily on the text, Interpretive Structuralism and CDA also deal with the broader context. This is one of the reasons why, in particular, CDA became very successful in organisational studies (Wodak and Meyer 2009).

CDA is primarily connected with the name of Norman Fairclough. Fairclough (1989; Norman 1995) played a major role in establishing discourse analysis in the social sciences. CDA is in particular interested in the power dynamics around discourses. It presumes that discourses produce and maintain asymmetrical power relations. Like many critical perspectives, it also aims to liberate oppressed actors (Alvesson and Willmott 1992). Furthermore, it includes both text and context. One interesting aspect of CDA is that it bridges this micro and macro divide through three layers of analysis: those of the text, the discourse practice, and the social cultural practice. Through this approach it aims to understand how social structures determine discourses and vice versa.

This PhD dissertation acknowledges the importance of power, but argues that it is more appropriate for the purpose of this study to see power as one of many media (Luhmann 1995), and not the dominant one.[2] Furthermore, this dissertation is not

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[2] However, from a second-order perspective, we can observe the importance people place on power.

interested in revealing 'why' the convergence discourse is constructed the way it is, but rather how. Finally, in particular CDA's epistemological assumptions are quite different to the assumptions of this study. Fairclough (2005) himself states about his theory that his

> "position is an ontological realist one: the social world is indeed a socially (and in part discoursally) constructed world, but at any point in time people are confronted with a pre-structured world (...) which cannot be reduced to, and are unconditionally subject to, people's knowledge of it" (p. 1).

If we use Philips and Hardy's (2002) categorization, this PhD dissertation follows the constructivist route of discourse analysis. The Danish professor Niels Å. Andersen uses the notion of analytical strategies (Andersen 1999). By doing so, he intends to emphasize that a second-order observation is not a method deployed in order to get closer to the truth about an object, but an analysis of the social perception of objects - in our case, the idea of convergence. Hence, the focus of analytical strategies is not to see ICT convergence as a phenomenon, but rather to observe the way in which convergence discourses are formed and take shape. Andersen (2008) points out that a second-order perspective is essential if the researcher does not want to run the risk of emphasising one random perspective on convergence, e.g. it might be the case that a characteristic of convergence is the coupling of many different perspectives. An analytical strategy constructs both the observer and the observed. The difference to a first-order approach is that the goal of an analytical strategy is to question presuppositions in contrast to producing true knowledge about a given object (Andersen 2003). The following section will present the rational for choosing Luhmann's Systems Theory as the most suitable analytical strategy for this dissertation.

4.1.2 Rationality for choosing Luhmann's Systems Theory as Analytical Strategy

Andersen (2003) identified at least eight scholars from whom he could distil analytical strategies supporting second-order observation: Althusser, Boudieu, Habermas, Foucault, Koselleck, Laclau, Latour, and Luhmann. However, each of

these approaches puts a different emphasis on particular elements, specifically related to power and contexts. This dissertation does not have the space to discuss all of these approaches in detail, however, a clear account is provided of why Luhmann's approach is considered the most suitable candidate as theoretical framework, in particularly, compared to approaches suggested by Koselleck, Latour, and Foucault.

One of the constructivist approaches referred to by Andersen is Koselleck's history of concepts (Andersen 2003). Reinhart Koselleck developed one of the linguistic-centric approaches towards discourse analysis. His history of concepts has been influential primarily within the historical sciences. He studies the history of a large number of concepts based on the premise that concepts are central to the constitution of society (Koselleck 1982). This focus on concepts is one of the key differences when compared to other discourse theories. He offers a clear distinction between words and concepts. For him, concepts can only be interpreted, whereas the meaning of words can be defined (Koselleck 1972). The evolution from word to concept happens through condensation of meaning. Koselleck sees concepts as something reaching into the future. Another relevant aspect of Koselleck's work for this dissertation is the distinction between concept and counter-concept, which plays a very important role for Koselleck. However, his analysis focuses primarily on the history of a concept. Furthermore, this approach works on a semantic level. Thus, despite some of the interesting features of Koselleck's theory, this dissertation eventually decided not to follow a too restrictive, purely linguistic approach.

Another theoretical approach that may be used as analytical strategy is Bruno Latour's actor-network theory (Latour 1987). Actor-network theory is an established theory in the field of Information Systems (Walsham 1997; Hanseth, Aanestad et al. 2004), and in particularly in the domain of information infrastructures (see e.g. Monteiro 2000; Tilson 2006). According to Hanseth, Aanestad et al. (2004), one of the main contributions of actor-network theory (ANT) in IS is the focus on the relationship between the social and the technical. As analytical strategy, ANT can help to describe how an idea like convergence becomes connected to other ideas, actors, or artefacts, and how they form a network. However, ANT does not provide analytical help to analyse contradictions. Furthermore, methodologically it does not give guidance where to stop with data collection and analysis. It is one of the key

limitations of actor-network theory that it does not set boundaries (Monteiro 2000). Finally, while ANT is useful to describe the interactions between the social and the technology, its focus is not on communication as compared to Koselleck.

The third potential analytical strategy briefly considered at the offset of this dissertation has been Foucault. Foucault is one of the primary proponents of discourse analysis (Andersen 2003). However, the main focus of his studies is the study of power relations (Willcocks 2006). While the idea of ICT convergence may be interesting to study in relation to power, it is not at the centre of this PhD dissertation. The primary focus is instead on the description of the contradictions inherent in the notion of ICT convergence and to provide a clarification and unfolding of the identified contradictions around ICT convergence.

Luhmann's Systems Theory has been applied in many areas, including management and organisational science, and in particular to the study of discourses (Luhmann 1989; Luhmann 1993; Titscher et al. 2000; Muntigli et al. 2000; Andersen 2003; Andersen 2009). Discourses take a central position in Luhmann's theory of society, which assumes that communication is the main operation of social systems (Luhmann 1984). However, Luhmann avoids the term discourse (Luhmann 1989:7) and rather sees systems as a network of recursive communication. The literature review has already pointed out the ambiguity of the notion of ICT convergence, primarily because of the numerous contradictions it is based upon. Therefore, it is argued that an appropriate analytical strategy needs to provide enough flexibility to deal with distinctions, contradictions, and paradoxes. Furthermore, most of the analytical strategies (e.g. Koselleck) are primarily operating on the semantic level, whereas Luhmann's systems analysis works also beyond the semantic level (Andersen 2003: 102).

Another approach is Luhmann's Theory of Social Systems, which has also been selected as a key theoretical framework for this study. Systems Theory bridges the self-referential/practice divide. According to Westrup (2002), discourse analysis can be self-referential or relational to practice. He argues that technology shows the limitations of a purely self-referential perspective of discourses. This study takes a

slightly different perspective on discourses, which is located outside this dichotomy of self-referentiality and relation to practice. Discourses are seen as social systems of communication. These systems are operationally closed but structurally open. Therefore, they are both self-referential and relational to other systems (Luhmann 1984). Finally, systems theory offers an answer to the macro/micro divide, which is particularly seen as an issue in discourse analysis (Wodak and Meyer 2009). Discourse analysis works primarily with micro elements of society like text and talk. However, these texts are embedded in a larger context.

The macro/micro distinction is based on levels and therefore is based on logic. It is an analytical distinction (Wodak and Meyer 2009). The concept of levels, as Luhmann (1987) argues, disregards the interdependencies in the context of the micro/macro distinction. In the context of ICT convergence, we could argue that something is divergent on one level and convergent on a higher level. This would circumvent the confrontation of the paradox convergence is divergence. Luhmann (1987) argues to use instead systems theory, which considers self-reference and paradoxes as empirical phenomena and does not exclude them. Summarised, Luhmann's Theory of Social Systems has been chosen as the most appropriate analytical strategy for the following reasons:

- It assumes that communication is the main operation in society (Luhmann 1984)
- It offers a set of analytical strategies to deal particularly with contradictions and paradoxes (Andersen 2003)
- It has been successfully applied in the past in the field of Information Systems (see e.g. Kallinikos 2002, 2004; Demetis 2010; Marton 2010)
- The approach was also successfully applied in two conference papers (Herzhoff 2009; Herzhoff 2010)

The operationalisation of Luhmann's "grand theory" (Lee 2000) has been conducted through Andersen's concept of analytical strategies. The following section will reflect on the compatibility of this theoretical framework with the epistemological assumptions from chapter three.

4.1.3 Compatibility of Theory with Epistemological Assumptions

Luhmann does not respect the philosophical game, and his epistemological stance is, therefore, difficult to grasp (Thyssen 2004). He sets himself clearly apart from any form of realism on the one side, and from idealism and post-modernism on the other (Christis 2001). While he states that a reality exists, and, moreover, "systems exist", he sees knowledge as completely dependent upon the observer (Luhmann 2002). Luhmann (2002) himself says that he takes a radical constructivist stance. This view should not be conflated with the radical constructivist view suggested by von Glasersfeld and von Foerster. Furthermore, as pointed out by Elena Esposito, Luhmann's Systems Theory deals with "many issues that are absolutely empirical and real" (Esposito 1996).

In his farewell lecture from the University of Bielefeld, Luhmann (1994) addresses the three research approaches of positivism, critical sociology, and interpretivism. According to Luhmann (1994), the controversy between these three approaches is reflected in the tension between the two questions: what is the Case? and what is behind it? Based on the approach of second-order observation, he argues that the case is what is observed including the observation of the observer, and what is behind the facts is what the observation fails to observe. This approach, which is closely related to constructivism, is the one applied in this dissertation.

While a mild constructivist epistemology is compatible with Luhmann's theories, this dissertation questions the compatibility of critical realism. Although Jac Christis (2001) makes a very profound argument to link Luhmann's theory ontologically and epistemologically with Bhaskar's critical realism, there are still key differences in terms of the interpretation of causality, the implied objective of science, and particularly the correspondence of truth. Some of these key differences have also been pointed out by Elder-Vass (2007).

4.2 LUHMANN'S SYSTEMS THEORY

This section introduces Luhmann's Theory of Social Systems as the underlying theoretical framework of this dissertation. First, it situates Luhmann within the broad field of systems theories. Second, it gives an overview of his Theory of Social Systems before it introduces some of its core concepts. Finally, an account is given of its consistency with the epistemological assumptions outlined above.

4.2.1 Situating Luhmann in the Larger Context of System Theories

There is not *one* Systems Theory. Instead, Systems Theory can be regarded as a tree with a few common roots and a large variety of different branches (Bausch 2002). One of the primary roots of systems thinking has been in the idea that a whole is greater than the sum of its parts (Bausch 2001). This idea can be traced back to the ancient Greeks and has been applied in many contexts (e.g. circulatory system by Harvey 1628 or Hobbes *Leviathan* 1651).

This dissertation operates in the nexus of a very specific form of System Theory, namely the Theory of Social Systems by Niklas Luhmann. Luhmann's Theory of Social Systems is one of the grand theories in the social sciences (Lee 2000). When this dissertation uses the term systems theory, it means the Luhmann's version, granting that it is only one of many systems-theoretical approaches.

Luhmann's theory has very distinctive characteristics compared to other approaches of systems thinking like theories of closed or open systems. He starts from the common ground of General Systems Theory that all systems define their boundaries and maintain them through internal operations. However, one of the key differences between Luhmann's Social Systems and the General Systems Theory (GST) is that he questions the openness of the systems (Luhmann 1992): "how does a system operate so that it may be called an open system?" (p. 1421). He sees it in the properties of operational closure and structural coupling. Although systems operate internally, they are open to the outside. But the stimuli coming from the outside does not determine the internal operations. The interactions between the systems might be analysed in terms of structural coupling and the internal operations as self-referential processes.

A second difference to other approaches of systems thinking is Luhmann's definition of social systems. What distinguishes social systems from other systems, according to Luhmann (1984), is that social systems communicate. Social systems do not consist of human beings but communication. Luhmann relegates the individual to the sideline and replaces the individual with a psychic system, a biological system, and a social system. This assumption has raised a lot of criticism. Another difference to GST is that Luhmann borrows the concept of autopoiesis from the realm of natural sciences from Maturana and Varela (1980) and adopts it to the social sciences.

Finally, bringing Systems Theory and Theory of Distinction together, systems are themselves observers. They make distinctions, primarily between themselves and the environment. First-order observation takes an external reference, observing the environment. However, a system can also observe to some extent itself as an observer. In this case, the system copies its guiding distinction and re-enters it into itself (Luhmann, 1984). It is therefore self-referential. However, the system will not be able to observe its blind spots. This is only possible through second-order observation. Summarised, a systems-theoretical perspective is based on three constituting distinctions: distinction and indication, first- and second-order observation, and system/environment.

4.2.2 Distinctions and Forms

Although there are many different ways to access Luhmann, this dissertation has chosen the Spencer-Brownian route via the Theory of Distinction (Luhmann 2002; Andersen 2003: 64). Luhmann's Theory of Distinction is inspired by mathematician G. Spencer-Brown (1969), physicist H. von Foerster (Von Foerster 1981), and philosopher G. Guenther (Guenther 1976). Luhmann himself suggested in his magnum opus "Die Gesellschaft der Gesellschaft" that the Theory of Social Systems is in fact only a special form of a Theory of Distinction, based on the distinction system/environment. Drawing on George Spencer Brown's Law of Form (1969), observations consists of two components, distinction and indication. Whenever an observer observes something, he makes a distinction between the inner side and the outer side by choosing or "marking" the inner side as our unit of analysis. There is always something left "unsaid", the residual category (Demetis and Angell 2007).

Whenever we observe a 'scene', we make a distinction; the scene is indicated by one side of the distinction, but the remainder is left unobserved (Luhmann 2002) – the "residual category". Added to this is the fallacy that the scene and the residual category make up the whole (Demetis and Angell 2007): structural couplings between the two parts are lost in the observation and disappear into paradoxes. Furthermore, more observations will introduce yet new distinctions, new scenes, and new residual categories. Luhmann warns of the paradoxes in what he calls "blindspots" (Luhmann 2002):

> "To put it shortly: we are dealing with a permanent production of blind spots. In order to see that which a first-order observer does not see, a second-order observer is needed who may observe how the first-order observer constructs his reality, but who, by doing so, produces blind spots just the same way – and so forth".

This brings us to observations of different orders. First-order observation indicates something within a distinction, e.g. fixed-mobile convergence. It is directed to the environment of a system and therefore uses external reference. Second-order observation looks at the first-order observation and what it cannot observe, namely its blind spot. It asks about the distinction fixed and mobile and if these two can in fact converge. It is therefore self-referential. However, from a higher-order observation, second-order observation may always be observed as a first-order observation. What changes between first- and second-order observations is besides the visibility of blind spots the insight that the world is not mono- but poly-contextual, it is not only the object of study but also the observer that needs to be included in the analysis.

Distinctions impose order on the "unorder" of the "things" in the world. However, as Demetis and Angell (2007) point out, the things themselves

> "will remain 'structurally coupled' to the 'rest of the world' but those couplings are cut by the linear distinctions implied in observation, thereby becoming lost in a non-referential system" (p. 412).

According to Luhmann (1993:15-16), there are three ways to make distinctions. First, a distinction can be made without specifying the other side of the distinction (e.g., convergence/no convergence). Second, a distinction can be made restricting the other side of the distinction (e.g., convergence/divergence). Luhmann refers to the first category as objects and to the second category as concepts. Finally, there is a special

kind of concept in which a distinction is made by copying it to the inside or outside of the concept itself. Luhmann refers to these concepts, which can re-enter themselves, as second-order concepts (he gives an example of government and opposition, where government can itself have a deciding fraction and an opposition).

Distinctions consists themselves of two parts, indication and the distinction. What we can observe here is a re-entry of the concept of distinction in itself. This emerging paradox can be unfolded if we make the distinction between an internal and external observer. Does the observer observe himself and his own distinctions (internal observer) or does he observe other observers' distinctions (external observer)? Another element introduced by the observer is causality. Causality is selective, some causes are seen as important, some effects are interesting. In his lectures on systems theory, Luhmann (1991) argues that to understand causalities, the observer needs to be observed.

Paradoxes are unities of distinctions. Many paradoxes are invisible and only become visible when the observer asks about the unity of the distinction (Luhmann 2002). However, paradoxes lack connectivity (Luhmann 2000). They need to be *unfolded*, i.e. to refer to a different perspective or layer (Luhmann 2004). Unfolding is the process of making an existing paradox invisible through a new distinction (Luhmann 1995:74, FN102). The process of unfolding is, according to Luhmann, the only way to deal with paradoxes. No observing operations, even logic, can avoid paradoxes or indeed "solve" them. Paradoxes have to be unfolded.

It is important to note that this process does not ontologically change or dissolve the paradox. The paradox is there and cannot be changed. The new distinction just makes the paradox invisible again. So what do we gain by unfolding the paradox? New distinctions can help to "untangle concepts and refine thoughts" (Lee 1997:18) and provide a "fruitful" ground for further analysis and therefore connectivity (Luhmann 2004). Paradoxes are unfolded by the introduction of a new distinction. However, sometimes the unfolding of distinctions can have diminishing returns and it may be more productive to go back to questions related to the underlying unity of the paradox (Lee 1997).

Luhmann (1991) gave in his lecture series on systems theory a very instructive example of an event that occurred to him in a small hotel in Brisbane. He picked up the phone and found a small note on the handset: "If defective, call this number...". He asks his students how they would deal with this paradox and suggested to introduce first a distinction between defective and non-defective phones, write down the number, and find a non-defective phone and call up the help line.

4.2.3 Meaning

One important concept for second-order observation is meaning. As Koselleck (1972) points out, the evolution from word to concept happens through condensation of meaning. Luhmann draws upon Husserl's phenomenology and defines meaning as the "simultaneous presentation (in Husserl's terms, intention) of actuality and possibility" (Luhmann 2002: 83). Meaning, defined this way, has no outside form. Both sides of the distinction are meaningful. Meaning is not a given but is also linked to an observer (Luhmann 1997).

Concepts have actualised a variety of different meanings from the horizon of possibilities. According to Luhmann (1984), concepts are introduced on this basis to organise distinctions. He suggests three underlying dimensions of meaning: The factual, temporal, and the social dimension. Luhmann also uses these three dimensions to structure his overall theory architecture (Luhmann 1997): the factual or functional dimension is represented through differentiation, the temporal dimension through evolution, and the social through communication. Furthermore, these three dimensions of meaning play an important role in unfolding paradoxes through guiding the new distinction, which makes the paradox invisible again.

4.2.4 Systems and Environment

Systems have an environment. However, this environment is relative to the system. Each system has therefore a different environment depending on the boundaries drawn by each system. Although the environment is relative to the system, a distinction needs to be made between the environment and other systems within the environment (Luhmann 1984). Other systems in the environment have their own environment, which includes the previous mentioned system.

A system can be decomposed in two ways. Firstly, a system can be decomposed in *internal system/environment relations*. The system becomes environment for each of its subsystems. However, each time it will be a different environment with a changing perspective. This decomposition is primarily based on differentiation and not on hierarchy. Hierarchy is a special case of differentiation and is not very common, since it is based on the assumption that further subsystems are bounded by the initial system (Luhmann 1984:39).

Secondly, a system can be decomposed based on the distinction of *element and relation*. Elements can be regarded as the fundamental building blocks of a house, whereas subsystems are the individual rooms. Elements and relations form a unity and depend on each other. Elements are the smallest building blocks of a system. A system cannot dissolve its elements but it can constitute and change itself through a change of relations. However, systems can themselves decide the number of elements. Systems are not only relations of elements. Besides the relations there are also conditions or constraints. Not all elements are directly linked to each other. This produces contingency.

4.2.5 Differentiation and Codes

The previous section has already introduced the concept of *system differentiation*. Luhmann (1997) differentiates between four different forms of system differentiation: segmental, central/peripheral, stratified, and functional differentiation. These forms of system differentiation describe how sub-systems within a system are related to each other. Specifically, system differentiation is the form through which sub-systems can observe themselves as sub-systems. Luhmann's argument is that society moved over time from segmental and central/peripheral, over stratified to functional differentiation. Segmental differentiation is based on homogeneity, e.g. similar origins or tribal memberships. Central/peripheral differentiation is based on inequality, primarily linked to location and limited to two sub-systems, e.g. if a certain prominent group or family within a tribe lives separately from others. Increasing wealth as well as power of this group may lead to the emergence of further inequality leading to a hierarchical differentiation based on ranks, consisting of at

least three layers to suggest stability (Luhmann 1997). Luhmann calls this form of system differentiation stratified differentiation and gives the examples of medieval Europe and the Indian caste system. The fourth type of system differentiation is the main focus in Luhmann's studies, namely functional differentiation. He sees functional differentiation as the most important characteristic of modern society. It differentiates subsystems both based on equality and inequality.

Functional differentiation is not hierarchical; it does not suggest the supremacy of one subsystem over another. Functional systems are therefore equal in relation to each other. The inequality emerges from the perspective of each subsystem. Within each functional subsystem, the other systems are regarded as less important. Furthermore, there is no "super-system" governing all other functional systems (Moeller 2006).

Table 4-1: Examples of Functional Systems after Luhmann (1997)

	Legal System	Economic System	Mass Media	Political System
Code	Legal / illegal	Pay / not pay	Information / non-information	Govern/ governed

Luhmann has identified many functional systems (Table 4-1 for a small selection). Functional systems differentiate between each other based on a *code*. The legal system is based on the code legal/illegal, the economic system on pay/not pay, the mass media on information/non-information, the political system on govern/governed. The binary character of the code results in a division of the world. Besides its code, each functional system has developed a symbolic generalised media that makes the continuation of communication more likely. The generalised media for the economic system is money. Money can therefore ensure the continuation of economic communication.

As discussed in the introduction (chapter 1), convergence discourses can be observed in all functional systems of society. It is important for a second-order observation to understand the code of each subsystem. For example, the decline in the number of

articles on ICT convergence after the burst of the dot.com bubble does not mean that convergence discourses have become less important. Instead, if we observe the discourse based on the code of information/non-information, the reason might just be that it was not regarded anymore as something new, as something which makes a difference (Bateson 2000).

4.2.6 Technology

Luhmann describes technology as functional simplification and closure within the medium of causality (Luhmann 1993). Causality is the medium, technology is its form.

The inner side of this form, which is indicated by an observer as technology, is based on fixed causal couplings reducing complexity. These causal couplings have to be protected from interferences from outside, the other side of the form. According to Kallinikos (2006), this closure means the "construction of a kind of protective cocoon that is placed around the selected causal sequences or processes to safeguard undesired interference and ensure their repeatable and reliable operation" (p. 33). Technology can therefore be regarded as the difference between these two sides of the form (Marton 2010).

Luhmann primarily discusses technology in its wider context. Only a few of his last monographs like "Die Gesellschaft der Gesellschaft" (1997) and "Organisation und Entscheidung" (2006) deal explicitly with information technology based on computers. Luhmann did not see technology as a social system in its own right. Instead, he regarded technical systems as allopoietic systems, systems that are controlled from outside and stop working if there are no further impulses (Luhmann 2006).

Recent work in the field of information systems (Kallinikos 2002, 2004; Demetis 2008; Marton 2010) suggests that information technology is in the process of becoming a social system in its own right. Therefore, it challenges the distinction between social and technology (Marton 2010). However, this dissertation is not interested in the question if technology itself can be considered a social system. For

this dissertation, the focus is rather on how the idea of convergence has become so prominent in the context of technology. What are the characteristics of technology that make technological convergence discourses likely?

4.3 ANALYTICAL STRATEGIES WITHIN SYSTEMS THEORY

Over the past 15 years Andersen has been highly productive in developing analytical strategies from different theorists, including Luhmann. So far he has distilled six analytical strategies in Luhmann's Systems Theory: *Form Analysis, Semantic Analysis, Media Analysis, Systems Analysis, Coupling Analysis,* and *Formation Analysis.* Luhmann's two monographs on Risk (Luhmann 1993) and Ecological Communication (Luhmann 2008) illustrate some of these techniques well.

While Andersen had already elaborated the first four analytical strategies in his 2003 work, the last two only appeared in a later work on partnerships (Andersen 2008). All of these analytical strategies are based upon different guiding distinctions and upon addressing different questions. They cover all research questions outlined above, except for the question of why convergence is so important in the context of technology. To answer this question, an additional analytical strategy is suggested, based on the distinction causality/technology. In the following section we will briefly describe these strategies.

4.3.1 Semantic Analysis

An analysis based on systems theory usually begins with semantic analysis, in particular looking at the history of the concept in question. The guiding distinction of a semantic analysis is the distinction between condensation/meaning. Meaning, as defined above, is based on the distinction actuality/potentiality. Through condensation, a variety of meanings can be condensed into a specific form, such as an image, symbol, or idea (Andersen 2003). The focus of this present analysis is the condensation of meaning into concepts.

Along the lines of this argumentation, Andersen (2009) defines a concept as the condensation and generalisation of a multiplicity of meaning and expectations. Hence, concepts have four characteristics. First, they are always ambiguous. Second,

they provide a specific expectation structure for the continuation of a communication. Third, concepts are not identical with a specific actualisation in a specific situation. The specific situation or context actualises a specific meaning and a specific expectation structure. Finally, as pointed out above, concepts are forms that contain a concept and a counter-concept. Thus, as Andersen (2008) explains, a concept can only hold together if the key characteristics are similar in their difference from a counter concept. In particular a semantic analysis has to pay attention to conceptual shifts related to the relationship between concept and counter-concept (Andersen 2009).

A semantic analysis looks at all three meaning dimensions: the factual, the social, and the time to understand the condensation of meaning. The factual dimension is the most obvious, e.g. the distinction between technology and market convergence. The social dimension takes into consideration different observers using the concept and actualising it differently. Finally, the temporal dimension is based on the distinction between past and future. A semantic analysis usually tracks these three dimensions over time. All three dimensions of meaning can be analysed separately, but are ultimately intertwined. Based on these three dimensions, semantic analysis creates an "horizon of inquiry" (Andersen 2009).

Semantic analysis is always historical (Andersen 2008b). Therefore, since the semantic analysis traces a concept over time, the data is based on documents and not on the interviews, since interview data has to be handled very carefully in relation to time. Convergence as a concept comprises a variety of meanings. The question this analytical strategy attempts to answer is therefore how is convergence as a concept constructed. The purpose of this analysis in the overall context of this PhD dissertation is to provide the "horizon of inquiry". Therefore, semantic analysis is also highly relevant beyond the traditional field of linguistics.

Convergence as a contemporary form provides an additional challenge for semantic analysis. In his work Luhmann focused primarily on semantics like love, politics, and religion, which span the centuries. As Andersen (2009) points out, Luhmann therefore has a very rigid distinction between a concept and no concept.

4.3.2 Form Analysis

Drawing on George Spencer Brown's Law of Form (1969), the basis of form analysis is observation, which consists of two components: distinction and indication. Form analysis provides the foundation of the data analysis, and focuses on the following question: which distinction allows the observer to see the environment in terms of convergence? Form analysis is not an end in itself, rather it leads to the question of how social systems cope with the contradictions and paradoxes inherent in the notion of convergence (Andersen 2003: 101).

4.3.3 Systems Analysis

Systems Analysis is based on the guiding distinction system/environment. Andersen (2003) sees commonalities with Koselleck's history of concepts and his distinction concept/counter-concept. However, he argues that Luhmann's distinction has the advantage that it goes beyond the semantics since it works on an operative level. The distinction between system and environment is based on meaning-constituted boundaries (Luhmann 1995). Since every communicative event is linked to the system/environment distinction, it reproduces these boundaries. Since the boundaries are constituted through meaning, the criteria for inclusion and exclusion (Bausch 2001) are based on the three dimensions of meaning: factual, temporal, or social. Systems analysis, in addition to the coupling analysis presented next, will be helpful in understanding the systemic characteristics and dynamics of the ICT convergence discourse. In particular, this analysis aims to unfold the convergence paradox.

4.3.4 Differentiation Analysis

Differentiation Analysis is based on the distinction similarity/difference. This analysis has two objectives. The first is to understand the meaning convergence has for different observers, the second is to understand how convergence is used in a large variety of different contexts. Specifically, differentiation analysis will be used to observe the functional differentiation between different types of convergence in order to build a taxonomy of archetypes of convergence.

4.3.5 Coupling Analysis

Coupling analysis uses the guiding difference of coupling/differentiation (Andersen, 2008). It aims to understand the mechanisms through which systems are linked at the same time as their differentiation is maintained. Systems are closed, however, they can be irritated by other systems in their environment. Couplings between systems are therefore always based on the relations between closed systems. Therefore, structural coupling does not deny operational closure of systems (Moeller 2006). Instead, the coupling is internalised by the system. In the context of convergence, this analysis aims to shed further light at the convergence paradox.

4.3.6 Technology Analysis

Technology analysis is a new construction of analytical strategy. It aims to understand why convergence discourses are so dominant in the context of technology. In the first step, a guiding distinction needs to be adapted to observe technology. Technology can be observed through the form *functional simplification and closure* (Luhmann 1997; Kallinikos 2006). From this perspective, technology reduces the complexity of a part of the world to a few variables and links them through tight causal couplings (Luhmann 1997: 241, Luhmann 2006: 364). These tight couplings ensure that the technology works, or better, that it "functions". However, technology produces a complexity gradient (*Komplexitaetsgefaelle*) between the inner and the outer form. While the inside is designed and controllable, the outside of the form is sheer complexity.

4.3.7 Fashion Analysis

Observing fashion from a systems-theoretical perspective has some compelling characteristics compared to other previous approaches studying management fashions. Firstly, a study on fashion from a systems-theoretical perspective implies shifting the analysis away from the phenomenon and towards the observer. It does not directly deal with the phenomenon but rather how the phenomenon is dealt with. Furthermore, fashion is in itself reflexive since it is based on observations of other observations. A study on fashion, therefore, leads to at least a second-order observation (Esposito 2004).

Furthermore, the systems-theoretical perspective questions some of the underlying assumptions of previous approaches towards management fashions. One of the assumptions of Abrahamson's (1996) management fashion theory is that fashions are driven by manager's need to justify their decisions based on rationality and progress and hence, need concepts that are widely accepted by the community. However, Esposito (2004) argues instead that when it becomes visible that a decision is dominated by fashion, that the decision will most likely be rejected. The code of the relevant functional system, in this case the economic system, provides the rationality for the decision and for the communication to continue, not the fashion.

According to Luhmann's Systems Theory, fashion works subtler. It does not increase the likelihood that a communication, or in this particular case, a decision is accepted (Luhmann 1997). However, in itself, fashion does play an important function in society. In fact, fashion has become diffused in all functional systems of society. Esposito (2004) proposes that fashion functions as a pre-code for other functional systems such as the economic or academic systems. The codes of the economic system (*profit/loss*) or academic system (*truth/no truth*) still decide what is economic or academic; however, fashion initiates the selection process. Fashion, therefore, according to Esposito (2004), is the operationalisation of contingency; that is, the starting point of a selection. Therefore, fashion is a social mechanism that provides the motivation for the system to operate. Furthermore, fashion is not short living; its unstoppable quest for something new produces continuity.

Finally, a systems-theoretical perspective has implications for the methodology and data analysis. The observation of mass media discourses has both advantages and disadvantages when studying fashion. Esposito (2004) argues that fashion, similar to the mass media system, has a contingent relationship to the factual dimension. Mass media constructs reality based on temporal and social dimensions. A topic needs to be interesting in order to make a difference and be observed by mass media. Therefore, the disappearance of a topic in the press does not mean that it disappeared in practice. Hence, this dissertation argues that an additional analysis needs to go beyond the mass media system.

The following table (Table 4-2) summarises the findings from this section and gives an overview of the strategies and the questions guiding them when related to convergence.

Table 4-2: Overview Analytical Strategies

Analytical Strategy	Aim
Semantic Analysis	To understand the meaning that becomes condensed in convergence establishing a semantic reservoir along the factual, social, and time dimension
Form Analysis	To determine the form of ICT convergence communication, the guiding distinction and which paradoxes this form establishes
Differentiation Analysis	How is ICT convergence differentiated?
Systems Analysis	To understand the systemic characteristics of the idea and the discourse along the guiding distinction of system and environment
Coupling Analysis	To understand the mechanisms through which systems are linked at the same time as their differentiation is maintained
Technological Analysis	To understand the connectivity of technology and convergence
Fashion Analysis	To understand if convergence is just a fashion

4.4 THEORETICAL IMPLICATIONS, CONTRIBUTIONS, AND LIMITATIONS

The decision to use analytical strategies has implications on the chosen research question. Andersen (2003) sees a shift from 'what' and 'why', to 'how' questions. Luhmann (2006:56) puts it this way in his example dead fish in the River Rhine:

> "Along this path, one also gains access to specific questions. One finds out whether only the popular press speaks about them; whether they are only a topic of instruction in schools or of discussion in youth groups; how the economy reacts to them; in other words, which of the three enumerated systems communicates about these topics and what the consequences of such communication are. These are the sociologically interesting facts about the topic at hand—not the fact that the fish are dying."

The chosen philosophical stand and the theory therefore have substantial influence on this study. The following paragraphs will discuss some of the further implications for research design, data collection, and analysis.

4.4.1 Implications for Research Design

Luhmann's Theory has several implications for research design. First, related to the adopted research approach of analytical strategies, Luhmann (1997) clearly differentiates his approach from both positivism and critical approach, and is consistent with the constructivist/interpretive approach outlined in this dissertation.

Theory can be understood as process or perspective (Eisenhardt 1989). While theory as perspective provides a lens through which we can view the data, theory as process uses the data to build up the theory after the data has been analysed. This PhD dissertation takes a deductive/inductive approach. The literature review in chapter two shows that knowledge on convergence from a second-order observation is scarce. Therefore, this study has been introduced through a Grounded Theory approach in order to learn how convergence has been conceptualised from an IS perspective. Within the PhD dissertation in its entirety, empirical work will have a place after the theory building. The propositions gathered from the Grounded Theory approach has guided the literature review and will also loosely guide the empirical research but not constrain it to verification. This dissertation views theorising as a cognitive process, i.e. continuously interacting between theory and method. This is also very much aligned to the rejection of positivism, and the inclination toward an interpretive approach.

The overall research design of this dissertation is a case study. Case studies using Luhmann's Theory of Social Systems are still quite rare: in the management literature see Rennison's (2007) work on pay systems, Andersen's (2008) work on partnerships, and in the information systems literature Demetis' (2010) work on Anti-Money Laundering. Hence, a case study using systems theory provides interesting methodological challenges, which will be addressed in the next section.

For this research project, Systems Theory has primarily been seen as a lens for data analysis, but it also has some implications for the data collection, in particular the Theory of Distinction. The question about how much influence theory should have on the research design has been fiercely debated in the literature (Carrol and Swatsman 2000). Carrol and Swatsman identified two extreme positions: effectiveness (little pre-defined structure), and efficiency (focus the research through pre-defined

structure). The choice between the more appropriate of these two positions depends on the problem at hand, the theories available, and on the epistemological assumptions. Since the literature lacks theory-driven second-order studies on convergence, a more theory-centred approach has been chosen. On the other hand, this studiy has stayed open to concepts arising from the data itself (see e.g. Grounded Theory approach in chapter two) and follows Marshall & Rossman (1995) who suggest aiming for a balance between the two extremes.

4.4.2 Implications for Data Collection and Analysis

According to Luhmann, every researcher has to decide how he or she will observe the object of study (Luhmann, 2002). Any choice of distinction is contingent, and hence open for criticism. Luhmann (2002) suggests looking instead at how the object itself draws the distinction between itself and its environment. Thus, this dissertation is particularly interested in how both the interviewees and the authors of the texts collected make their own distinctions on convergence. By taking the role of a second-order observer, the researcher is forced to have continuous reflexivity. Esposito (1996) provocatively states, "the extension of reality grows considerably larger to now include observations themselves" (p. 279).

One of the primary data sources of this dissertation are interviews with telecommunications experts. In the light of the theoretical framework this provides a considerable difficulty, which needs to be discussed. According to la Cour et al. (2003), interview data from a system theoretical perspective can be seen as an *independent system of interaction*. The interview is positioned between the scientific observation and its object. Hence, interviews cannot be seen as *representation* of the convergence discourse between mobile telecommunications experts, but instead have to be seen as a construction (Rennison 2007). Furthermore, during the analysis of interview data from a system theoretical perspective one has to be aware of the fact that the second-order observer observes a system of interaction that observes observations. Hence, interviews from this perspective do not provide disclosure on the phenomenon itself (la Cour et al. 2003).

However, this study regards the interviewee as an observer in his/her own right, and hence, the interview can reveal how the interviewee observes the convergence discourse. This is not only limited to first-order observation, but also provides, through self-reflection of the interviewee, access to second-order observations. Furthermore, an interview has the advantage that it is based on verbal as opposed to written communication (la Cour et al. 2003). Rennison (2007) points out a challenge with conducting interviews using Luhmann's Theory of Social Systems. She argues that an interview is normally geared towards studying the personal thoughts and interpretations of the interviewee regarding a certain phenomena, and hence it is focused on the psychological system, and not on the communication system. She argues that interview questions should not be about opinions and attitudes, and instead should focus on communication. Hence, in a systems-theoretical analysis communication needs to become the subject of the interview, not opinions and attitudes (la Cour et al. 2003).

Another challenge for the data comes from the analytical strategies. Semantic analysis sets high requirements for the data collection. First, investigation of the social dimension requires a large variety of different points of observation. This has been achieved during the data collection process. Several different observers were interviewed who have different points of observations on the topic at hand. Second, investigation of the temporal dimension requires a relatively stable data corpus. While interview data can be helpful in providing further insights that help analyse the social dimension, it is not suitable for studying how the meaning of a concept has changed over time. Therefore, semantic analysis focuses in particular on the data corpus collected through the business press.

The decision for a systems-theoretical analysis requires, as a minimum, that the researcher account for his or her choice of guiding distinction, for the conditioning of this distinction, and for the observation point (Andersen 2003:69-70). All of the analyses are, therefore, guided by these three conditions, which will be addressed in chapter six.

4.4.3 Limitations of Luhmann's Theory

As with all grand theories (Lee 2002), there have been difficulties in applying Luhmann in empirical contexts (Anders la Cour et al. 2007). Although Luhmann's Systems Theory is used quite frequently in German speaking countries, there are calls on the one hand for more empirical studies on the international stage (la Cour, Vallentin et al. 2007). On the other hand some empirical studies in Organisational Science show promising application of Luhmann's theories (see Anders la Cour et al. 2007 for examples). While General Systems Theory and Parsonian functionalism has been applied quite frequently in IS Research (Markus 2004), the Luhmann variant has only found its application recently (see e.g., Kallinikos 2006; Demetis and Angell 2007). Many authors reject the idea of following Luhmann's theories too strictly, but suggest seeing these theories more as a consistent toolbox for analysis (Anders la Cour et al. 2007). Another limitation is their accessibility for scholars who are not used to the Luhmann language style. Many concepts are very abstract, and require much time and effort to appreciate the full horizon of meaning.

One of the biggest limitations perceived by this author, in particular related to the present dissertation, is their consideration of power. Here we have to differentiate between Luhmann's earlier work, completed before "Social Systems", and his later work. Before Luhmann fully adopted the systems-theory perspective, he wrote a book on power (Luhmann 1979) in which agency was still the focus of his analysis, and not the system (Clegg et al. 2006). Power was for Luhmann, a communication, intrinsically connected to the ability to impose sanctions (Clegg et al. 2006). He sees it as a generalised symbolic media of communication, similar to money and trust. According to Luhmann, generalised symbolic media of communication are semantic devices bridging differences and increasing the likelihood of the success of acts of communication. Due to this reduction of a difference, power can also be regarded as a steering medium.

In Luhmann's later work, power was primarily restricted to the Political sub-system (Clegg et al. 2006). Therefore, for Luhmann, power is no longer the main medium to secure social order, rather, through system differentiation, merely one of many (Clegg et al. 2006). He still acknowledges power as a steering medium, but only as restricted to the political system.

Luhmann acknowledges the existence of hierarchies, asymmetries, and difference in influence, but points out that through the connectivity of the elements within a social system, no element can control any other without "being itself subject to control" (Luhmann 1995: 36). Therefore, he does not deny the existence of control as domination; rather, he denies the belief that this control can be fully exercised without any counter-control. From his point of view, the distinction between systems and environment "blows apart the old thematic of domination/oppression" (Luhmann 1995: 17).

Therefore, Clegg et al. (2006) argue, Luhmann's view on power may not be of much use to analyse power and domination relationships, at least in the framework of his Systems Theory. Some researchers argue that Foucault's ideas on power, in particular, might be a good candidate to enrich Luhmann's Systems Theory, so as to overcome the shortcomings mentioned above (Andersen 2003; Rempel 1996).

5. Description of the Empirical Findings from Fieldwork

It has been more than 120 years since Alexander Graham Bell submitted patent 174,465, "Improvement in Telegraphy," to the U.S. Patent Office and nearly 150 years since Antonio Meucci first demonstrated the prototype of the first telephone. It might seem a little bit strange to the reader that this empirical study focuses on such an old technology as telephony to study a new phenomenon such as ICT convergence. However, this study argues that, in fact, telephony is one of the most exciting areas attributed to ICT convergence, as will be shown in this chapter, which presents the data collected between October of 2007 and December of 2009 on the convergence discourses in the UK mobile telecommunications sector in general, and the introduction of mobile VoIP in particular. The key questions driving the rationale of this chapter are: What are the ICT convergence discourses shaping mobile VoIP? What are the characteristics of these discourses, related in particular to the three dimensions identified in the literature? How does the convergence paradox establish itself in the context of mobile VoIP?

The data presented here is based on a simple context/case distinction, seeing a case study as drawing the difference between context and case. Furthermore, in the tradition of second-order observation (Luhmann, Bednarz et al. 1995), the case includes both what is observed as well as the observation of the observer. The data are based on an extensive data corpus of 39 semi-structured interviews and a wide-range of documents from regulatory and political consultations, technical white papers, business press coverage, and observational data. As outlined in the research design chapter (chapter four), the data presented here are regarded as the researcher's constructions of other people's constructions. It is, therefore, pivotal to be aware of the three limitations of this data: (1) they are always observer-dependent, (2) they depend on particular settings, and (3) they are not stable over time, especially in a social context.

This chapter is structured as follows. First, it provides the contextual data of the case of mobile VoIP, giving a brief account of the history of the UK mobile

telecommunications sector, its actors, and its boundaries. Second, this chapter introduces the reader to the case itself through the origins of mobile VoIP and its development in the UK mobile telecommunications sector over the past ten years, from 2000-2009. Third, it presents the broad convergence discourses identified within the UK mobile telecommunications sector, and explores in detail the convergence discourses surrounding mobile VoIP. The final section reports the initial findings related to the questions posed above. This chapter does not make any use of systems theory terminology; instead, it leaves the systems-theoretical analysis to the analysis chapter that follows.

5.1 CONTEXT: THE UK MOBILE TELECOMMUNICATIONS SECTOR

The following section provides a brief overview of the UK mobile telecommunications sector. For a more detailed introduction, the following books are highly recommended: for a general history, see Gruber (2005); for a history of standards, see Tilson (2008).

5.1.1 Actors and Descriptions of the Mobile Telecommunications Sector

The UK mobile telecommunications sector encompasses a large variety of different actors. In the literature, different views are held regarding, which actors belong to the mobile telecommunications sector and how they relate to each other.

As a part of the Mobile VCE project, the researcher conducted a stakeholder workshop to ask industry experts themselves how they draw the boundary. One of the key findings was that those who are included and excluded depends, again, on the observer who draws the boundary - for example, an equipment vendor included semi-conductor vendors but not operating system vendors for mobile phones. One of the interviewees pointed out:

> "There are other parts of the value chain that we always forget, so besides the traditional value chain of players and device manufacturers you can go even more backwards, the chipset manufacturers or beyond, etc that are going to be affected by convergence." (Interviewee 3 - Former Head of Strategy - GSMA)

Hence, since most companies have built up some form of mobile presence, the list of actors can be literally endless. However, Basole (2009) seems to provide the most complete list with 14 industry segments, although it is interesting to note that

customers are not included. Table 5-1 gives an indication of the wide-range of actors considered in the literature as a part of the mobile telecommunications sector:

Table 5-1: Actors in the Mobile Telecommunications Sector

Tilson (2006)	Nystroem (2008)	Basole (2009)
• Semi-conductor manufacturers • Device manufacturers • OS and middleware vendors • Infrastructure manufacturers • Network operators • Content providers • Service providers • System integrators/ solution providers • Customers (corporate and consumer)	• Network operators, service operators, MVNOs • Content providers • Content owner • Content packagers • Mobile portals • Mobile retailers • System and platform providers • Software companies • Technical enablers • Mobile handset manufacturers • Regulator • End-users/mobile service subscribers	• MNOs • System integrators • Service & billing providers • Application & service providers • Platform providers • Network & infrastructure providers • Device manufacturers • Silicon vendors & other Component providers • Content providers • Media & entertainment providers • Photography & digital imaging • Cable providers • Gaming providers • Internet service providers

The primary focus of this study is the convergence discourse in the context of mobile VoIP. Hence, actors participating in this discourse are relevant. While mobile network operators and mobile VoIP service providers are the focal actors, a few other focal actors emerged during the course of this study, in particular handset manufacturers like Nokia and Apple. The importance of the regulator only emerged in a second step, and surprisingly at a much lower level than expected, particularly in the UK.

Four prominent ways have been suggested in order to conceptualise the mobile telecommunications sector: the value chain, the value network, the layer model, and the systems approach.

The traditional view is to illustrate the mobile telecommunications sector based on the value chain metaphor of Michael Porter (Porter 1985), which suggests deconstructing the relationships between actors through activities (Trossen and Fine 2005; Karrberg and Liebenau 2006). This approach is intuitive; however, it assumes that these activities happen sequentially and not concurrently (Vesa 2003).

Furthermore, it ignores other important actors such as regulators and the capital markets. Hence, recently, several scholars have argued that the description of a linear value chain has lost its appeal because of its deconstruction through technological convergence (Tilson 2006; Nystroem 2008). Instead they developed the description of so-called value networks (Wirtz 2001; de Montalvo et al. 2004). According to De Montalvo et al. (2004), these value networks consist of (a) structural partners providing essential resources to the value network, (b) contributing partners providing network-specific resources, and (c) supporting partners providing generic resources, which makes them essentially replaceable.

Another approach that has gained much popularity is the layer model, which suggests three or more different layers upon which the telecommunications industry is built, e.g. physical, logical, and content layers (Benkler 1998). Layer models have advantages. However, they also have shortcomings such as the fact that they obscure the modes of co-ordination and intra-layer diversity, as well as neglecting interacting institutions such as the capital markets or regulators (Fransman 2002).

Finally, a few authors have developed systemic descriptions of the mobile telecommunications sector (see, e.g., Vesa [2003]; Tilson and Lyytinen [2006]; Basole [2009]; Herzhoff et al. [2010]). One prominent framework in the information infrastructure literature for capturing the mobile telecommunications sector has been that of Lyytinen and Yoo (2002). It has been used primarily in the context of understanding the standardization processes between the different actors in the telecommunications sector. Tilson and Lyytinen (2006) further refined this framework (see the following figure 5-1).
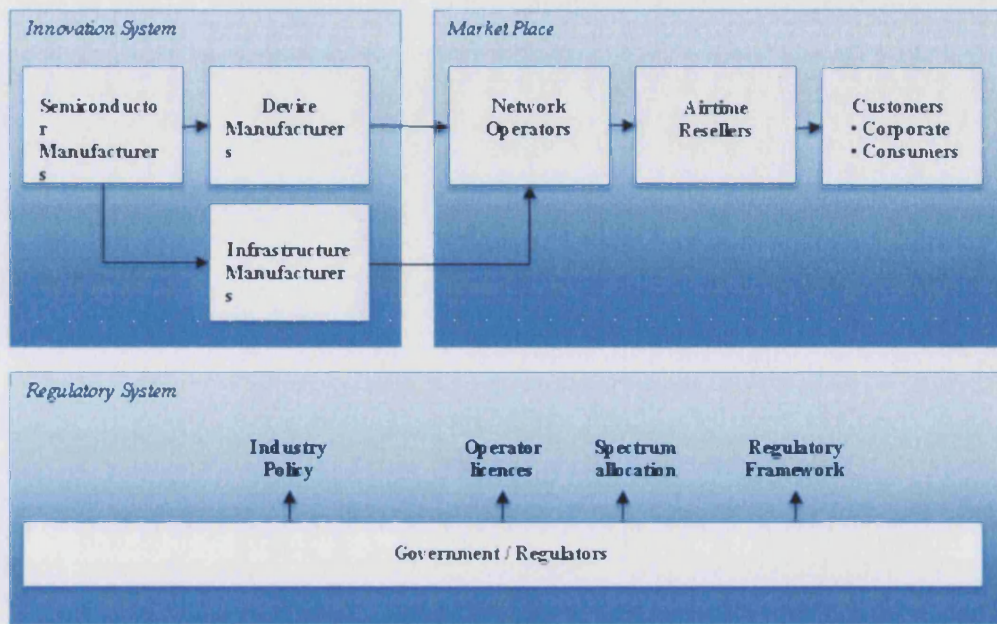
Figure 5-1 Framework for Mobile Telecommunications Industry

(after Tilson and Lyytinen 2006)

This framework has a couple of advantages since it includes regulators as well as customers. However, it does not capture changes in the role of actors, which is often associated with convergence (Hacklin 2007). Device manufacturers such as Apple are moving into the marketplace and network operators are taking a greater regulatory role (Wu 2007). Since convergence spans many different organisational and even artificial industry boundaries, traditional analysis based on industry codes or actor networks have their shortcomings.

Another systemic conceptualization is the idea of the mobile ecosystem. The notion of a business ecosystem was introduced by Moore (1993) and based on a metaphor of biological ecosystems. Basole (2009) maps the mobile ecosystem based on an extensive network analysis of intercompany relationships. He identifies 14 segments belonging to the mobile ecosystem such that three segments accounted for 75% of the companies: network and infrastructure providers (29.1%), application and service providers (26.5%), and silicon vendors and other component providers (21.0%). However, Basole (2009) also acknowledges that many companies have in fact several roles, and so cannot be linked clearly to the categories.

For the purposes of this study, the application of the metaphor "ecosystem" might be misleading. A business ecosystem, in the traditional sense, is "an economic community supported by a foundation of interacting organisations and individuals – the organisms of the business world" (Moore 1993:76). It eventually comes down to what constitutes a system. Naruse and Iba (2008) suggest that the notion of the ecosystem should instead be based on autopoietic systems. Hence, actors are not included, only communication. This perspective also helps to abstract from the notion of the actor.
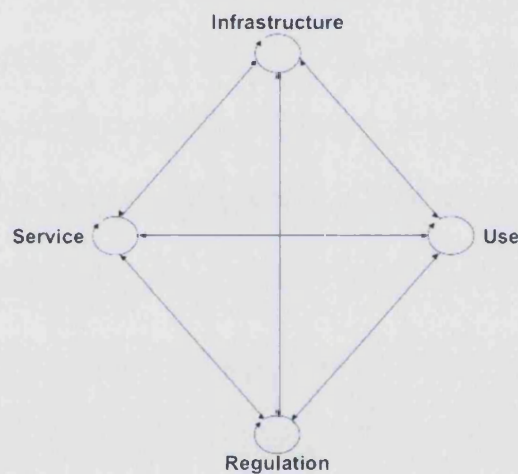
Figure 5-2 The Four Socio-Technical Systems observing each other as the Telecommunications Sector (Own Figure)

A step in this direction is suggested by Herzhoff et al. (2010) through making the distinction between four social-technical, self-referential systems (Figure 5-2): (1) the infrastructure system, (2) the service system, (3) the regulatory system, and (4) the use system. From this perspective, the telecommunications sector itself is only the environment for these four systems. Each of these subsystems sees the other systems as well as the overall system as the environment. Individual organisations and technologies are elements in each of these systems. In other words, organisations are not limited to one function system (Moeller 2006). On the other hand, function systems also do not focus on just one type of organisation. The following presentation and adjacent analysis uses this conceptualisation of the UK mobile telecommunications sector.

5.1.2 History of the UK Mobile Telecommunications Sector

The historical development of the UK mobile telecommunications sector is presented based on the distinction of three phases developed based on coding the data along a critical event code. The three phases identified are "the early days," from 1982-1998; "3G and the early mobile Internet," from 1998-2007; and "post-iPhone and 3G dongles", from 2007 to 2010.

Phase 1: The Early Days (1982-1998)

Mobile phone services were available in the UK in the 1950s. However, only the Duke of Edinburgh was allowed a private mobile phone, which was interoperable with the fixed-line network (Meek 2002). The first pre-cellular public mobile phone service was tested in 1959 in the South Lancashire area and was made available in London in 1965 for operator-controlled car telephony service, primarily for diplomats (Harrison and Bishop 1995). However, it was not until 1982 that the United Kingdom adopted cellular mobile telecommunications (Gruber 2005).

The UK government granted two licenses in May of 1983. The first was granted to Cellnet (a joint venture between BT and Securicor) and the second to Racal-Millicom (a joint venture between the UK military equipment company Racal and the U.S. mobile telecommunications company Milicom), which later became Vodafone. Both joint ventures launched their first mobile services at the beginning of 1985 (Gruber 2005). The government issued the license for both joint ventures under the same terms. It is interesting to note that the UK government made a clear distinction between network and service provision to encourage competition. According to the licences, neither of the two joint ventures was allowed to sell services or equipment. This privilege was granted solely to so-called service providers. However, both network operators were allowed to set up subsidiaries to take over this role.

Since the tariff prices did not change much over the following 4 years, the government granted another bidding round and eventually three more licences, one to Mercury, one to Microtel, and the third to Unitel. Mercury was BTs main competitor in the fixed-line business and a subsidiary of Cable&Wireless. These new networks were called personal communication networks (PCN) and based on the Global Systems for Mobile Communications (GSM) standard. Mercury One2One was the

first PCN operator launching a mobile service in September of 1993 (Tilson 2006). The second PCN, with the brand name Orange, launched in April of 1994. The newly issued licences required that the PCNs be based on GSM, and the spectrum was restricted to 1800 MHz. When the three competitors joined the UK mobile telecommunications sector, the regulator suggested abolishing the distinction between network and service provision, allowing all of the players to integrate vertically. Furthermore, new entrants were allowed to share network capacity in rural areas. In August of 1999, Virgin Mobile started as the first MVNO as a joint venture between One2One and Virgin. The joint venture focused primarily on the prepaid segment of the market.

Phase 2: From 3G over Walled Gardens to the Early Mobile Internet (1998-2007)

Access to the Internet from a mobile phone had been possible since the early first-generation mobile phones. However, the access was limited to tethering, i.e. linking a portable computer with the mobile phone. The first mobile phone with the capability to access the Internet on its own was the Nokia Communicator 9000, which was released in 1996. However, it was in 1998 that the vision of a mobile Internet started to take shape when a coalition consisting of Nokia, Motorola, Ericsson, and Psion released in 1998 the wireless application protocol (WAP) specifications, founded the joint mobile operating system vendor Symbian in mid-1998, and released the Bluetooth specifications in June 1998, which later became one of the most important technological driving forces for mobile VoIP. This coalition was essentially an inter-device coalition to distinguish mobile handsets as credible alternatives to PDAs such as Microsoft Windows CE and Palm (Funk 2002:218).

Funk (2002) calls this the first coalition wave to overcome the distinction between mobile computing and the Internet. The second wave concentrated, according to him, on intra-device coalitions, distinguishing different mobile handsets from each other through partnerships with PDA companies. The UK regulator Oftel, which was superseded by Ofcom in December of 2003, auctioned the 3G licences in the UK and in April of 2000 raised GBP 22.5 billion. This auction led to the entrance of a fifth mobile network operator, Hutchinson Three UK. Furthermore, BT incurred a high level of debt through the auction, and had to spin off its mobile unit in 2001, which

became mmO2, later O2. Hutchinson Three UK launched the first 3G network in the UK in 2003, followed by the other operators in 2004.

In particular, the idea of a mobile version of the Internet gained more interest towards the end of the 1990s. Several mobile network operators launched so-called walled gardens (Tilson, Lyytinen et al. 2006), such as Vodafone Live! and Orange World. These walled gardens allowed only limited access to Web content that was carefully selected by the operators and presented in a portal structure. The first breach of the walled gardens happened in 2005 when T-Mobile announced the introduction of its Web'n'Walk product, offering direct internet access without portal.

However, the importance of walled gardens has only gradually declined over the following years. According to the Nokia 360 Smartphone Panel in the UK (Nokia 2008), which records mobile phone usage through a software application on the Nokia S60 platform, only 22% of the participants accessed the mobile network operator Web site in 2008, whereas in 2007, the percentage was 57%. On the other hand, Google, which has been synonymous with free Internet on the mobile phone, was accessed by only 44% in 2007, and 82% in 2008. Hence, within one year, the walled gardens in the UK collapsed.

Phase 3: Post-IPhone and 3G-Dongles (2007-2010)

Overall revenue growth has slowed down since 2007, and early indications from the quarterly financial reports of 2009 show that this trend is going to continue. In particular, revenue from voice and messaging has been stagnating, offset only by bundles, which include monthly rental, bundled calls, SMS, and data (see Figure 5-3).

Today, the mobile telecommunications industry in the UK is very fragmented, with five highly competitive network operators and profits under pressure (see Figure 5-4). This is primarily related to the emergence of H3G as the fifth MNO in 2003 followed by decreasing prices that could be only partly offset by increasing voice volume. Between 2002 and 2007, the mobile call volume nearly doubled from 53 billion minutes in 2002 to 99 billion minutes in 2007 (Ofcom 2008). The overall market structure remained stable until 2009. In the aftermath of the financial crisis, T-Mobile and Orange decided to merge in the autumn of 2009.
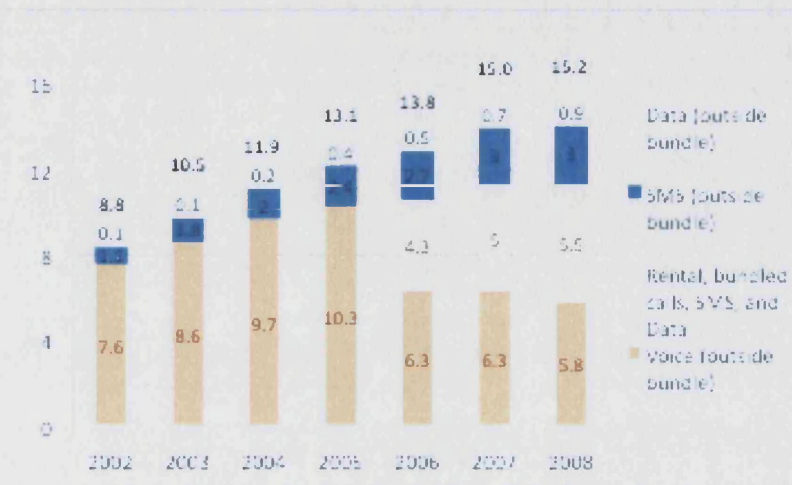
Figure 5-3 Revenues UK Mobile Operators in GBP, Billions

(Ofcom 2008; Ofcom 2009)

While the closed walled-garden model was the most dominant type of mobile Internet in the UK, operators had to begin opening up their networks and started converging their infrastructure with the open Internet. Since then, mobile network operators have been at pains to identify new converging services capable of generating data revenue to offset the losses in voice and messaging. Since 2007, data usage has accelerated and several mobile network operators announced in 2008 that data traffic volume had exceeded voice traffic on their networks (Grant, Dehiri et al. 2008). This increased data traffic resulted, according to market observers, primarily from the use of USB dongles and the iPhone (Grant, Dehiri et al. 2008). For instance, the use of data-intensive iPhone applications in the greater London area resulted in clogging O2's network in the second half of 2009 (Parker 2009).

Figure 5-4 Average EBITDA Development UK MNOs from 2000-08

(Ofcom 2007, 2008)

The mobile telephony sector is the immediate environment or context of the following case study on mobile VoIP. Interviewees and documents presented in the following sections will often refer to these developments.

5.2 CASE DESCRIPTION: MOBILE VOIP IN THE UK

This section presents a detailed description of the case study on the convergence discourses surrounding the introduction of mobile VoIP in the UK. It is based primarily on 39 semi-structured interviews and an extensive document analysis of press clippings and other documents. The case description does not contain system-theoretical concepts. However, it does follow Luhmann's definition of a case, as what is observed includes the observation of the observer. This means that the description of the case includes not only the observation of convergence discourses in the context of mobile VoIP, but also that of the observers and their distinctions.

After a short introduction to mobile VoIP, the development of mobile VoIP in the UK will be presented within three stages identified in the period between 2000 and 2009. Furthermore, the socio-economic and technical aspects will be discussed. This is followed by a detailed discussion of the identified convergence discourses in the following section.

5.2.1 Introduction to Mobile VoIP

Mobile VoIP has a short history, but a long past. The first efforts to conduct voice calls over the Internet's predecessor, ARPANET, happened in 1972 in the work of Bob Kahn along with that of Jim Forgi and Dave Walden (Gray 2005). However, the first experiments showed poor quality and resulted in the understanding that a change in packet handling and data compression was required. In 1974, the transmission control protocol (TCP) was specified by Bob Kahn, Vint Cerf, and Danny Cohen, who developed the network voice protocol (NVP). However, Cohen decided not to use TCP but ARPANET message headers because of lack of reliability. In a famous quote, Cohen compared the difference between real-time traffic and the traditional data transmission as:

> "The difference between milk and wine: you had to deliver the milk quickly before it spoiled even if you spilled some on the way, but you can deliver wine a lot more slowly" (Gray 2005, p. 89).

Due to these quality problems of TCP with real-time signal transmission, Cohen, Cerf, and Postel agreed to separate the Internet protocol from TCP to allow for real-time applications. As Gray (2005) points out, the irony is that VoIP is nowadays mostly known for using Internet protocol and, in particular, IP is criticized for not supporting the Quality of Services needs of real-time applications. However, IP was designed as a requirement for making voice and other real-time applications possible. During the following years, only a small minority of users used VoIP. One of our interview partners who had been in the telecommunications business for over thirty years recalled:

> "I've got a textbook sitting on my shelf that was written around '79 or '80 that said all voice would be going over to packet within five years."
> (Interviewee 4 - Former Chief Technologist - Regulator)

In 1995, a start-up company in Israel called Vocaltec, Inc. developed the first commercial VoIP product, called Internetphone. Vocatel was founded in 1989 to develop speech-recognition technology. Israel became a hub for VoIP developing companies after the IPO of Vocaltec in 1996. This development is still immanent in the mobile VoIP arena; with a large number of mobile VoIP companies having their developing centres in Israel.

Standards and Signalling Protocols for Mobile VoIP

Over the following years, four different VoIP implementations emerged (H.323, media gateway control protocol [MGCP], H.248 [Megaco], and session initiation protocol [SIP]). In November of 1996, the International Telecommunications Union (ITU-T) published the first version of the H.323 standard (ITU 1996), which primarily aimed at video-conferencing over packet-based networks. MGCP was the predecessor of H.248 (Megaco) and was jointly developed by Cisco Systems and Telcordia Technologies. However, only as H.248 (Megaco) did it became a standard accepted by the ITU and IETF in June of 2000. The primary focus of these VoIP implementations has been fixed-line. It was only SIP that got official backing from the 3rd Generation Partnership Project (3GPP) in November of 2000 through integration as a permanent element in the IMS architecture. Hence, SIP became more mobility-specific and, therefore, it will be the primary VoIP implementation discussed in this dissertation.

The origins of SIP started in the early 1990s during the development of the MBone (Nokia 2004). The MBone was developed as an experimental multicast backbone in 1992 to provide an overlay network over the existing Internet for a broad range of multimedia content from space shuttle launches to music concerts. SIP provided the functionality to invite users from these multicast sessions. Henning Schulzrinne and Mark Handley from Columbia University extended SIP to support unicast sessions, i.e. one-to-one connections, such voice-over-IP in 1996. SIP works as an application layer protocol. Hence, SIP can be used to create new forms of telephony services. It can also theoretically carry content but is used for transportation, primarily underlying protocols such as UDP, TCP, SCTP, or SMS (Nokia 2003; Nokia 2005). In November of 2000, SIP was accepted as a 3GPP signalling protocol and permanent element of the IP multimedia subsystem (IMS) architecture for IP-based streaming multimedia services in cellular systems. This essentially means that all 3G terminals and networks that follow the 3GPP standard have to support SIP (Nokia 2004). However, SIP has drawbacks as one of the interviewees pointed out:

> "On the SIP level you have like a Bible, so you have one big book but it is so big and open that you can create many religions. That's the biggest issue. You have these interpretations, which is a mix of conflict between self-interest and third party interest. It's really hard to integrate the whole SIP world that we have right now. Even though, everything is integrated by SIP. Still, there is a lot of drawbacks on that."
> (Interviewee 19 - VoIP Product Developer - Mobile VoIP Company B)

Another signalling protocol was designed outside of the traditional standardisation bodies by the Jabber Open Source Community in 1999. It was called the extensible messaging and presence protocol (XMPP) and has been formalised by the IETF from 2002-2004. The Jabber XMPP has its origins in instant messaging technology, and the most prominent implementation has been Googletalk. Since a couple of mobile VoIP companies also use XMPP extensively, most prominently Nimbuzz, this dissertation will sometimes refer to it.

Relevant Actors in the Mobile VoIP Domain

The mobile VoIP system encompasses many organisations operating in the mobile telephony sector. Network operators, mobile VoIP developers, OS vendors, venture capitalists, handset manufacturers, and network equipment vendors all play their roles. The primary focus, however, is on the relationship between mobile VoIP companies and network operators. The following section will provide an initial description of the historical development of these relationships before the study focuses on the convergence discourses.

5.2.2 History of Mobile VoIP

The past ten years have seen mobile VoIP applications emerging from initial visions and patents to become some of the most frequently downloaded applications in mobile application stores (e.g. the Skype client was downloaded two million times worldwide and 280,000 solely in the UK within one week). The history of mobile VoIP in the UK can be told in many different ways. This dissertation follows a chronological approach. Both document and interview data have been coded with a CHRON code to maintain a good overview of the timeline (Miles and Huberman 1994). Furthermore, critical incidents have been assigned a CRIT code. Critical incidents are seen as "critical, influential, or decisive in the course of some process" (Miles and Huberman 1994: 115); in this case, critical incidents are important moments in the development of mobile VoIP in the UK. Based on the CRIT codes, three stages have been constructed to describe these developments. The first stage deals with the early days of mobile VoIP, when the primary focus was on visions, patents, and the development of workable prototypes (1999-2005). The second stage started in 2005 with the announcement of Truphone. This period was primarily

driven by the idea of WiFi, and the third stage began in 2007. A summary table of the developments through all three stages is presented at the end of this section.

Stage One: Visions, Patents, Prototypes (1999-2005)

The idea of using voice-over-IP for wireless connections was first conceptualised in the late 1990s. Lucent Technologies filed a patent in August of 1999 that outlined in detail a method for optimizing mobile wireless communications routed across multiple interconnected networks (Patent Number US 6,434,139 B1):
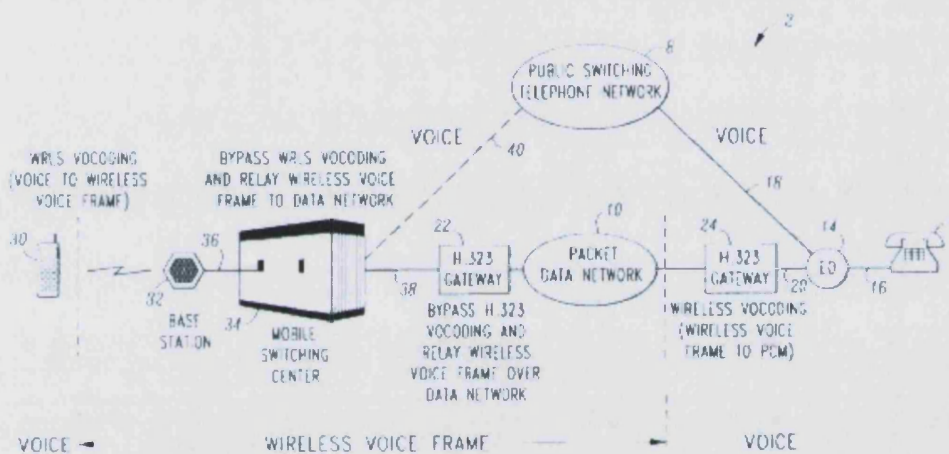
Figure 5-5 Lucent Technologies Mobile VoIP Patent

(United States Patent and Trademark Office, Patent Number US 6,434,139 B1)

The patent suggests setting up an H.323 gateway between the mobile switching centre and a packet-based data network to enable mobile VoIP calls. Two years later, Nortel Networks filed another patent on a push-to-talk (PTT) wireless telecommunications system utilizing a voice-over-IP network (Patent Number US 7,170,863 B1). PTT was the first worldwide commercial mobile voice service based on IP. However, it provided only one-way communication. While in the U.S. there were already early trials conducted by Motorola to use push-to-talk for mobile VoIP calls, in Europe, the development was primarily encouraged initially through Bluetooth and later through the emergence of mobile handsets with WiFi chipsets. The push-to-talk technology was also the very first conduit for a mobile VoIP application. The Indian company Indtelesoft presented at the Fall 2003 VON

conference a program called Buzz2Talk. This program allowed one-way communication via the data channel using SIP.

The history of mobile VoIP in the UK started in April of 2000 when Software Cellular Networks (SCN) was founded. SCN later became widely known under the trademark "Truphone". Since then the mission of the company has been "to revolutionise wireless connectivity through the use of unmanaged bandwidth" (Truphone 2009). The company was incorporated 2001 in Cambridge to develop "fixed-mobile convergence VoIP systems for WiFi and Bluetooth" (SCN 2001). However, due to a lack of financing during the burst of the dotcom bubble in 2000/2001, SCN suspended the development of the mobile VoIP client. Although these initial ideas regarding mobile VoIP circulated at the beginning of 2000, the official story of mobile VoIP in the UK started with a service called "Bluephone" launched by BT in 2004, which was re-launched in 2005 under the name BT Fusion. "Bluephone" was a successor of "Onephone", the first commercially available fixed-mobile service in the world, introduced by BT and BT Cellnet in mid-May of 1999. However, the "Onephone" was not based on IP technology. It was a fixed-mobile service working on the DECT and GSM standard. The user would use the same handset at home as a cordless phone and outside the home as a mobile phone. The successors, Bluephone and BT Fusion, were built upon the same idea but relied technically on Bluetooth respectively WiFi opposed of DECT. However, the VoIP component was only used on the "fixed" side using an ADSL router, whereas the mobile component was essentially still implemented via circuit-switched mobile networks. For the cellular calls, BT obtained the status of a mobile virtual network operator (MVNO) with Vodafone, which also included access to Vodafone's home location register (HLR). The HLR is a part of the core network of a mobile operator and stores permanent subscriber details such as the international mobile subscriber number (IMSI) to identify each subscriber.

The handover and exchange between the two networks was based on the unlicensed mobile access (UMA) standard, which later was renamed by the 3GPP standard-setting body to the generic access network (GAN) standard. However, due to the restrictions of UMA, access could be provided only through BT's own hotspots. Three of the interviewees (interviewee 7, interviewee 24, and interviewee 35) worked

in the BT Fusion project before they moved to mobile VoIP companies. According to interviewee 7, the project itself was started initially in 2002, and it was decided to use Bluetooth because it was the most widely available short-range wireless technology for mobile phones. In the following years, the idea emerged to use WiFi instead of Bluetooth as more and more WiFi-enabled mobile phones became available. In the case of BT, the decision to used WiFi was also based on stability and costs:

> WiFi was also much more stable, it was much more pervasive in terms of in the home hub. The cost of, for example, providing the home hub with Bluetooth in as well starts to go up when you have to add more and more technologies.
> (Interviewee 7 - Director Business Development - Mobile VoIP Company C).

The first mobile VoIP company to adopt this idea was SCN. The initial prototype was called "Freephone", and it established a Bluetooth link between a mobile handset and a PC, and the PC routed the call over the Internet. The name Truphone was created at a later stage and as a direct response to BT's Bluephone product. Initially, the company conducted trial runs in the form of Bluetooth prototypes, but Truphone soon realised the potential of WiFi in combination with the open Symbian platform. The CEO of Truphone, James Tagg, filed a patent application on May 12th, 2005 on a system providing mobile VoIP via WiFi:
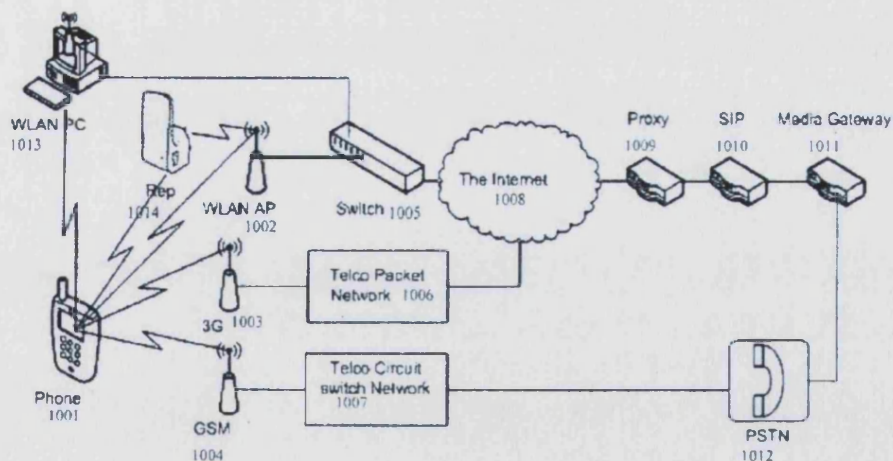
Figure 5-6 Mobile VoIP Patent of Truphone

(United States Patent and Trademark Office, Patent Number: US 2005/0286466 A1)

This patent shows a wider range of connections compared to the Nortel patent from 1999. In particular, while the Nortel patent blackboxed the technology for the user through envisioning one singular branch from mobile phone to the base station and diverging branches only after the mobile switching centre (MSC), essentially in the access network of the mobile network operator, Truphone's patent envisioned five potential branches diverging directly from the mobile phone: private WLAN, public WiFi repeater, public WiFi router, GSM, and 3G network.

Stage Two: Funding, WiFi, Symbian, SIP (2005-2007)

Several technical and social developments have driven mobile VoIP from 2005 onwards out of the prototype stage. The first has been the increasing use of WiFi chipsets in mobile phones, which, according to In-Stat (Instat 2009), went up from one million in 2005 to 56 million units shipped worldwide in 2008. Another was the availability of an SIP plug-in. In June of 2004, Nokia announced in a press release that it would make an SIP plug-in available for the Symbian S60 Software Development Kit (SDK) for developers. In an interview with ZDNet UK, James Tagg (CEO of Truphone) pointed out the critical incident convincing him to continue with his mobile VoIP venture:

> "The idea's revival came when Nokia introduced Wi-Fi-capable handsets in 2004, complete with SIP (session initiated protocol) technology that made them suitable for VoIP."
> (James Tagg, CEO Truphone in an interview with ZDNET [2007])

However, it was not just the WiFi chipset but rather the tight integration of VoIP support within the operating system. One of the interviewees added that the VoIP support within the Symbian was crucial.

> "Basically, WiFi enabled a reasonable connection to take place between a router and a handset. Secondly, with the obviously availability of the open platform the Symbian OS that Nokia were using at the time. The combination of those two available with a single handset was I think as far as mobile Voice-over-IP the starting point."
> (Interviewee 7,- Director Business Development -Mobile VoIP C)

Truphone presented a first client, but one still based on Bluetooth, in May of 2005. Since the end of 2004, more and more companies have developed mobile VoIP solutions over WiFi and 3G, most prominently Truphone, Fring, Nimbuzz, and iSkoot (Skypephone). Fring was founded at the end of 2004, while Nimbuzz and iSkoot were both founded in early 2006. While Truphone is a UK company, the other three companies are highly visible in the UK market but primarily based in Israel

(Fring), the Netherlands (Nimbuzz), and the U.S.A. (iSkoot). Although the number of start-ups is relatively large, the big players know each other quite well. For example, the marketing director of one mobile VoIP player said:

> "Are you also in contact with iSkoot or JaJah? If you want I can introduce you to them."
> (Interviewee 5 - Marketing Director - Mobile VoIP Company A).

An important aspect in these early days of mobile VoIP was funding. In an interview, Avi Shechter, CEO of Fring, pointed out:

> "We started with Fring project toward the end of 2004, so about 2 years ago. (...) In 2006 we raised some money and got started, got employees on board, and are testing right now." (Avi Shechter, CEO Fring).

Similarly, in an interview with ZDNet UK (2007), James Tagg pointed out the critical event of the launch of Skype in increasing awareness in the venture capitalist community:

> "In 2005 we were looking for funding. We were a technology company, but got interest from venture capitalists who said 'why not turn it into a service rather than selling technology?' Then Skype got bought [by eBay], and within eight weeks we were offered over £8m." (James Tagg, CEO Truphone, in an interview with ZDNET [2007])

Since 2005, more than a hundred mobile VoIP start-ups have emerged worldwide. When interviewees were asked why so many start-ups have emerged during the past three years, the common answer was the large investments made by the venture capital companies in mobile VoIP companies.

> "Mobile operators are making quite a bit of money and you go to a VC company and say, we can basically replicate the amount of money that we are earning and at the same time passing huge cost saving benefits onto the customers. The VC companies were basically saying, if you can get even a fraction of the amount of providers that Vodafone has, for example and still charge even 50% let's say of what Vodafone are charging for the calls, you will make ex amount of millions of pounds per year."
> (Interviewee 3 - Director Business Development - Mobile VoIP Company C)

EBay announced the purchase of Skype for $2.1bn on September 12th, 2005. The following table (Table 5-2) shows the venture capital funding based on press releases by the 8 biggest mobile VoIP companies. These companies together have received more than 220m U.S. dollars since 2006, with the UK-based Truphone receiving 57.2m U.S. dollars. This compares to the funding of $2m and $18.8m, respectively, that Skype obtained in its second round of funding. The rationale convinced many

VCs in the early days, aside from the case of Skype, of the potential for high profitability in the mobile business compared to the fixed business.

Table 5-2 Venture Capital Funding of the 8 Biggest Mobile VoIP Companies
(Press Releases)

In Mio. U.S. Dollars	Tru-phone	Nimbuzz	Fring	EQO	iSkoot	Jajah	Mig33	Reb-tel	Total
2006	0	0	3	3.5	6.2	8		20	40.7
2007	24.5	10	10	9	7	20	10	0	90.5
2008	32.7	15.5	0	0	19		13.5	0	80.7
2009	0	0	10	0	0	0	0	0	10
Total	57.2	25.5	23	12.5	32.2	28	23.5	20	221.9

Key events since 2005 included the partnership between Three UK and Skype and the resulting development of the Skypephone and the iPhone App Store. In an interview, James Tagg, CEO of Truphone, stated the reasons for not offering 3G support (Malik 2007): "We are not offering it at present because there is a lot of confusion about the 3G data tariffs, and we don't want our customers getting stuck with big bills".

Stage Three: 3G, iPhone, Conflicts (2007-2010)

Stage three can be characterised by both increasing conflicts and cooperation among various actors in the mobile VoIP space. It also saw another shift in technology. While the first phase was dominated by the vision of Bluetooth as bearer technology for VoIP, and the second stage was dominated by WiFi, stage three revealed the first 3G VoIP clients. Fring announced in January of 2007 a mobile VoIP client capable of using 3G. While some network operators initially welcomed this new technology since it was profitable through high data rates and allowed them to keep some form of control, in contrast to WiFi; this changed gradually with the introduction of data flat rates.

T-Mobile and Three UK were the first mobile network operators introducing data flat rates at the middle and end of 2006, respectively. Orange and Vodafone followed in May and June of 2007, respectively. These data flat rates also saw the introduction of

so-called fair use polices regulating how much data "unlimited data" means, as well as which services could be used. It is interesting to note that all operators specifically addressed the usage of VoIP. According to Meyer (2007) the initial strategies differed quite substantially from MNO to MNO: while Three UK had a relatively liberal approach, explicitly allowing the use of Skype on the data plans, T-Mobile demanded a premium for the usage. While Vodafone banned the use of VoIP completely, Orange discouraged the use of VoIP: "our terms and conditions will state that the bundle should not be used for these services", and added "we would discourage any customer from using VoIP through the mobile Internet due to the quality of service they may experience" (Meyer 2007).

Mobile network operators started to become aware of the potential danger of mobile VoIP. The first open clash between mobile network operators and mobile VoIP companies surrounded the Nokia smart phone handset N95. Orange and Vodafone decided to switch off the built-in VoIP functionality of this handset:

> "It is not Orange's policy to remove VoIP functionality from devices (...). This is a handset-specific issue, and in this particular instance Orange was asked by Nokia whether they wanted the VoIP functionality switched on or off, and Orange selected off. The VoIP functionality is available with the E60." (Orange 2007).

Orange and Vodafone did not remove the SIP stack, however, the menu items for configuration were switched off. As James Tagg, CEO of Truphone pointed out, in an interview:

> "Not so, said Tagg, who claimed the issue had nothing to do with the SIP stack; a crucial component of any integrated VoIP solution. The VoIP stack is still there, he said, [but] the menu items that allow a user to get to it are switched off." (Meyer 2007).

One of the interviewees remembered this tussle as a fight of "David against Goliath" that had large coverage in the public sphere:

> "Vodafone and Orange both decided that they're going to block the use of that particular function on the N95 device. There was a big backlash. There was lots and lots of webbloggers and news reports about how bad this is and I think that's about the time Truphone really, really went through a very popular rise because they saw Truphone as being the David in the David and Goliath fight, if you like, in the mobile voice industry." (Interviewee 35 - Business Development Director - Mobile VoIP Company C).

In June of 2007, Truphone released a 3G client for VoIP. At the same time, T-Mobile began to block calls from its customers to Truphone numbers, which resulted in the first mobile VoIP court case worldwide.

In the autumn of 2007, Truphone presented the first mobile VoIP client for the iPhone. However, the phone had to be 'jailbreaked'. One of the main events that the interviewees referred to was the introduction of the Apple App Store. In July of 2008, Truphone became the first VoIP client available through the Apple App Store. At that point, delivery became much easier. A significant 3rd-party developer community has emerged to make VoIP possible, despite the design restrictions. These applications work on different levels of restrictions on both hardware and software. For example, the initial IPod Touch had no possibility of making a phone call because a microphone was not included. Developers developed a microphone and an application in a very short period of time. The restriction imposed by Apple to allow only WiFi calls has been circumvented by an application called 3GUnrestrictor. Finally, some developers pointed out that virtual private network support would render it impossible for deep-packet scanning tools to identify VoIP packages.

Also, the regulators on the national and international levels became more aware of the blocking practices. Ofcom was aware of the blocking practices, but argued that there is enough competition in the UK market and that consumers should instead switch their network:

> "There is no regulatory requirement to offer VoIP access over a mobile phone network," said a spokesperson. "Not every mobile operator blocks VoIP. Ofcom believes there is enough competition in the UK mobile market-place, so that users will vote with their feet and move to a service provider that does provide VoIP access." (Ofcom 2009)

However, the European Commission took a different position. In an open letter to the EU Parliament, Commissioner Viviane Reding pointed out on 7th July 2009 that the Commission has been actively "monitoring the conduct of mobile network operators with respect to new Internet-based services such as mobile VoIP". She discouraged this practice and pointed out that "discrimination of voice-over-IP services by operators with significant market power must not be tolerated by national regulatory authorities and should be addressed with the tools available already today under the regulatory framework for electronic communications networks and services".

On 31st July 2009 the FCC started an inquiry regarding the Apple App Store with respect to the approval process for applications (Apple 2009). Questions 3 and 4 of the official inquiry are directed towards mobile VoIP and, in particular, the usage of AT&T's 3G network.

> "There is a provision in Apple's agreement with AT&T that obligates Apple not to include functionality in any Apple phone that enables a customer to use AT&T's cellular network service to originate or terminate a VoIP session without obtaining AT&T's permission. Apple honors this obligation, in addition to respecting AT&T's customer Terms of Service, which, for example, prohibit an AT&T customer from using AT&T's cellular service to redirect a TV signal to an iPhone. From time to time, AT&T has expressed concerns regarding network efficiency and potential network congestion associated with certain applications, and Apple takes such concerns into consideration." (Apple 2009).

Despite these tussles, the third stage also showed an increasing number of partnerships. While in the second stage, partnerships dominated between mobile VoIP and hotspot providers, stage three also showed some partnerships between mobile network operators and mobile VoIP companies, e.g. Three UK and Skype, JaJah and O2/Telefonica, as well as Vodafone and Truphone. Partnerships also emerged between mobile VoIP and handset manufacturers, e.g. Nokia and Skype. Furthermore, several mobile network operators started in November 2009 the 'One Voice' initiative. This initiative focuses on how voice can be supported efficiently over the next-generation mobile networks based on LTE using operator-controlled IMS. Although IMS has been in development for a long time, the focus has primarily been on multimedia services and less on VoIP.

An analyst report by Unstrung (2009) highlights the following recent developments of mobile VoIP applications. First, many mobile VoIP players integrate other systems such as social networks. Second, new functionalities such as voice-enhanced instant messaging, voice mashups, and voice plug-ins for social networks are added. Venture capitalists still show a high interest in mobile VoIP technology, and mobile operators seem to be gradually dropping their bans. The following critical incident graph (Table 5-3) illustrates, based on the CHRON and CRIT codes, the historical development of mobile VoIP in the UK.

Table 5-3 Summary Historical Development Mobile VoIP (Own Table)

Time	Network Operator	Mobile VoIP Developer	Vendor	Regulator
2000		SCN founded		
2001	BT spins of O2	No funding due to dot.com crash	Symbian releases S60 1st edition	
2002	Start of BT Fusion project			
2003	Hutchinson Three builds first 3G network	Indtelesoft presents first mobile VoIP client based on PTT technology	Symbian releases S60 2nd edition	
2004	BT launches Bluephone, Orange launches PTT service	Initial ideas of Truphone and Fring	Nokia releases SIP plugin in S60 SDK	
2005	Fusion launch, Web&Walk launch	Truphone announced first VoIP client based on S60 and SIP	1 Mio. smartphones shipped worldwide with WiFi chipsets	
2006	All MNOs offer mobile data flatrates, Skype and Three announce Partnership	First funding round from VCs		
2007	Orange and Vodafone block Nokia N94, IPhone release on O2 network, 3 releases Skypephone	Truphone announced first IPhone app	Apple announces iPhone	Court Case Truphone/T-Mobile, Ofcom sees no malpractice in blocking since enough competition
2008	Walled-gardens collapse, international Skype-Out on Three Skypephone, increasing blocking practice of VoIP reported	Truphone releases first IPhone app on appstore	Apple opens App Store	EC begins to monitor blocking practice
2009	Partnership between Truphone and Vodafone, Skype free on Three UK, O2 acquires JahJah, OneVoice initiative	Fring announces Video support, increasing number of partnerships	Partnership between Nokia and Skype	EC & FCC condemn blocking and Apple's block of 3G support in IPhone SDK

5.2.3 Seeking the IT Artefact in Mobile VoIP

As this section will show, mobile VoIP is the umbrella term for numerous technical artefacts (Arjona 2009). However, at its core is a protocol negotiating voice calls between different platforms and infrastructures. As Steve Pusey, CTO of Vodafone Group, pointed out in a presentation to financial analysts: "VoIP is an enabling protocol, not a service" (Pusey 2006: 10). However, as a protocol, it works on the service layer, not on the transport layer of the infrastructure (Noldus 2008). As articulated above, VoIP can be implemented in different ways; however, SIP is the de facto standard in the mobile world, endorsed by the Third Generation Partnership Project (3GGP), and used by the majority of mobile VoIP companies.

Mobile VoIP can be operator-controlled or operator-independent. Operator-controlled forms of mobile VoIP are implemented via IMS as well as UMA (Unlicenced Mobile Access) or GAN (Generic Access Network). Operator-independent mobile VoIP implementations are applications such as Truphone, Nimbuzz, Fring, and Skype. This study focuses primarily on operator-independent mobile VoIP, since it allows a socio-technical decoupling of the service from the underlying network infrastructure. A mobile VoIP architecture consists of several IT artefacts: (1) the mobile VoIP client; (2) servers for load-balancing, least-cost routing and customer data; and (3) gateways to public-switching telephony networks or other services. Furthermore, the mobile VoIP service needs a bearer technology such as 2G, 3G, WiFi, LTE (Long-term evolution), or WiMax. Mobile VoIP works well when connected to WiFi, but it is becoming increasingly complicated for the user to decide which network to use. According to one of our interviewee partners, setting up a small mobile VoIP service is fairly simple:

> "Of course, technically it could be done as an individual, anybody with the technical knowledge and capability could of course configure the handset manually and they would have got themselves a server from open source software and built themselves a network". (Interviewee 35 - Director Business Development - Mobile VoIP Company C).

The following table gives an overview of a few more complicated operator-independent mobile VoIP architectures. The complexity results primarily from an increasing number of gateways to other services, the support of a wide range of handsets and access technologies, and load-balancing servers.
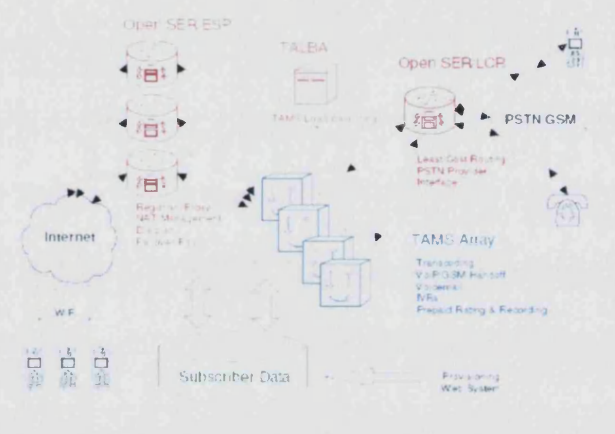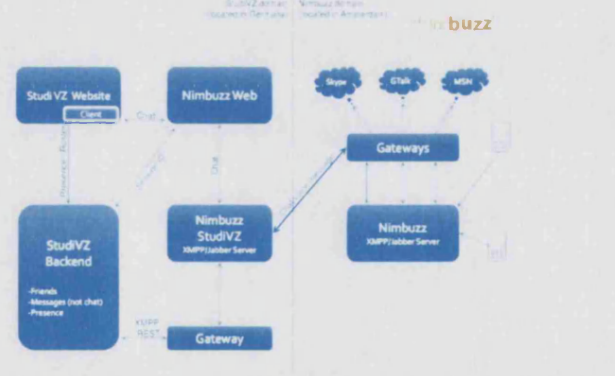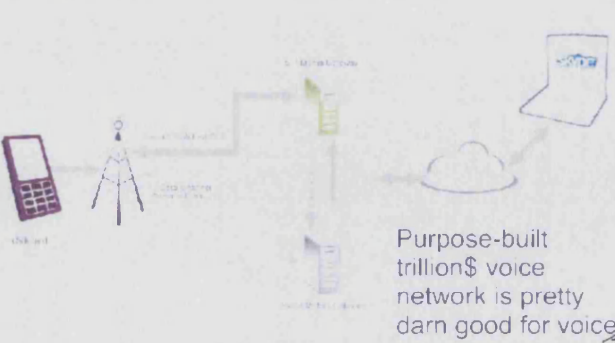
Architecture	Overview	Comments
Fring (Fring.com, 2009)		The Fring architecture is SIP-based. It also has an API server to provide interfaces to a wide range of Internet services.
Truphone (Presentation by Network Director James Body at the Open SER Conference in Berlin, 2008)		It is completely open source-based and, therefore, cheap and easy to maintain.
Nimbuzz (Presentation by Tobias Kemper, at the Mobile Monday Presentation in Duesseldorf, 02/02/2009)		Nimbuzz architecture has traditionally gateways to many social network and IM services. Furthermore, it uses XMPP instead of SIP.
Skype (Presentation by iSkoot CEO Mark Jacob-stein at the eComm conference in San Jose, 18/03/2008)		The traditional 3 Skypephone architecture uses iSkoot technology. It is the only technology, which uses the voice channel and the data channel only for presence and IM.

Table 5-4: Examples of Mobile VoIP Architectures

One important element of a mobile VoIP architecture is the mobile VoIP client. Mobile VoIP clients are software applications, which have to be installed on a mobile device. These applications have up to three main functionalities: the capabilities 1) to show the presence information of a contact, 2) to send instant messages, and 3) to initiate a VoIP call: "We have three core products: voice, presence, and instant messaging. These are our foundational pillars" (6-Head of Communications, mobile VoIP). Depending on the access route they use (WiFi, 3G, or sometimes a local landline number for GSM) and the level of integration with different existing services (Skype, Googletalk, etc.), each application raises different technical and institutional challenges. Mobile VoIP clients have to be tailored for the operating system of the phone and for the phone itself. The Truphone software currently permits the conducting of free calls via SIP protocol; outbound calls to PSTN (public switched telephone network); inbound calls from PSTN to Truphone numbers; and inbound and outbound SMS via SIP. Truphone has so far established a gateway to Googletalk and is fully integrated in the infrastructure of The Cloud, the biggest public WiFi operator in Europe. Due to a strong tie with Nokia, the software is deeply integrated within the Symbian operating system. The Truphone client is available for both Nokia and the iPhone. The following table shows the Truphone client, and compares it to Fring and Nimbuzz.
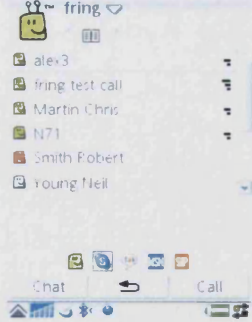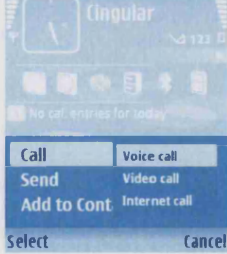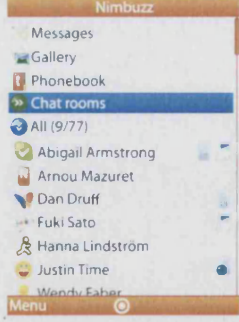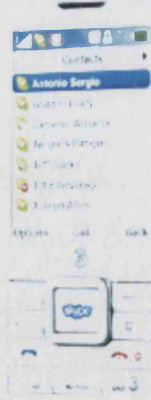
Fring	Truphone	Nimbuzz	Skype
Separate application; also supports instant messaging and presence	Highly integrated, no separate user interface, but no instant messaging or presence functionality	Separate application; supports, in addition to instant messaging and presence, social networking and data transfer	The Three Skype-phone can be accessed through a button, offers also Skype-out calls

Table 5-5: Mobile VoIP Client sin Comparison (Corporate Web Sites)

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One of the key components of a mobile VoIP client is the SIP stack. Operating systems such as Symbian usually come with a built-in SIP stack. However, these SIP stacks often need to be re-configured or even built again from scratch:

> The SIP stack that was available on the very early Nokia devices, I'm not going to slag it off, but it wasn't the best SIP stack in the world. The very lightweight version of SIP in itself in terms of a technology, in terms of a protocol was actually quite heavyweight. It was designed primarily for use on a fixed line communication. Protocol if enforced and tried to use it over a mobile bandwidth that's available to you, you very quickly find that you don't really need half of the commands that are available to you
> (Interviewee 35, Director Business Development, Mobile VoIP C).

Another important and often over-looked element in a mobile VoIP architecture are the necessary servers and gateways. In addition to a user register, servers are necessary to manage load-balancing, network address translation (NAT) management, and other features such as voicemail (see, e.g. Truphone architecture in Figure 5-7 above). Furthermore, a wide range of gateways is necessary to support interfaces to different networks from mobile network operators or PSTN to instant messaging or social network communities. In the case of Skype, these gateways are even more important.

The following section will take the mobile network operator, and in particular its information infrastructure, as point of observation. The information infrastructure of a mobile operator (see Figure 5-7) consists of an access network (the base stations and the radio network controller linking several base stations) and the core network (linking different radio network controllers through the so-called serving GPRS support node [SGSN], providing customer information through the home location registry [HLR], and billing capabilities). The core network is linked through a gateway, the so-called gateway GPRS support node (GGSN), to external networks such as the Internet. It is usually protected from the outside through a firewall and a network address translator, shielding the IP address of the mobile device of the customer. This gateway is essential for the initial convergence processes between mobile telephony networks and the Internet. An additional compression server within the SGSN can be used to protect the network from unwanted traffic from the user.

System: 3G Mobile Information Infrastructure
(only data)

HLR

User   Internet

RNC   3G-   GGSN
         SGSN
                    BS

Radio Access Network   Core Network

HLR = Home Location Registry; RNC = Radio Network Controller
SGSN = Serving GPRS Support Node; GGSN = Gateway GPRS Support Node
BS = Billing System

Environment
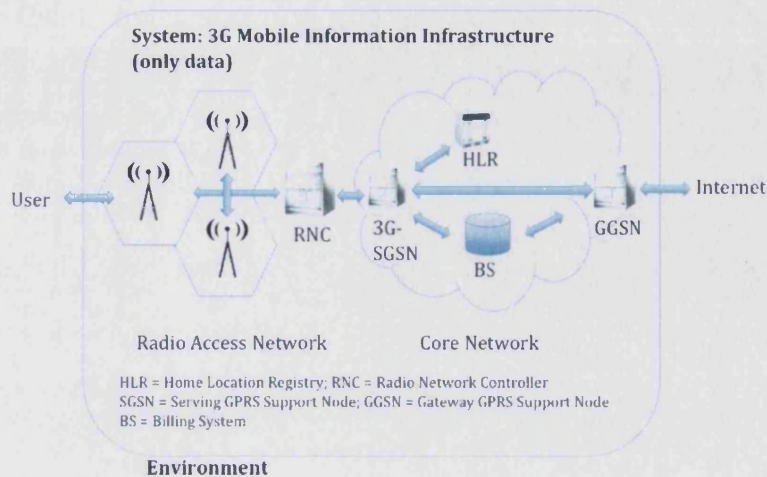
Figure 5-7 Overview of a Generic 3G Mobile Network (Own Figure)

In summary, mobile VoIP comprises a large variety of different technologies. However, these artefacts are embedded in specific discourses and shaped through an ongoing socio-economic process (Orlikowski and Iacono 2001). Before looking at these discourses in more detail, we will look briefly in the following section at the socio-economics of mobile VoIP.

5.2.4 Socio-Economics of Mobile VoIP

The business models of the mobile VoIP companies under study varied substantially. The distinctions made by the mobile VoIP companies themselves vary from fixed-mobile termination fee arbitrage to white-label models such that the technology is provided to a network operator but promoted under its brand. First, we will look at the arbitrage models. One of the key arguments for mobile VoIP adoption has been economics. Since mobile VoIP calls are terminated on a fixed line and not on a wireless line, the economic effects can be substantial, particularly in Europe.

> "The economics of it though is interesting. So if you can cut the current rates are something like 10 Eurocents per minute. That's the bulk of the—that's a significant proportion of the total revenue build for the minute of use. If you circumvent that, then you cutting your, you are immediately destroying an awful lot of revenue for the industry".
> (Interviewee 31 - Director Telecommunications Research - Investment Bank)

However, interconnection charges are not the only regulatory distortion that makes mobile VoIP economically interesting. Another is the artificial pricing structure of time-based pricing (e.g. per minute). Finally, there are additional surcharges for

international calls. The following table shows the differences in charges for a one-minute call to India (Table 5-6):

Table 5-6: International Calling Rates (Example: UK-India), 20th January 2010

Post-paid customer calling a landline in India for one minute without saver plans (in GBP)					Calling a landline in India for one minute (in GBP)			
Vodafone	T-Mobile	O2	Orange	Three UK	Truphone	Nimbuzz	Fring	Skype
1.65	1.30	1.50	1.00	0.95	0.03	0.05	Depends on SIP provider	0.05

While most of the network operators have introduced special bundle deals, the prices are still substantially above those of mobile VoIP companies. Another interesting economic aspect results from the different pricing of voice and data:

> "The cellular operator is recovering for the use of that spectrum in such a way that he's earning a rate of return on the use of the spectrum, a profit on the use of the spectrum, reasonable profit on the use of the spectrum. Then the cellular operator would be relatively indifferent to whether the customer was doing his mobile voice over the top or using their own voice service, right? So the reason these things would be a threat to a cellular operator is because they're exploiting the difference between the prices for the data service and the voice service."
>
> (Interviewee 4 - Former Chief Technology Officer - Regulator)

The second type of business models has involved partnerships with network operators. The most famous and probably also the most successful has been that between Hutchinson Three and Skype. Their partnership started in 2006 and reached a peak in 2007 with the introduction of the joint Skypephone.

Despite the intensive efforts carried out by mobile VoIP companies, the adoption of mobile VoIP has so far been relatively low. According to the Deloitte Digital Index (Deloitte 2009), only 2% of the UK population uses fixed-line VoIP and a couple of hundred thousand use mobile VoIP, in particular the Skypephone by Hutchinson Three. However, the iPhone phenomenon has most likely increased substantially the number of mobile VoIP clients on mobile phones, as the example of Skype mentioned above has shown. Despite the current very low numbers of mobile VoIP users, many analysts see a bright future for mobile VoIP, in particular for VoIP over operator-controlled networks, since more and more operators plan to change to VoIP in the course of LTE implementation; e.g., the CIO of Vodafone Group, Steve Percey (2008, 10), pointed out that "LTE will use VoIP from the outset". This silent shift

from circuit-switched to IP highlights one of the key problems with mobile VoIP that has been pointed out by the Vice-President Marketing of Mobile VoIP Company B:

> "As a user, do I really need to know what mobile VoIP is? No, I just want to make a phone call." (17-VP Marketing, Mobile VoIP Company B)

In summary, the socio-economics of mobile VoIP have some interesting aspects, including the arbitrage model between fixed and mobile as well as the partnership model. Despite the large number of available mobile VoIP clients, the adoption rate has still been rather low. These three points will be important to keep in mind for the following study of the convergence discourses surrounding this technology.

5.3 CONVERGENCE DISCOURSES SURROUNDING MOBILE VOIP

Having dealt with the case description of mobile VoIP, it is now time to turn towards the unit of analysis of this dissertation, the convergence discourses surrounding mobile VoIP. This section aims to identify the link between mobile VoIP applications and convergence, identify the relevant convergence discourses, and delve deeper into the characteristics of each discourse using the three convergence dimensions identified in the literature as guidance. The first sub-section provides an overview of the convergence discourses in UK mobile telecommunications, primarily based on business press articles and profiles on the professional social network LinkedIn. The second sub-section presents the four core distinctions upon which the convergence discourse surrounding mobile VoIP is based. This is followed by an in-depth discussion of the emerging convergence discourses themselves. The fourth sub-section identifies initial traces of the convergence paradox within these discourses prior to the following section's discussion of the initial findings from this chapter.

5.3.1 Overview Convergence Discourses in UK Mobile Telecommunications

An initial analysis of the data corpus shows that the notion of convergence related to technology was used for the first time in the UK business press in 1981. Figure 5-8 shows that there was a very low usage of the notion in the 1980s.
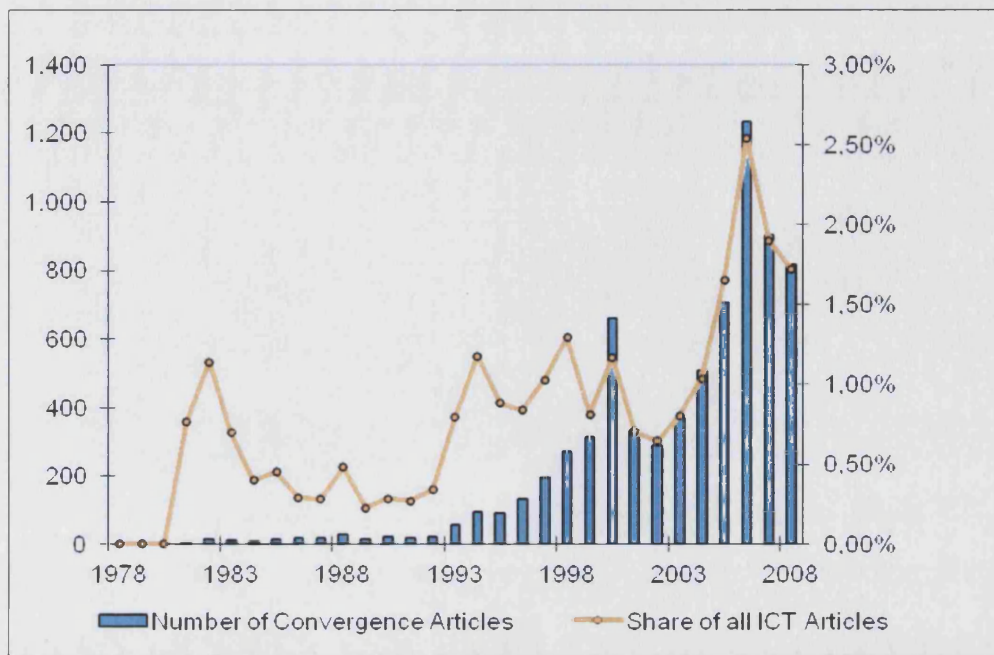
Figure 5-8 Articles on Convergence in the UK Business Press

(Own Figure)

Only in the early 1990s do we observe a substantial increase. Lind (2004), who focused on the use of convergence in the U.S. media observed a similar increase in 1993 and explained this increase in a report produced by the investment bank Goldman Sachs (1992), which put the promise of technological convergence on the agenda of many organisations. The articles in the data corpus do not reference this report; however, many of the articles in 1993 reference the CEOs of Apple and AT&T and their "convergence visions". The first peak of discussion of convergence was reached in 2000, with 660 convergence articles in the UK. The reason for the sudden decline in 2001 and 2002 is most likely related to the burst of the dotcom bubble (Lind 2004). Several articles from this time period referred to convergence as a buzzword. According to the fad and fashion literature, we would expect a further decline since more and more negative connotations and failure stories became associated with the notion of convergence. However, the data shows another steep increase, reaching its peak in 2006 with more than 1,200 articles, nearly double when compared to the first peak in 2000.

Figure 5-10 sheds some more light on these findings. It shows that the increase in convergence articles in the UK business press from 2003-2006 resulted primarily through the usage of the term in the context of mobile telecommunications.
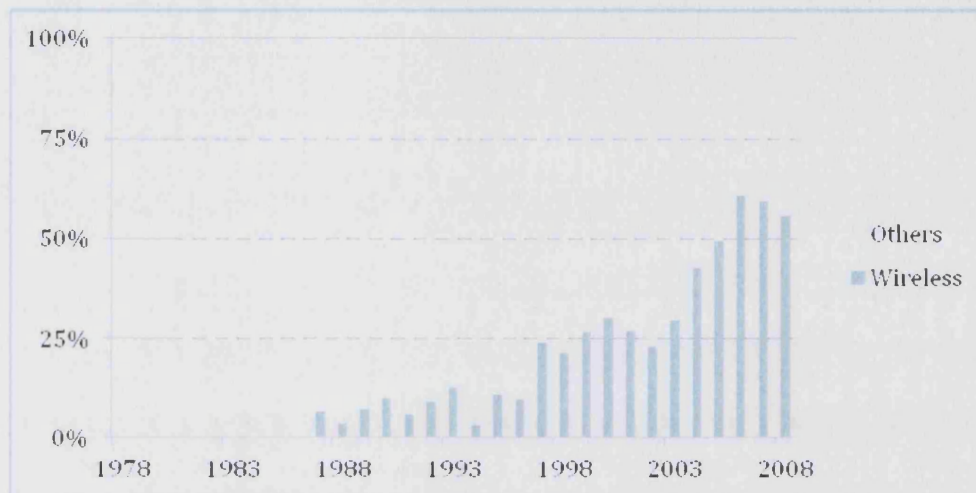
Figure 5-9 Distribution between Convergence Articles in Mobile and Non-Mobile Contexts (Own Figure)

There is evidence in the data corpus that convergence has been used in the context of mobility since 1987. The share of convergence not related to mobility has decreased over the years, although the absolute number of articles has increased. The years from 2000 until 2004 show an overall decline. However, the number of articles using convergence in non-mobile contexts increased again. This trend changed sharply in 2004. Convergence in the context of mobility has been the prominent context for the notion of convergence in the media and since 2006 has contributed nearly 50% to the overall convergence communication. The years after 2006 show another decline; however, it is still above the first peak in 2000. In summary, the initial bibliometric analysis shows that since 2004 mobile convergence is with a share of >50%, the most prominent technological convergence discourse in the UK.

The following table (Table 5-5) shows the use of convergence in the profiles compared to six other management fashions. The selection of these fashions is

intended to exemplify how the convergence discourse can be compared to two fashions studied in the literature (knowledge management and business-process reengineering), two typical telecommunication fashions (Web 2.0 and next-generation networks), and two recent fashions (benchmarking, sustainability).

The analysis of the LinkedIn data shows that in general management concepts are not often used in job titles and profiles. One reason for this might be that managers who are only a small share of the overall LinkedIn community primarily use these concepts to make sense of the world. However, the analysis shows that convergence has a relatively high adoption rate in the UK telecommunications workforce compared to other management concepts. 2.5% of the UK employees working in the telecommunications sector have used convergence as a descriptor in their job profile, and nearly a fifth of these use it in their job title. While it does not reach the diffusion of sustainability in the profiles, it has the highest diffusion in job titles compared to any of the other six management fashions. 60 of the 181 profiles (33%) with a convergence job title and 665 of the 1007 total profiles (66%) mentioning convergence were related to mobility.

Table 5-7: Profiles of Telecommunications Professionals using Convergence in LinkedIn UK

UK Profiles from LinkedIn (07/2009)	Profile Total (job titles)	LinkedIn Share In percent	Industry Share Estimate in percent
Convergence	1007 (181)	1.07%	2.46%
Knowledge management	144 (24)	0.15%	0.35%
Web 2.0	179 (0)	0.19%	0.44%
Next-generation networks	741 (64)	0.79%	1.81%
BPR	48 (3)	0.05%	0.12%
Benchmarking	229 (13)	0.24%	0.56%
Sustainability	2910 (118)	3.09%	7.12%

The initial findings from this data corpus suggest that convergence is not limited to mass media, but is also grounded in practice, in this case institutionalised through job titles. Convergence seems to play in a different league compared not only to the traditional management fads of knowledge management and BPR, but also to new ones such as Web 2.0. Furthermore, it is interesting to note that convergence was used across hierarchical levels (from support staff to director) and crossing different

functions (from operations to sales). It is also interesting to note that compared to the findings in the Factiva data corpus, convergence is used here in most cases without any qualifier or detailed explanation regarding what convergence the individual practitioner is dealing with.

In summary, the data shows that convergence is not just a concept used in the trade press but it is also embedded in practitioner's self-perception. However, it has to be made clear that LinkedIn profiles are used by many practitioners for job search or raising attention to head hunters. The use of potentially fashionable terms such as convergence or sustainability provides a signalling effect. The first mention of the notion of convergence in the context of mobility was found in the data corpus in 1987 in a report issued by Logica (Logica 1987: 1):

> "There are also prospects for greater convergence between mobile radio communications and fixed, wired services. The rapid growth of cellular telephony services, which provide interconnection with the fixed telephone network, has already started this process."

This quote mentions the distinction between fixed and mobile. Convergence in this context means basic interoperability between calls from mobile phones to fixed lines and vice versa. Another very early form of convergence was between mobile standards. This distinction was based primarily on different standards in handsets and different frequencies. It was envisioned in 1990 that UMTS could fulfill this vision of convergence, as mentioned in an article in the *Times* (Times 1990: 3):

> "But integration and convergence between different mobile types, and between mobile and wireline networks, will take place in the next few years. This is expected to result in a universal mobile service (UMTS) early next century".

Fixed-mobile convergence (FMC) became a dominant discourse from 1995 onwards when the UK fixed-line operator BT attempted to take over a 40% share of mobile operator Cellnet from Securicor. Until 1998 most of the articles in the corpus were concerned with the distinction between fixed and mobile (see table 5-8). In 1998, the form of convergence differentiated into other forms based on different distinctions. One was based on the mobile/Internet distinction. It was driven primarily by the release of the wireless application protocol (WAP) specifications. In the same year, the mobile/computing convergence form gained momentum through the introduction of the Symbian mobile operating system in mobile phones. Another emerging form was based on the voice/data distinction, which gained momentum through the development of 3G networks.

The mobile/Internet distinction reached its peak in 2000, when 40% of the articles were concerned with this distinction. FMC reached only 11%, similar to the mobile/computing distinction, with 9% for voice/data. However, this changed very quickly in the following years. In 2004, BT co-founded the Fixed-Mobile Convergence Alliance. Furthermore, BT launched a new product in 2004 called Bluephone that was based on the idea of opening up broadband routers for mobile phone access. Vendors and mobile operators started to work on so-called FMC products. In 2005, 66% of all articles were concerned with fixed/mobile, 12% on the distinction between different media, and only 3% on mobile/Internet and 2% for mobile/computing, respectively (Table 5-8).

Table 5-8: Distribution of Key

Convergence Distinctions, in Percent

Distinctions	1995	2000	2005	2008
Fixed/mobile	60	11	66	64
Mobile/Internet	0	40	3	8
Mobile/computing	10	11	2	2
Voice/data	10	9	1	2
Mobile/media	10	10	12	3
Others	10	19	16	21

This distribution has changed only marginally over the past three years; however, the focus shifted in the context of FMC away from the fixed-line operators such as BT to mobile operators and VoIP service providers. In 2008, 64% of the articles were concerned with FMC, 8% with mobile/Internet, 3% with mobile/media, and 2% with mobile/computing and voice/data.

However, the description so far only provides an overview of the landscape of convergence discourses (Herzhoff 2010). Hence, the following section will analyse in more detail the case of mobile VoIP in the UK, followed by a detailed analysis of the convergence discourses.

5.3.2 The Four Core Distinctions of Mobile VoIP

Before going into the detailed description of these discourses, it is important to ponder the question of which convergence discourses underlie mobile VoIP. Asked differently, what are the converging elements?

It seems feasible to begin this inquiry with an analysis of the self-description of the four main mobile VoIP companies in the UK. The table below (Table 5-9) illustrates how these companies describe their mobile VoIP client. It becomes clear that the two main distinctions they want to address are Internet and mobile (in the case of Fring, Truphone, and Skype/Three) as well as fixed and mobile (in the case of Truphone). Truphone sees itself as a "new age converged mobile operator" (Truphone 2007), whereas Fring heralds its auto-roaming functionality between 3G and WiFi networks as delivery of "Fixed-Mobile Convergence" (Fring 2007).

Table 5-9 Self-Description Mobile VoIP Companies

Fring	Truphone	Nimbuzz	Skype
"Stemming from this desire to cut loose from telecom dependency, the Fring founders created the first true peer-to-peer mobile VoIP application. Fring represents true convergence of Internet and mobile telephony." (Fring.com)	"Truphone turns a standard cellular phone into a dual mode converged phone, allowing calls to be made over the phone's wireless link via SIP, or through the cellular system." (Truphone. com) "Truphone is a converged GSM/WiFi Solution." (Truphone Presentation, 2007)	"Convergence is, for us, basically Internet-based communication for everyone, everywhere, all the time from any device – so-called mobile freedom". (Director for Communication, Nimbuzz)	"Weighing about 90 grams, the 3 Skype-phone is the new poster boy for the convergence of Internet applications and mobile broadband technologies" (Hutchinson, 2007)

Similar to Truphone, BT, as an important mobile VoIP pioneer in the UK through its Fusion product, primarily focuses on the fixed-mobile distinction:

> "Convergence lies at the heart of the rapid changes in communications, and it is central to BTs strategy. For example, we are offering our customers a converged 'best of fixed and best of mobile' combination through our BT Fusion product, giving them freedom and flexibility, rather than worrying about choosing between those two ways of delivering services." (BT, 2009)

However, it is interesting to note that mobile operators and equipment vendors look in particular at the distinction between voice and data, as well as IP and circuit-

switching in the context of mobile VoIP. The network equipment unit of Nokia (2005) published a white paper titled "Mobile VoIP: IP Convergence Goes Mobile":

"The telecommunications industry is in the midst of the megatrend of IP (Internet Protocol) convergence, with the shift from circuit-based networks and system to IP packet-based networks (...). The most visible aspect of IP convergence is through Voice over IP (VoIP), a way to carry voice calls over an IP network by digitizing and packetizing them as data streams" (Nokia, 2005: 1).

Several documents of mobile operators were analysed in detail, including company presentations and response documents to Ofcom's mobile sector assessment consultation (Ofcom 2009). The following table (Table 5-10) shows how three of the five mobile network operators in the UK conceptualise convergence in their responses to Ofcom's mobile sector assessment:

Table 5-10 ICT Convergence according to Mobile Network Operators (Ofcom 2009)

Hutchinson Three UK	T-Mobile	Vodafone
As **fixed mobile convergence** (FMC) takes place the distinctions between the two types of technologies are becoming increasingly blurred as time goes on (Hutchinson 2009, p. 4)	The blurring of boundaries between fixed and mobile services is largely being driven at the software and applications layer, with major brands replicating the fixed service experience on the mobile device. Developments in the **fixed Internet** will increasingly create new opportunities in the mobile services space. A key emerging trend in **FMC** is the growth of cloud-based storage and applications - customers will be able to access content and services from any Internet enabled device, stimulating demand for always-on connectivity. As such, developments in the fixed Internet will increasingly create new opportunities in the mobile services space. Furthermore, with the majority of smart phones being Wi-Fi enabled and with the connectivity being controlled by the device and end user, there is a risk that fixed operators could cherry-pick traffic in busy areas, leveraging the capacity and cost advantage of fixed infrastructure compared to mobile. (T-Mobile 2009, p. 11)	For instance, the discussion of Ofcom's 'convergence' trend is based almost entirely on the observation that both fixed and mobile networks are gravitating from **voice-centric circuit switched technology towards increasing use of IP**. This is in itself is relatively uncontroversial. What is far from uncontroversial, however, is the apparent suggestion that 'convergence' in the limited sense above "also raises the question of future mobile call termination rates, in a world where the delivery paths of fixed and mobile services may easily cross over". (Vodafone 2009, p. 4)
Remark: Convergence Forms were highlighted		

An initial coding of the document and interview data shows four meta-forms of convergence discourses in relation to mobile VoIP:

- Convergence of mobile and fixed
- Convergence of mobile and Internet
- Convergence of voice and data
- Convergence of IP and circuit-switched technologies

These four distinctions are the underlying schemata guiding the observation of convergence in the context of mobile VoIP. However, the initial findings suggest the proposition that different observers prefer different schema. Even though these four discourses are highly interconnected, each discourse will be described in the following sub-sections individually for the purpose of retaining analytical simplification. The description of these four discourses entails a detailed discussion of the three convergence dimensions identified in the literature review in chapter two: the social/technical, differentiation/unification, process/vision dimensions and their underlying forms, alignment, correspondence, optimization, recombination, and interoperability. Furthermore, the distinctions are not only based on these meta-concepts but also include another distinctions related to the converging elements: networks, services, devices, organisations, industries, and functions - anything can converge in the realm of the distinction.

In the final sub-section, the findings from the four descriptions will be contrasted with each other. However, this section does not make any use of systems theory terminology, leaving this to the analysis section.

5.3.3 Convergence Discourses Emerging around Core Distinctions

The convergence discourses emerge around these four core distinctions. In this sub-section, each distinction will be used to describe the surrounding convergence discourse.

A. Fixed/Mobile Distinction

Similar to the overall convergence discourses in the context of mobility identified in section 5.1.3, the fixed-mobile convergence discourse also plays a major role in regards to mobile VoIP in the UK. The data corpus indicates that one of the promises of mobile VoIP is that it bridges the divide between fixed and mobile. Different

mobile VoIP implementations such as the BT Fusion phone and the Truphone application are mobile VoIP convergence programmes with respect to this distinction of fixed and mobile. However, what this means depends on the observer looking at this distinction. While mobile network operators see fixed-mobile convergence as a vision to reduce capital expenditure and increase coverage (e.g. through femtocell technology), fixed-network operators such as BT see fixed-mobile convergence essentially as a programme to recapture voice traffic from mobile network operators. Mobile VoIP players, on the other hand, see fixed-mobile convergence as an opportunity for the arbitrage of termination charges. One manager from Swedish and Finnish telecommunications incumbent Telia Sonera pointed out something crucial at the Open Mobile Summit Conference in London in 2009:

> "I agree that the time of distinguishing between fixed and mobile is sort of out. But it has nothing to do with convergence. It has to do that the customer is moving towards wireless solutions. No customer wants to be connected to the wall (...) It has nothing to do with convergence because people want wireless access."
>
> (Kenneth Karlberg, President of Mobile Services Telia Sonera)

Furthermore, this fixed/mobile distinction is not just spatial. Instead, it is based on different socio-technical arrangements that have grown over the past thirty years. One of these arrangements is the issue of *termination charges*. The following table provided by Ofcom (2009) shows the current termination rates for fixed and mobile calls:

Table 5-11 Wholesale Mobile Voice Call Termination Rates (Ofcom 2009)

	Termination 2009/10 (2010/2011)			
	Vodafone and O2	T-Mobile and Orange	Hutchinson 3G	Fixed (BT)
Originator Mobile/Fixed	4.4 (4.0)	4.5 (4.0)	5.5 (4.3)	0.17-0.25 depending on day/night (N/A)

Mobile termination fees are substantial revenue generators for mobile operators and accumulate, according to Ofcom (2009) up to 14% of total revenue for mobile operators in the UK. In the same report, mobile VoIP is seen as having some profound implications on interconnection fees. First, a mobile VoIP call does not terminate on a mobile number. Second, it moves away from the regime in which the calling party pays to one in which both parties pay through their mobile data connection. The Ofcom (2009) report sees this as favourable since it might solve the problem of the monopoly of termination over calls to the mobile operator's subscribers.

Another interesting difference between fixed and mobile is *capacity difference.* In most circumstances, a fixed line has higher capacity than a mobile line (exceptions might be rural areas). Higher capacity, a tighter coupling to the Internet infrastructure, and a less controlled network have led to a ten-years-earlier offering of VoIP on the fixed network compared to the mobile network. Furthermore, convergence as interoperability is used to explain the main technical function of the Truphone application, namely to enable a bridge between WiFi and normal GSM telephony.

Along the unification/differentiation dimension the fixed/mobile distinction has a few interesting characteristics. Mobile VoIP distinguishes itself in at least three ways from fixed VoIP. The first, most obvious distinction is that between mobile and fixed-line. Fixed VoIP requires no handover between cells or between WiFi and 3G, and is therefore less complex to implement. The second aspect is related to the device. While fixed-line VoIP is accessed primarily via a PC or through a traditional phone, in the case of mobile VoIP the phone is the computer. This has a couple of interesting consequences, e.g. a user saves his contacts on his mobile phone but does so less on a stationary phone. Hence, the mobile VoIP client is on the same device as the primary address book. However, there are also more hurdles involved to install the VoIP on the client. While a fixed-line VoIP client just needs to be downloaded from the Internet, installed on the computer and 'ready to go', a mobile VoIP client often needs to be downloaded through a cumbersome process and configured separately. Despite these differences, both infrastructures have co-evolved in many different respects. For example, mobile telephony networks despite early digitisation through GSM, have relied until today on circuit-switched technology (Tilson 2006). Another interesting aspect is unification. It makes a world of difference if the convergence vision FMC addresses consists of, as BT puts it, a "best of fixed, best of mobile combination" (BT 2005: 1), or if it is more of a replacement or substitution of fixed-line through mobile as mobile network operators see it. However, the assumption of convergence as sameness is also in the context of mobile VoIP a

fallacy such that it becomes particularly messy for the designers of converging systems:

> "I'll tell you a little bit, just briefly, going back to Fusion, the phone that went onto WI FI. One of the important things is to avoid bill shock to the customer. But you can imagine it made it much more complex if you had to change the billing part way through to flip over, so what would happens is that whatever rate you started the call stayed the rate for the rest of the call. You had to simplify it for the customer, it's just too much otherwise. It meant that you could win if you initiated a call and WI FI phoned you and you walk outside. You can also lose if you walk into your home, etc, you would be paying over the odds. That's the sort of messy area."
>
> (Interviewee 36 - Head of Mobile R&D - Fixed Operator)

Fixed-mobile convergence conveys different expectations. For example, BT marketed its BT Fusion product as "the world's first seamless combined fixed and mobile service" (BT 2006). The notion of seamlessness seems to play an important role in convergence discourses. It signifies on the one hand a desired state or vision, and on the other it is a specific expectation towards the technology:

> "You can take a conversation with you, everywhere. Fixed mobile doesn't really make much sense any more."
>
> (Interviewee 37 - Head of Regulation EMEA - Mobile VoIP Company D)

B. Mobile/Internet Discourse

While the FMC distinction is particularly important for fixed-line operators as well as equipment vendors selling products to overcome this distinction, most of the mobile VoIP companies aim at the distinction between mobile and Internet. However, access to the Internet from a mobile device has been possible since the early 1990s:

> "It is just a new way of accessing the Internet. Mobile Internet was already there on the CSD". (Interviewee 26, Senior Engineer, mobile network operator).

1st and 2nd generation mobile phones were capable of accessing the Internet (Haas 2006). However, this was only possible by attaching them to a portable computer, and the speed was limited to a maximum of 9.6 Kbps. In 1996, Nokia presented the Nokia Communicator 9000, the first mobile phone with a Web browser capable of accessing Web pages. As seen by the walled-gardens business model prevailing in the late 1990s up to 2007, the mobile/Internet distinction primarily has been maintained and carefully controlled by mobile network operators. All four mobile VoIP companies, which took part in the interviews, had specialists from both

domains. Despite its long existence, mobile/Internet is still regarded as the most interesting convergence distinction by market observers:

> The problem you get into is that, to your earlier point that the really interesting thing happening in the world today is the convergence of the Internet and the mobile device. That requires a lot of investment over time in network. If you take the primary profit stream i.e. voice and you destroy it, then you need no money.
>
> (Interviewee 31 - Director Telecommunications Research - Investment Bank)

The most prevailing archetype is interoperability. It was used in the context of announcing a partnership with Google: "Interoperability between Google Talk and Truphone means the Web/mobile VoIP divide has been bridged. Google Talk can call Truphone, and Truphone can call Google Talk" (James Tagg, CEO of Truphone). However, the differences between both domains do cover not only technical but also many socio-economic aspects. The bridge, for example, is not only technical, but also social:

> "We are a broker and converged IM and VoIP broker and we expose different legacy networks to each other. But there is a lot of -- cooperation is required in efforts to sustain a high level of quality of service and high availability. And that is not technological challenge but it imposes some technological challenges because until we have solid agreements, contracts with all these networks, we still have to fight in an effort to allow the users the connectivity and the quality of services et cetera."
>
> (Interviewee 18 - Chief Architect - Mobile VoIP B)

Table 5-12 shows the five main differences between mobile networks and the Internet. However, many of these differences have deteriorated over the past few years. Flat-rate models have also become more common for mobile operators, however, most of the infrastructure is still circuit-switched based. In the case of mobile VoIP, we can see this, for example in how VoIP attempts to emulate circuit-switched characteristics such as emergency number calls, the dial tone, and other elements:

> "(...) when you use IP for real time services for voice, what you try, you actually do is make it look like circuit switched because you take the headers off the packets, you route all the traffic through, re-identify a route or through the same way, through the same circuits so there's no delay, so you make it look like circuit switched. So we've gone, everybody said oh yeah circuit switch is old, old fashioned, and then you spend great deal of money actually trying to make it look like circuit switch in order to fulfil regulatory requirements and QoS."
>
> (Interviewee 22, R&D Engineer, Mobile Operator B)

Table 5-12 Some Key Differences Between Mobile Networks and the Internet

Mobile telephony network is traditionally...	Internet is traditionally...	Findings
Circuit-switched-based	IP-based	Difference is slowly deteriorating, however, focus on imitating circuit-switched
Pay-per-minute-based	Flat-rate	Mobile data flatrates increasingly popular but with lots of usage restrictions (fair use policies)
Closed	Open	Internet is itself also moving towards a more closed environment
Based on Hardware	Based on Software	Mobile telephony increasingly based on software (e.g., apps)
Controlled through the network	Controlled through the edges	Difference still holds

Furthermore, the control mechanisms are still centralised. One of the interviewees even argues that the direction of the Internet itself might shift towards the mobile networks. Similar to the fixed/mobile distinction described above, the direction of convergence in the context of mobile/Internet may also be contingent and dependent on the observer:

> "So I think rather than saying that the mobile Internet space will develop as the Internet has, I would say that there's an equal ...... no, not an equal possibility, there is a remote possibility but an entirely feasible possibility that the Internet space could move towards the mobile space in terms of the degree to which it's a managed environment."
> (Interviewee 36 - Head of Regulation EMEA - Mobile VoIP Company D)

The more centralised control in the mobile network environment is a common theme in the net neutrality debate.

C. The Voice/Data Discourse

One market research report on mobile VoIP suggests, "applications such as Skype and Vonage have influenced users to think of voice as a data application" (Instat 2009). Behind this idea of voice/data convergence is the move from circuit-switched to packet-switched networks. This is still a highly relevant topic for mobile network operators as the discussion around the OneVoice initiative has shown. For other market participants, the distinction data/voice has become a more and more irrelevant distinction:

> "What happens is that some Telecom operators are still thinking that they are primarily voice

people. What they are doing is that their business is the business of voice. Actually, that's not true. Their business is a network, a data transfer network."

However, there are still many socio-technical arrangements reinforcing this distinction. Organisational structures as well as IT systems like the large-scale mobile network billing systems still mirror this distinction. Furthermore, mobile network operators differentiate in their internal and external communication between voice and data key performance indicators like voice and data ARPU (average revenue per user).

D. IP and Circuit-Switched Convergence

While most of the previous examples of convergence have been contested by observers, several interviewees pointed out that the only real convergence is IP convergence:

"So, in the long term, convergence in a sense is providing a common protocol platform. So the fact[is] that, under convergence, I become indifferent to whether I'm accessing the network over a Wi-Fi network versus a cellular network versus a WiLine network."
(Interviewee 4 - Former Chief Technologist, Regulator).

Nokia, one of the main promoters of mobile VoIP, takes a similar perspective:

"The most visible aspect of IP convergence is through Voice over IP (VoIP), a way to carry voice calls over an IP network by digitizing and packetizing them as data streams. Operators already use VoIP through IP trunking and the use of softswitches to reduce backhaul and transmission charges". (Nokia, Whitepaper).

However, even in the case of IP convergence, there is not a clear convergence. The underlying network technologies are still very heterogeneous, and the only fully-IP based elements are the gateways and interfaces between the different network technologies:

"The original idea of UMTS was packets are wonderful. Much cheaper, much easier to manage. So you take your voice calls over this nasty circuit switch network, convert it to voice over IP, get it into nice packets, send it over the packet switch network. You can switch off your circuit switch network. Great. The original idea was to do that in Release 5 of UMTS. Now it's Release 9, or something like that. It keeps on going back to the point where everything is going to go IP based (...). The gateways or the interfaces are IP based, but the networks themselves might still be very heterogeneous (...) and these underlying structures running below IP will determine how the IP protocol performs in terms of its packet throughput, its delay etc."
(Interviewee 11 - Reader in Electrical Engineering - Academic)

Hence, the convergence happens at the edges of the network. The convergence of network does not mean unification but rather interoperability. The existing networks are still in place and co-evolve instead of being replaced by one new entity.

5.3.4 Convergence Paradox

Convergence discourses have a very interesting characteristic. They are asymmetrical and paint over any form of divergence or fragmentation. While it is the essential character of convergence to bring elements together, it also produces divergence and fragmentation at the same time. In the interview with the regulator on converging services such as Truphone, the interviewee made a very interesting point:

> "Convergence is the fact that platforms that are previously characterised by having single uses become more flexible and can offer a broader portfolio of services. And conversely, services that were usually instantly linked into the platform, the most obvious [being] the parallel with [the] television and broadcast spectrum, become available on multiple platform[s]... convergence enables choice, enables a broader range of consumer choices in a whole range of different ways."
>
> (Interviewee 2 - Head of Convergence - Regulator)

In the case of mobile VoIP, this can be observed on various occasions. Mobile VoIP developers have not only to deal with fragmentation but they also produce fragmentation. On the one hand, they have to deal with a very high level of fragmentation of devices, networks, operating systems, and different interpretations of standards. On the other, they produce fragmentation through multiple numbers, multiple bills, and networks. As one interviewee pointed out:

> "So on the topic of convergence I think that we've seen a radical shift in our communications in the sense that we really are moving away from this notion of, you know, I have a dedicated device running on a dedicated network that I can only use for one purpose."
>
> (Interviewee 16 - Global Head of Business Development - Mobile VoIP Company D).

Instead, convergence in the context of mobile VoIP means multiple devices running on multiple networks with multiple purposes in mind. In particular, this can be observed from the user perspective. However, this can be also interpreted as increasing choice for the user:

> Yes, I think what characterises convergence is increased consumer choice and increased fragmentation in myriad related markets. So I think from one viewpoint, there's more competition and sometimes what competition does is enable the pace of competition to be significantly increased in a number of different markets but what that means, in as much as more competition implies, you could characterise it as divergence.".
>
> (Interviewee 2 - Director of Convergence - Regulator)

Finally, one engineer from a mobile network operator pointed out that this convergence/divergence phenomenon might be just there for a limited time:

> "It is a brainstorming going on in the market. Perhaps we are facing a divergence stage right now."
>
> (Interviewee 9 - Senior Engineer - Mobile Operator A)

5.4 INITIAL FINDINGS

This chapter has presented the empirical data from the case study on mobile VoIP. The findings suggest that convergence discourses have played an important role over the past 20 years in the mobile context. The chapter aimed to answer three questions: First, what are the convergence discourses shaping mobile VoIP? Second, what are the characteristics of these discourses, particularly related to the three dimensions identified in the literature? Third, how does the convergence paradox appear in the context of mobile VoIP?

The initial findings suggest that convergence discourses in the context of mobile VoIP materialise around four distinctions: mobile/fixed, mobile/Internet, data/voice, and IP/circuit-switched. These discourses form the intertwined convergence narrative in which mobile VoIP applications are embedded. Different observers have regarded Mobile VoIP as a converging technology and therefore impose different expectation structures on this technology. The common convergence discourses identified in the case of mobile VoIP all aim to reduce a distinction, with a marked emphasis on one side. Hence, these discourses are asymmetrical. The following sub-sections will contrast the findings from each of the four convergence discourses in relation to convergence as fashion, its characteristics, and particularly in relation to the convergence paradox.

5.4.1 Convergence as Fashion

Convergence shows some characteristics of a fashion. Some interviewees regard it as a meaningless buzzword; others saw it on the top of the agenda of the strategies of most ICT companies. In the context of mobile VoIP, this study made a couple of interesting observations. In principle, convergence is used as a notion primarily in discussions between industry experts and even more thoroughly by their observers,

i.e. the mass media, regulators, financial markets, and consultants. Hence, it is often used in communications with external observers and also at the practitioner conferences I visited. Convergence is not often communicated to the user. An exception is, for example, Vodafone 360, a converging platform that might also include VoIP in the near future.

The idea of convergence – as technological convergence often embedded in the notion of interoperability and as social convergence, often in the notions of partnership – is an important characteristic. For many start-ups, the driver to build a mobile VoIP client was the technical possibility of interoperability through the availability of SIP clients and Bluetooth or WiFi chipsets. Convergence was used in many cases to convey the vision to venture capitalists. This vision, however, became compatible for venture capitalists through the success of Skype and, furthermore, the existing arbitrage possibilities. The empirical study also found similarities to the experience mentioned by Hannah Knox (2003) to justify funding for convergence:

> As we enter the next phase of the Truphone revolution, the success of this financing round makes it clear that our investors recognise the business opportunity from convergence and disruption in the mobile space (Truphone press release, 17th April 2008).

5.4.2 Characteristics of Convergence

Each of the four convergence discourses in the context of mobile VoIP has been scanned for the characteristics of ICT convergence identified in the literature review as well as for other potential dimensions. The literature review suggested three dimensions of ICT convergence: (a) the technical/social, (b) the process/vision, and (c) the unification/differentiation dimension. The data from the case study revealed a fourth dimension, an (d) internal/external dimension. Figure 5-10 represents an initial overview of these dimensions.
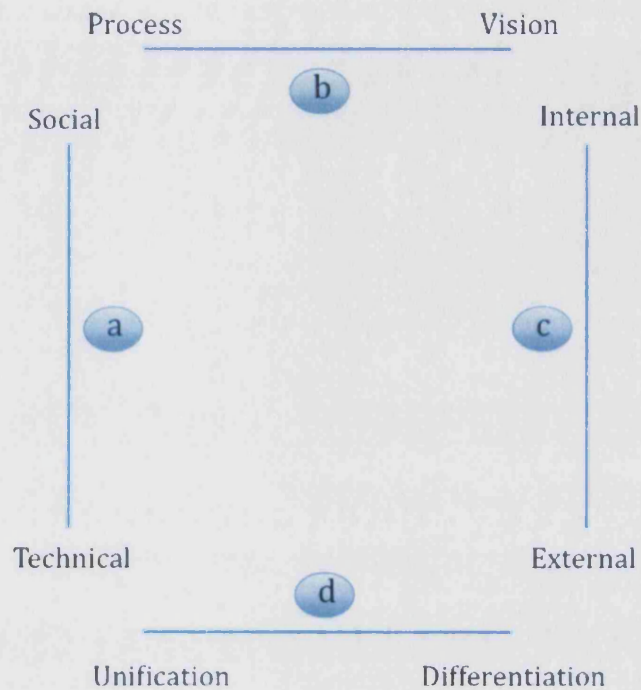
Figure 5-10 Four Dimensions of Convergence

(Own Figure)

A. Technical-Social Dimension

The initial findings from the case study have shown that convergence from the perspective of a mobile VoIP company is related not only to interoperability but also to social alignment between different actors, e.g. the establishment of partnerships. For example, it was not the technical interoperability that was the challenge in bringing together the Truphone and the T-Mobile network. Instead, the main challenges were the issues surrounding interconnection charges, which even led to the court case between Truphone and T-Mobile[3]. However, the convergence discourses surrounding mobile VoIP also showed that the semantics of convergence put a strong emphasis on the fact that the technological interoperability works. One example for this is the term "seamlessness", which plays an important part in the expectation structure of the convergence discourse. The technical-social dimension plays a more significant role in the context of the fixed/mobile and mobile/VoIP distinctions. All four distinctions are based on a wide array of socio-technical

---

[3] Truphone had achieved an interim injunction from the English High Court that T-Mobile UK had to provide T-Mobile customers access to the Truphone number range (Subiotto & Snelders 2008).

arrangements and convergence discourses question the assumptions of these socio-technical arrangements. However, all of these discourses are asymmetrical and usually favour one particular side of the distinction.

B. Process-Vision Dimension

The notion of convergence is particularly successful as a vision since it offers interpretative flexibility. Mobile VoIP has been in its early stages primarily focused on visions. However, an increasing number of observers point out that convergence is already there and needs to be "managed". Furthermore, convergence is perceived not only as a single, linear process but also as an iterative sequence:

> "You want to store the next round of convergence as long as possible, because you want to make as much money from the existing investment you make, of course. I can see that from their perspective."
>
> (Interviewee 37 - Head of Regulation EMEA - mobile VoIP Company D)

C. Internal-External Dimension

The internal/external dimension emerged from the empirical data. Actors clearly differentiated between convergence as something external to them in the environment posing a challenge or opportunity, and convergence as an action or programme within their organisations. For a mobile network operator, internal convergence programmes are regarded as something positive, maintaining the organisation and giving it ability to deal with the changing environment. However, external convergence programmes can be un-controlled mobile VoIP clients or fixed-mobile convergence programmes initiated by fixed-line operators. However, other actors have re-introduced convergence into their own organisations. For example, one interviewee working for the regulator said:

> "[Convergence] is in the fabric of our organisation, although we are not in the business of creating convergence. We try to anticipate it and to respond to it in our decisions."
> (Interviewee 23 - Strategy Principal - Regulator)

D. Unification-Differentiation Dimension

Most interview partners who challenged the unification characteristic of ICT convergence agreed that, at least IP convergence provides the unifying characteristic of VoIP. However, even this assumption can be challenged. Although most network operators indicated that they are moving towards an "all-IP core", this does not mean that there will be only one network left. All-IP in most cases just means that the

network interfaces can communicate through IP; however, they have to translate this back due to the underlying technology. Networks are highly heterogeneous, and convergence as unification is concentrated in most cases only at the interfaces and gateways. Hence, convergence puts greater emphasis on technological interoperability than on sameness. Thus, the gateway metaphor might be a more useful description for convergence than the Swiss army knife. This also leads to the following section, which discusses the role of the convergence paradox in the context of mobile VoIP.

5.4.3 The Convergence Paradox

One interesting contradiction emerges from the findings in this chapter. On the one hand, mobile VoIP promises convergence. On the other, documents and interview data show divergence in terms of voice services, numbers, billing, and an increasing number of devices capable of making mobile phone calls. Henry Jenkins (2006) has called this the "black box fallacy" (see chapter 1). As one of our interviewees pointed out:

> "You'll have your camera and your music player and your entertainment device and your phone all in one and then hardware and software just becomes embodied within that and regarded as convergence; it's not happening at that level and quite the opposite. There is actually through the focus on differentiators that add value for consumers and their lives, you are actually getting more and more fragmentation in those respective product areas and your Swiss army knives don't do it." (Interviewee 32 – CEO - OS vendor)

He sees convergence happen instead at a more social level, between industries and among high-level strategies:

> "Where convergence is happening, however, I think it's at a macro level. I think it's happening between industries and among high-level strategies." (Interviewee 32 - CEO, OS vendor)

Does the black box fallacy still hold in the software space? While we will take a closer look at this question in chapter six, a few comments can be made. The Nimbuzz application is shaped by the mobile/Internet convergence discourse. In particular, it aims at interoperability across different networks, services, and social networks. A technological artefact such as Nimbuzz might be more interpretative and flexible compared to a physical artefact such as a mobile phone. However, it still faces restrictions at an institutional level, which the following section will present.

5.4.4 Blocks to Convergence

The findings of the case study have shown that convergence is not inevitable. It has taken a long time to establish itself, particularly in contrast to fixed-line VoIP. In fact, what is observable is the tension between convergence programmes and the status quo:

> Trying to safeguard the status quo by missing the opportunity with convergence. I think it was just the natural progress. I think it will be very difficult to stop the Internet now it's here. (Head of Regulation EMEA, Mobile VoIP)

> Established value chains are beginning to crumble at the edges, with new applications and service providers entering the market, new handsets and devices, new business models (23-Strategy Principal, Regulator).

The case study on mobile VoIP showed that convergence can reach limits. Furthermore, it indicates that these limits can result in forms of conflict. Finally, the initial findings from the case study suggest that conflict systems – if not managed well – can increase in size and go well beyond the initial boundaries of the conflict. They can span different socio-economic systems, as seen in the context of mobile VoIP. These conflicts seem to emerge primarily around specific control points and result in increasing fragmentation. One remedy for increasing fragmentation suggested by our interviewees is standardisation.

Funk (2002) pointed out that the convergence between Internet and mobile phone "requires a large number of standards to be created". However, he argued that these new standards differ from previous standardisation efforts in terms of the much lower level of investments and the number of undefined interfaces. He sees in the large number of undefined interfaces the biggest challenge for convergence of mobile telephony networks with the Internet. While previous standardisation efforts have focused primarily on an air interface and less on network interfaces, the mobile Internet requires an interface between user and handset, between handsets and application programs, and between handsets and the Internet. Hence, the consequence is not only competition between the standards for a specific interface such as WCDMA or GSM but rather between "various interfaces themselves" (Funk 2002, 215). However, even standards can lead to increasing fragmentation (Tilson 2006). However, what we found in this study was that one block of convergence is not the creation of standards but, rather, their interpretation. This is not limited to one layer of the stack, but several (e.g. networks):

"Things will sort of move forward, and I'm sure that we will have one day a seamless interoperability between the networks that you've mentioned."

(Interviewee 34, Network Solution Engineer, Mobile Operator A).

To summarise, so far the main findings from the empirical study are threefold:

1. Four key convergence discourses surrounding mobile VoIP have been identified: mobile/fixed, mobile/Internet, data/voice, and IP/circuit-switched. All of these discourses must include the observer since only one side of the distinction is indicated, leading to an asymmetry.

2. In addition to the previously identified three convergence dimensions, one further dimension has been identified. In addition to the social/technical, process/vision, and differentiation/unification dimensions, the internal/external dimension must be included in a framework for mobile VoIP.

3. The convergence paradox appears in the context of mobile VoIP through observing, on the one hand, the appearance of mobile VoIP clients promising seamless interoperability and the alignment of voice, instant messaging, and presence functionality between different networks and, on the other hand, an increasing number of different numbers, bills, devices, and networks.

The following chapter will analyse the data presented in this chapter through the lens of systems theory as introduced in chapter three.

6. Describing the Convergence Paradox through Distinctions

This chapter analyses the empirical data through the lens of Luhmann's Theory of Social Systems. Thus it brings together the data from the case study on mobile VoIP from chapter five with the systems-theoretical concepts from chapter four. The data is analysed according to the different analytical strategies presented in chapter four. The juxtaposition of the empirical with the theoretical concepts generates insight into the actualised operational form of ICT convergence in the context of mobile VoIP. It moves beyond traditional "theories of reflection" (Staehli 2008) in the academic discourse on convergence. Instead, the analysis focuses on popular self-descriptions by practitioners in the telecommunications sector that are often directed at "outsiders" like investors, regulators, or the mass media. Based on these empirical insights, a systems-theoretical conceptualisation of ICT convergence is developed. This conceptualisation provides the ground for unfolding the convergence paradox in the context of mobile VoIP. A new guiding distinction will be presented, and its wider implications for systems design for mobile information infrastructures will be discussed.

6.1 ANALYSIS OF THE EMPIRICAL FINDINGS

A systems-theoretical analysis starts with a "problematique" (Andersen 2009). The "problematique" of this dissertation is, as outlined above, how ICT convergence can be conceptualised through second-order observation to understand the contradictory discourses around convergence in the mobile telecommunications industry, with special reference to the case of mobile VoIP in the UK. This problematique covers three distinct themes: a conceptualisation of ICT convergence, the unfolding of the convergence paradox, and the role of technology in this discourse. Since this problematique cannot be solved directly, an array of sub-questions informed by Systems Theory has been derived from the existing research questions. The following table shows the relationship between the dimensions of ICT convergence, sub-questions, and the relevant analytical strategies (Table 6-1):

Table 6-1 Relationship between Sub-Questions and Analytical Strategies

Dimension of Convergence and Guiding Distinction	Sub-Questions	Analytical Strategies
Process/Vision	What is the Role of Time in the ICT Convergence Discourse?	Semantic Analysis
Convergence/ Divergence	What are the Tensions within the Form of Convergence/Divergence?	Form Analysis
External/Internal	How can ICT Convergence be both external and internal?	Systems Analysis
Differentiation/ Unification	How can ICT Convergence produce both Differentiation and Unification?	Coupling and Differentiation Analysis
Social/Technology	What is the Role of Technology in the ICT Convergence Discourse?	Technology Analysis
Fashion	Is Convergence just a Fad or Fashion?	Fashion Analysis

The different analytical strategies outlined in chapter four are used to provide answers to the sub-questions. However, these analytical strategies need to address three aspects (Luhmann 1988; Andersen 2003): first, the *choice of guiding distinction*; second, the *conditioning* of the chosen guiding distinction; and finally the implications of the exact *observation point*. Thus, before diving into a detailed analysis, this section will briefly introduce what observing convergence discourses means through the guiding distinction of indication/distinction. Furthermore, it gives an overview about the points of observation taken in the following analysis. This point of observation or system reference is important since it provides the anchor for the problematic. In the following sections the guiding distinctions and the conditioning of the analytical strategies will be discussed in more detail separately for each analytical strategy.

A. Observing Convergence Discourses

How can ICT convergence be observed as observation? As outlined above, many social systems in society construct the idea of ICT convergence to describe aspects of the phenomenon of technological change through digitisation. Hence, convergence is always convergence to an observer. Observation is the unity of the distinction of indication/distinction. Therefore, to observe ICT convergence as observation, convergence needs to be indicated. This is the condition of observing convergence as observation. For illustrating the distinctions made during the course of this analysis,

this dissertation follows the notation of George Spencer Brown (1969). He refers to the notation as the "mark of a distinction" that distinguishes between the marked (left), and the unmarked state (right). The mark of a distinction is both an instruction to cross from the unmarked state to the marked state, and a sign for the result of the crossing (Seidl and Becker 2005). Finally, the illustration also has an unwritten state or cross, which defines the context of the distinction (Figure 6-1). The unwritten state in this study is the context of mobile telephony networks in the UK, and, more specifically, mobile VoIP.

Convergence   Distinction

Observation
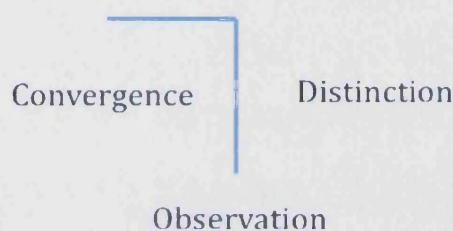
Figure 6-1 Observing Convergence through Distinctions (Own Figure)

The previous chapter has identified four distinct ICT convergence discourses within the context of mobile VoIP: fixed/mobile, Internet/mobile, data/voice, and IP/circuit-switched. However, a second-order observation has also to include the observer. Who observes these discourses? It has already been pointed out in the introduction that all functional systems participate in the convergence discourse. The phenomenon of the coming together of different digital technologies has penetrated society as a whole, and thus has 'irritated' all its functional systems. However, the main impetus for convergence discourses comes from the telecommunications industry itself. The convergence discourse can be observed in this context as a self-description. Self-descriptions are a necessary condition for the closure of a discourse or social system (Luhmann 1997; Staehli 2008). Therefore, this present study focuses in particular on how industry participants themselves construct the idea of convergence. As the empirical data has shown, within the industry the convergence discourse takes place not only in different forms and spaces – in PowerPoint presentations, business cases, patents, and practitioner conferences – but it also finds itself reflected in the artefact.

A crucial question is the point of observation or in Luhmann's words the system reference (Luhmann, Bednarz et al. 1995). Since all systems constitute their environment in their own way, the observer has to select a point of observation. This point of observation designates a particular system, and all other systems become the environment constructed by this very same system. However, this selection is only the starting point of the analysis, and it can be changed in the course of the study (Andersen 2003). This is particularly important since the convergence discourse spans a wide range of observing systems. Thus, the analysis cannot be restricted to a singular point of observation.

B. Points of Observation

Some previous studies have selected ICT (Hacklin 2007) or the telecommunications industry (Nyström 2008) as their point of observation. However, this is problematic in systems-theoretical analysis. Industries and markets can hardly be observed as systems in their own right. Markets are not systems. They constitute the internal environments of the subsystems of the economic system. Hence, the market for mobile telecommunications is only a construct of the observing systems – i.e., the market participants – and it does not constitute a system in itself.

A systemic view of the mobile telecommunications sector includes on the highest level the traditional functional systems of society like the economic system, the market system, the legal or regulatory system, the media system, the political system, and the academic system. Each of these systems observes the phenomenon of convergence in the context of mobile telecommunications. The mass media system observes the system for anything new in the code information/non information. The regulatory system observes the system for anything that is illegal or that needs to be regulated. However, it is the self-description of the market participants that is the focus of this study. This self-description can be targeted to communicate not only inside the organisation itself, but also to "outside" parties, like investors, mass media, regulators, or other practitioners. As introduced in chapter five, this dissertation differentiates between four different sub-systems in the telecommunications sector: infrastructure, service, use, and regulatory systems (Herzhoff, Elaluf-Calderwood et al. 2010). Since the focus of the analysis is the intersection between the infrastructure and the service system, the point of observation has been the infrastructure and the

service system. Both infrastructure and service systems contain different elements. While infrastructure can be mobile, WiFi, or fixed-line, the service can be a traditional circuit-switched voice service provided by the same operator that manages the infrastructure, a virtual mobile network operator, or a VoIP provider. Hence, use and regulatory systems both constitute the environment within the wider telecommunications system.

C. From Point of Observation to Analytical Strategies

The first two analytical strategies pursued, i.e. semantic and form analyses, focus on the conceptualisation of convergence. They develop a clear understanding of the boundaries of the concept, as well as of the meaning and expectation structure. Hence, semantic and form analysis constitute the foundation of the systems-theoretical analysis and both operate in close relation to each other. On the one hand, form analysis shows the paradoxical foundation of the concept of convergence, which is subsequently traced back by the semantic analysis. On the other hand, semantic analysis shows the condensation of meaning in the concept, and provides an overview of the semantic reservoir of the concept, which feeds back into the form analysis. Hence, there is a reciprocal relationship between semantic and form analysis.

6.1.1 Semantic Analysis

This section observes ICT convergence in the context of mobile VoIP as semantic. Luhmann (1995) defines semantics as structures that link communication with communication through different forms of meaning. In other words, semantics are "the stock of generalised forms of differences (e.g. concepts, ideas, images, and symbols), which can be used in the selection of meaning within the communication systems" (Andersen 2007). As outlined in the theory chapter (see section 4.3.1) the guiding distinction for the semantic analysis is concept/meaning. The semantic analysis seeks to find out how convergence is constructed as a concept and how it is related to its counter-concept (Figure 6-2).
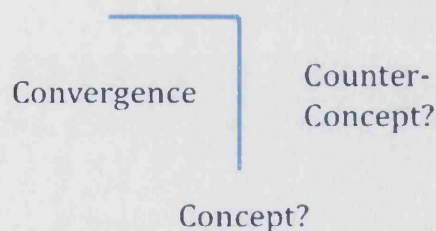
Figure 6-2 Observing the Concept of Convergence

From a systems-theoretical perspective, convergence as semantic provides a reservoir of concepts that different organisations in the telecommunications sector use to describe their environment technological change through digitisation. For example, through concepts, organisations as social systems observe themselves, their environments, and their relationships to other systems in their environment (Andersen, 2008). These concepts determine what an organisation can and cannot see.

Semantic analysis shows the condensation of meaning. The following figure illustrates the multiplicity of meaning condensed in the concept of ICT convergence, which the researcher came across during the course of this study. The figure is structured based on the four dimensions of convergence identified in the literature review and case study and the fashion theme (Figure 6-3).
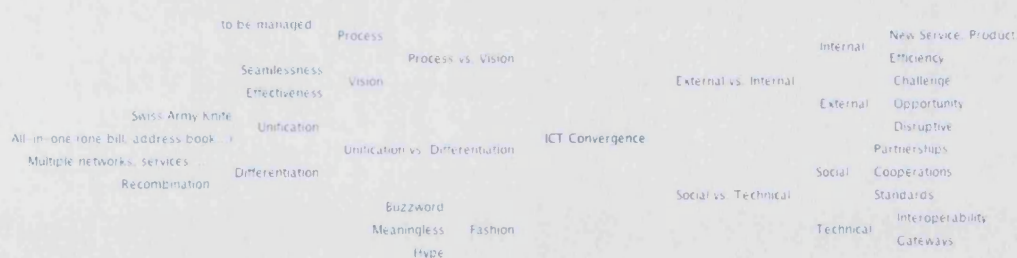
Figure 6-3 Condensation of Meaning within the Notion of ICT Convergence
(Own Figure)

Andersen (2010) suggests differentiating between three different levels of condensation: empty concepts, semantics, and norms. The shift from empty concept to semantics can be observed where there is not only a concept with a non-specific counter-concept, but also a large number of different concepts. Semantics become norms if they further condense concepts into specific forms. Convergence has

condensed meaning. The meaning that emerges is used in particular situations. The idea of convergence is made durable in artefacts, e.g. like the mobile VoIP client.

The historical analysis of convergence in the context of mobile VoIP is limited to the period between 2000-2009. Compared to the semantic analysis conducted by Luhmann (1982), which often stretched over several centuries, this is a very short period of time. However, it can be argued that some of the characteristics of convergence already show up in this limited period. In particular, it will be interesting to observe how digital convergence is different from previous forms of technological convergence. Historical processes cannot be divided through the emergence of new forms since change is very dependent on structure (Luhmann 1982). These forms are seldom "new"; instead, characteristics of a phase can also be identified if the forms gain a more central role. Therefore, it seems better to look for changes in focus instead of identifying epochal differences (Luhmann 1982). Here, in particular, semantic analysis looks at three meaning dimensions: the factual, the social, and the temporal. Although all three meaning dimensions may be analysed separately, they are intertwined. Changes in the meaning dimensions or in how convergence is observed can be indicators for a conceptual shift or may reveal the paradoxes underlying the concept.

What expectations are conveyed by ICT convergence? The data from both the interviews and documents show some repeat occurrences, indicating elements of an expectation structure that form the promise of convergence. One is the notion of *seamlessness*. Converging infrastructures, services, or devices promise the reduction of a difference. However, they promise not only the difference-reduction, but also its "seamless" occurrence, without any obstacles or hurdles:

> "Nimbuzz has positioned itself to become the largest global IP-based communications service providing a seamless communications platform across mobile devices, the web and social media." (Nimbuzz.com)

What is interesting in the above statement is that Nimbuzz aims to reduce the difference not only between different mobile devices and the Internet but also social media. Furthermore, it aims to accomplish this through IP-based technology.

Closely related is to this notion of seamlessness is the aspect of *efficiency*, which convergence also promises. Mobile VoIP applications for unified communication promise more efficient ways to collaborate with others: "From one contact list users can call, chat, message, and more, with all their friends in one place. Nimbuzz is a feature rich mass market product for the hyper-connected lifestyle" (Nimbuzz Press Release, 2009: 1). A similar view can also be found with Truphone: "Our goal is for mobile phone users to be able to reach any contact on their buddy lists, at any time and at no cost, using just one application" (Truphone Press Release, 2009: 1). The counter-concept of convergence needs to keep these characteristics of convergence in place, and needs to produce obstacles and hurdles. Hence, a closer look is needed at the counter-concept of convergence through form analysis.

As briefly outlined above (section 4.3.1), a semantic analysis looks at conceptual shifts in the relationship between concept and counter-concept. This is relevant in particular when we study the relationship between convergence and divergence. Andersen (2010) identifies seven possible conceptual shifts, as illustrated in the following table (Table 6-2):

Table 6-2 Possible Conceptual Shifts (based on Andersen 2010)

Conceptual Shifts
Concept remained constant while counter-concept changed
Concept changed while counter-concept remained constant
Both concept and counter-concept have been changed
Concept stayed the same, but has become counter-concept
Concept lost its counter-concept
Concept and counter-concept remained same, but meaning dimension shifted

The first part of this analysis takes the information infrastructure, namely the mobile telephony network, as its systems reference. From this perspective, four main distinctions have set the boundaries for the system (see figure 6-4). The traditional mobile information infrastructure is circuit-switched, voice-based, and double mobile – in relation to fixed telephony networks and to the Internet. All four distinctions

have maintained the system boundaries for more than twenty years. Control mechanisms have been established to reinforce these distinctions. Termination fees, particularly in Europe, have reinforced the distinction between fixed and mobile, while business models, based on walled-gardens, have for a long time excluded the Internet from the mobile information infrastructure. Circuit-switched networks have maintained their prominent position through legacy status and the need for downward compatibility. Finally, the distinction between voice and data has been reinforced within the organisations due to different billing models (price per minute vs. flat-rate models).
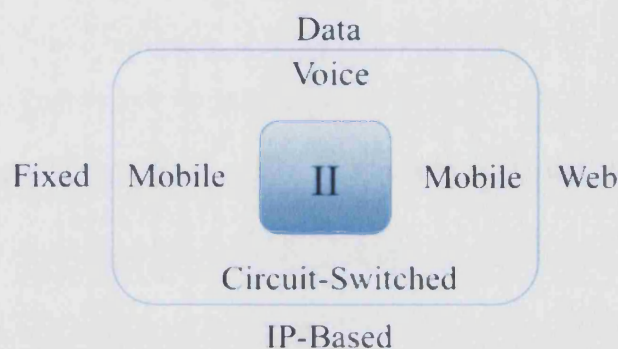
Figure 6-4 Distinctions around the Information Infrastructure

(Own Figure)

However, the emergence of mobile VoIP has been one of the convergence programmes challenging these four distinctions (Figure 6-4). The convergence discourse took on a grimmer twist towards "disruption", "thread", "risk", and "challenge":

> "Voice is still the cash cow for the operators, by a considerable margin. Data traffic might clog up their networks, but voice is what pays for everything and mobile VoIP threatens that revenue." (The Register, 2010)

In all four cases, the distinctions seem to perform a re-entry. Voice itself can now be separated into data and voice, and Web has made a re-entry into mobile, similar to fixed. IP-based networks have to incorporate characteristics of circuit-switched networks like emergency calls and line-tapping. Though distinctions still exist, these re-entries establish a paradox. Thus, a conceptual displacement has taken place.

Differences in focus have been observed in the convergence discourses around mobile VoIP. While all the four convergence discourses have been in the wider discourse since the 1990s, the focus has changed over time. The data corpus of business press articles on ICT convergence shows that from 2000 to 2004 convergence discourses around mobile VoIP focused primarily on the voice/data distinction. The analysis of the documents also shows the asymmetry between convergence and divergence. Of the 1,378 articles on mobile VoIP in the UK press between 2000 and 2009, 210 explicitly use the notion of convergence, but none mentions divergence. An analysis of the broader mobility context shows a similar picture. While between 2000 and 2009, 2,852 articles mention convergence explicitly, only ten articles explicitly mentioned divergence.

The temporal dimension is based on the distinction between past and future, and analyses the tension between these two, which is the present. Luhmann (Luhmann 1982) observes that "what moves in time is past/present/future together, in other words, the present along with its past and future horizons". Convergence itself, in the 1990s and early 2000s in the context of mobility, was used primarily to describe the future, i.e. a vision. One of the interviewees reflected:

> "Sure – back in those days, we were pioneering this work and we were really evangelising down to the market. This is going to be the future, there's going to be a point where a customer will be able to make phone calls from mass market mobiles by having applications like Jajah, Fring, Truphone etc."
> (Interviewee 35 - Director Business Development - Mobile VoIP Company C)

Recently however, the semantics seem to have shifted, and a tension has emerged between convergence as past, present, and future. The CEO of T-Mobile Hamid Akhavan mentioned in the interview series "Conversations on Convergence" that was conducted by Russell Reynolds Associates: "The first thing to understand is that convergence is not the future – it is happening now" (Russell Reynolds [2007: 1]). Steve Pusey, CTO of Vodafone Group, sees it similarly in the context of VoIP, pointing out that a "significant proportion of our voice traffic is already delivered over IP" (Pusey, 2008: 1). As pointed out by Wareham et al. (2009), the mobile computing and telecommunications industry, more than most, "suffers from a constant obsession with the future" (p. 139).

Another interesting conceptual shift has been observed in the social dimension (us/them). For a long time, mobile network operators had mobile VoIP only on their internal roadmap. However, since 2005 the discourse shifted towards the other side of the distinction and mobile VoIP became more a convergence challenge situated outside of the realm of mobile network operators.

Convergence as a concept is comprised of a variety of meanings. However, as Andersen (2008) points out, it can hold together only if the key characteristics are similar in their differences from a counter-concept. Different counter-concepts to convergence have been identified from the case study like

- good vs. bad convergence

- internal vs. external convergence

- micro vs. macro convergence,

- convergence vs. divergence,

- convergence vs. fragmentation

- convergence vs. maintenance.

Counter-concepts indicate the presence of an observer and make it worthwhile to ask about the interests of this observer (Luhmann 1997: 235). While mobile VoIP companies use the notion of convergence primarily to gain funding from venture capitalists and equipment vendors to sell their products, mobile network operators, in particular, try to understand their environment through the notion of convergence.

In summary, the semantic analysis shows that convergence, even in the limited context of mobile VoIP, has condensed a large variety of different meanings. Initial counter-concepts suggested from the case study are divergence and fragmentation. The following form analysis will show why neither divergence nor fragmentation is a useful counter-concept for convergence.

6.1.2 Form Analysis

Together with semantic analysis, form analysis provides the foundation for systems-theoretical analysis. It focuses on the question: when indicating convergence, what is the other side of the difference? What is the tension between both sides of the distinction (Figure 6-5)?
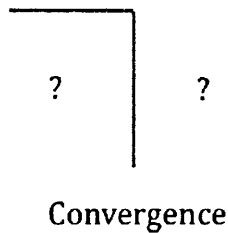
Convergence

Figure 6-5 The Form of Convergence (Own Figure)

A change in system reference to a mobile network operator shows that a similar re-entry of the convergence concept can be observed. Mobile network operators observing the environment through convergence have introduced the same distinction inside their organisations and inside their information infrastructure, the latter exemplified by next-generation networks and IP Multimedia Subsystem (IMS). Furthermore, the identified distinctions (mobile/web; mobile/fixed; voice/data; IP/circuit-switched) have re-entered the distinction.

The literature review in chapter two suggests divergence as the other side of the distinction. However, the empirical study reveals several tensions between these two notions. Before taking a closer look at these tensions within the case study, we need to analyse the basic structure of the form of convergence. The findings from the case study on mobile VoIP in chapter five suggest four dominant forms of convergence in the context of mobile VoIP: mobile/fixed, mobile/Internet, voice/data, circuit-switched/IP-based. In contrast to other distinctions, convergence presupposes another distinction in operation; hence, several informants have asked the question, convergence of what? Convergence is not a first-order distinction; it is a distinction of a second-order. It needs a constituting distinction to determine what elements are supposed to converge.

The observation of convergence is based on the reduction of difference. As an example of another change in system reference, taking the point of observation of a mobile VoIP developer, Nimbuzz, convergence as interoperability is illustrated at the heart of what the company does (see Figure 6-6). Shortly after Nimbuzz was founded, investor Mangrove Capital Partners, one of its main investors, spoke of Nimbuzz as the "first true bridge between mobile devices and the PC" (Mangrove, 2006).

As depicted in the figure below (Figure 6-6), Nimbuzz observes a fragmentation in its environment, which is constituted by a multitude of different services, both Internet-based and telephony-based. The suggested solution is to provide interoperability between these services, as illustrated by the clouds, which group similar services and the large circle connecting all three clouds.
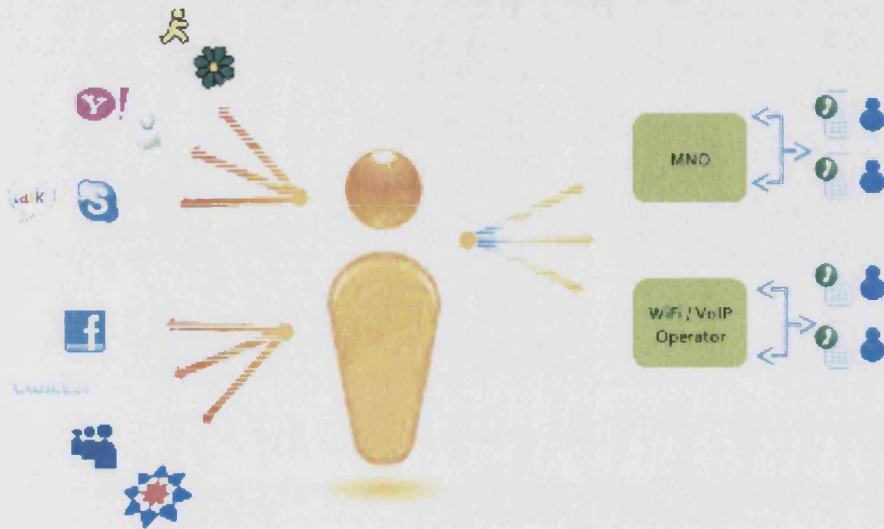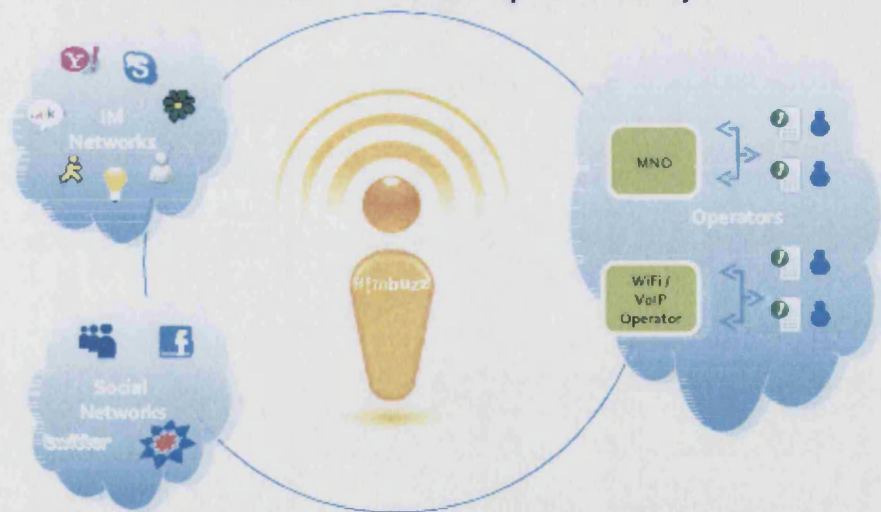
Figure 6-6 Problem Nimbuzz plans to address and the Solution (Kemper 2009)

The mission of Nimbuzz, as depicted in the presentation, is the reduction of the difference between mobile and the Internet. However, the Internet encompasses not only voice, but also instant messaging and social networks.

What is the blind spot? While divergence is illustrated in this presentation through the problematisation (Figure 6-6), it restricts divergence solely to the temporal dimension. The problem comes before the solution. However, convergence provides both further fragmentation and concentration. However, what is the difference in observing this? Convergence is an operation based on a difference, and it aims to reduce this difference. Hence, convergence indicates the reduction of difference. What is the other side of this difference? An initial proposition is divergence, and divergence is difference-increasing. However, as discussed previously, this reveals a paradox. Jansen and Nielsen (2005) call this unity "co-evolution". Along this line of argument, another question arises: how does one observe something as convergence? Furthermore, who observes something as convergence and who does not? Hence the answer to the "how" question is the presupposition of the "who" question.

The question is 'for which distinction is convergence the unity?' Convergence seems to be itself the unity of difference-reducing and difference-increasing. Seeing the world through convergence, we see difference-reductions and difference-increases. The form of convergence in itself always suggests divergence. The distinction between convergence and divergence has re-entered the concept of convergence. The counter-concept of convergence is, therefore, not divergence but difference-maintenance or conservation. Hence the main tensions arise not between difference-reducting and difference-increasing, but between difference and maintenance.

In summary, convergence is a difference-reduction programme set by an observer. It aims to reduce a specific difference. It seems that convergence is no longer a universal description of a first-order observer. Instead, it seems to be the reconstruction of a phenomenon of multiple contingencies that offers different perspectives to multiple observers. Furthermore, as Andersen (2008) points out, "any form establishes a paradox. It divides what cannot naturally be divided". Convergence as a form consists of several paradoxes. The most prevalent one is between convergence and divergence. However, another finding from the form

analysis is that convergence itself is taken for granted and that the possibility of divergence is either mostly ignored or seen as undesirable. Form analysis is not an end in itself; rather, it leads to the question of how social systems cope with these paradoxes (Andersen 2003).

6.1.3 System Analysis

The focus shifts from distinctions to systems: how they observe themselves as well as their environments, and how they maintain their boundaries. Boundary drawing is an intrinsic challenge in studying convergence (Hacklin 2007; Basole 2009). Elements that were previously considered to be separate are closely linked to each other in the light of convergence. The guiding distinction becomes that between system and environment. System analysis has particular conditions for what constitutes a system.

Social systems are recursive communication (Luhmann, Bednarz et al. 1995). Depending on the system reference, convergence can be analysed both as a system in itself and as part of the self-description of organisational systems in the mobile telecommunications sector. The following analysis will focus first on the latter, before shifting the point of observation to the convergence discourse itself.

One of the key findings from chapter five is the fourth dimension of convergence, the distinction between internal and external. The findings from chapter five suggest that most of the organisations observing convergence see it first as something external. Here, the findings of this study are similar to Hannah Knox's (Knox 2003:47) observations in relation to companies in the media industry in the UK:

> "Their awareness of convergence and their expectation of future developments in technologies is the performance of calculativeness. In attempting to frame their work these companies see the parallel work of other companies in related industries as an important consideration in the development of their own capabilities."

Convergence can have both an external and an internal reference for a system. James Tagg, the founder of Truphone, refers in his mobile VoIP patent to the external condition of increasing interconnectedness of systems. However, the concept of convergence also has made a re-entry into the Truphone system in the design decisions for a converged product between Wi-Fi and mobile networks. This decision has again produced disturbances in other observing systems like T-Mobile, which

perceived convergence as an external threat with the consequence, among others, that T-Mobile filed a law-suit against Truphone. However, T-Mobile also internalised convergence in its own organisation, as outlined by its CEO (Russell Reynolds Associates 2008). The distinction between internal and external convergence, though not used in the academic literature, describes an interesting characteristic of convergence. It also points to another interesting observation: many of the organisations participating in this field study used the term *convergence* for job descriptions or for new organisational units:

> "For the purposes of talking about convergence, my job title includes the word convergence, so I have a view obviously."
>
> (Interviewee 2 – Head of Convergence, Regulator)

While internal convergence is linked to internal operations in the system and to its decisions, it keeps the system alive and sustains the boundaries. External convergence, on the other hand, is an unspecified threat in the environment that jeopardizes the existing boundaries of the systems.

The example of Truphone may be contrasted to Nimbuzz. For Nimbuzz, the environment is not observed as convergence, but rather as fragmented islands. Convergence is internalised as interoperability, which is also regarded as the "solution". Nimbuzz itself provides this solution through being a bridge to instant messaging communities, social networks, and mobile operators. Hence convergence has an internal, not an external, reference in this example. A related distinction to internal/external convergence has been pointed out by one of the industry experts, a former strategy director of the GSMA. He pointed out that for mobile operators, there is 'good and bad convergence':

> "(...) new players will conquer mobile, actually the end users won't be better off, because there will be less investment from network providers, (...) the returns on investment will be really, really questionable, and therefore convergence will have played a bad role. They have actually, in effect, a definition of what good convergence is and what bad convergence is. Convergence is going to happen but there's bad and there's good."
>
> (Interviewee 3 - Former Strategy Director - GSMA)

In this context, mobile VoIP is often addressed as a disruptive technology (Bower and Christensen 1995). Jeremy Green, practice leader for mobile at Ovum, points out that "what mobile VoIP signals so clearly is the bit pipe scenario" (Taaffe 2009). The 'bit pipe' scenario has for a long time been regarded as the Sword of Damocles for

the mobile industry. It has often been attributed to the loss of its identity and the risk of becoming a simple utility company.

Steve Pusey, Chief Technology Officer of Vodafone, in his technology update presentation, addressed to investors and analysts on Vodafone's Technology Day on March 5, 2008, provided an interesting perspective. He observed that mass media and analysts see mobile VoIP as a challenge for mobile operators, and discussed whether mobile VoIP is a challenge or an opportunity. Two important aspects can be identified here. First, mobile VoIP is seen as an external challenge for the MNO system. However, Pusey argues that this challenge needs to be incorporated into the MNO system so it can become an opportunity. Recent examples have been Vodafone 360, the partnership with Truphone, and the smart pipe approach.

To summarise, the systems analysis thus far highlights two points: first, the importance of the distinction between internal and external convergence; and second, the importance of considering the forces that maintain difference when conceptualising convergence. The maintenance of the difference between system and environment is the key operation for an autopoietic system. Difference-reduction, therefore, produces tensions if it is related to system boundaries, and questions the very identity of the system. The observed tensions between Mobile VoIP operators and mobile network operators (MNOs) result from this.

In the next step, the analysis changes the point of observation to convergence as a system in itself. What are the properties of this convergence system? It has been previously pointed out that social systems in themselves are recursive discourses. What can be observed in relation to convergence is, first, its self-reinforcing dynamic. The findings from the form analysis suggest seeing convergence as the unity of difference-reducing and difference-increasing. Difference-reduction always causes an increase of a difference, which again will lead to another difference-reduction programme. Similar processes in many different observing systems have led to an increasing system of convergence communication. This may be one of the reasons for a phenomenon, which may be described as 'the urge to converge' or the need for convergence communication.

Another interesting observation is the convergence of convergence itself. As mentioned in chapter five, one of the interviewees pointed out, the macro convergence of business strategies related to convergence is another interesting aspect. Many companies are working on the reduction of the Internet and mobile networks. This dissertation sees a convergence of the two. An initial proposition would argue that this move must lead to a self-reinforcement of convergence.

6.1.4 Differentiation Analysis

The differentiation analysis is based on the distinction similarity/difference. Based on the point of observation, different insights can be gained. Luhmann (1997) has found evidence in several systems that modern society has moved from a segmented or stratified structure towards a functional differentiation. Hence one dominant system is no longer evident. Each system has developed its own code, which distinguishes what is relevant in the system. However, Luhmann acknowledges that the sub-systems of large functional systems, like the economic system, are still to some extent based on segmented differentiation (Luhmann 1997). For example, within the economic system, the banking segment is more powerful (here power is always seen as relative to other systems, not in terms of possessing power) than other systems – e.g., the mobile telecommunications segment. A similar observation can be made, one level lower, within the mobile telecommunications segment. Mobile network operators traditionally own most of the important control points. However, convergence as a difference-reduction programme challenges the existing differentiation e.g. between fixed-line telephony and mobile telephony, or the Internet and mobile telephony. On the other hand, in the context of mobile VoIP, it can be observed that difference-reduction leads to a functional decoupling of services and infrastructure. However, the conclusion that the existing mobile telecommunications sector is moving from a stratified to a functional differentiation cannot be supported. The emerging control systems are still keeping the coupling between service and infrastructure together. This will be analysed in more detail in the following coupling analysis.

6.1.5 Coupling Analysis

The coupling analysis uses the guiding difference of coupling/differentiation (Andersen 2008). It aims to understand the mechanisms through which systems are linked at the same time their differentiation is maintained. It is based on the assumption that systems are closed; however, they can be irritated by other systems in their environment. Couplings between systems are, therefore, always based on the relations between closed systems. This means, that the coupling itself has to be internalised by the system. Thus, a coupling both connects and separates systems (Andersen 2008).

ICT convergence always assumes some form of coupling between two elements or systems. Coupling analysis provides another perspective on the problem of the convergence paradox. When an observer sees two information infrastructures converging, like a mobile telephony network and the Internet, both infrastructures are usually "blackboxed". These macro forms of convergence are, in fact, fractured by a multiplicity of difference-reduction programmes. In fact, they contain a large number of different elements as illustrated in chapter five (e.g. devices, networks, services, standards or interfaces). As Luhmann (1995) points out, "interpenetrating systems converge in individual elements – that is, they use the same ones – but they give each of them a different selectivity and connectivity, different past and futures". First, large-scale systems consist of many elements, and not all need to be part of the coupling. Second, even the ones that are coupled have a very different influence on each system. These difference-reduction programmes may lead to difference-reduction between the system and other systems in the environment, leading eventually to a structural coupling or, in some cases, even to what Luhmann calls interpenetration. Interpenetration is a very tight structural coupling. If two systems are interpenetrated, they reciprocally co-determine their behaviour (Bausch 2001).

In the case of mobile VoIP, an increasing structural coupling between mobile telephony networks and the Internet can be observed (e.g., the intensive linkages between Nimbuzz, social networks as well as Internet instant messengers). However, on the other hand, a very interesting observation is the process of imitation between VoIP and circuit-switched mobile telephony. In many aspects, VoIP attempts to

imitate traditional voice calls via circuit-switched networks to fulfil regulatory requirements.

> "(...) when you use IP for real time services for voice, what you try, you actually do is make it look like circuit switched because you take the headers off the packets, you route all the traffic through, re-identify a route or through the same way, through the same circuits so there's no delay, so you make it look like circuit switched. So we've gone, everybody said oh yeah circuit switch is old, old fashioned, and then you spend great deal of money actually trying to make it look like circuit switch in order to fulfil regulatory requirements and QoS".
>
> (22-R&D Engineer, Mobile Network Operator)

The emergence of mobile VoIP essentially decouples voice service from the infrastructure. Whereas previously, voice service was possible only through a tight coupling with the mobile telephony infrastructure, besides tight-controlled MVNO agreements, mobile VoIP offers the opportunity to separate voice services from the information infrastructure. However, this decoupling of network and service is, as pointed out in the historical review, not something new. In the early years of mobile telecommunication in the UK, the government made a clear distinction between network and service provision to encourage competition.

6.1.6 Technology Analysis

The technology analysis is a new analytical strategy. It aims to understand why convergence discourses are so dominant in the context of technology. A full text analysis of all 3,479 of the articles on the notion of convergence that were published in the UK press on Factiva in 2009 alone showed that around 50 percent of all articles using the term *convergence* were related to information and communication technologies (see figure 6-7 below).

Overview Convergence Discourses in UK Press in
Percentage of articles, n= 3,479 (Factiva, 2009)

4%
10%
12%
50%
24%

- Technology
- EU & Politics
- Finance
- Others
  Accounting
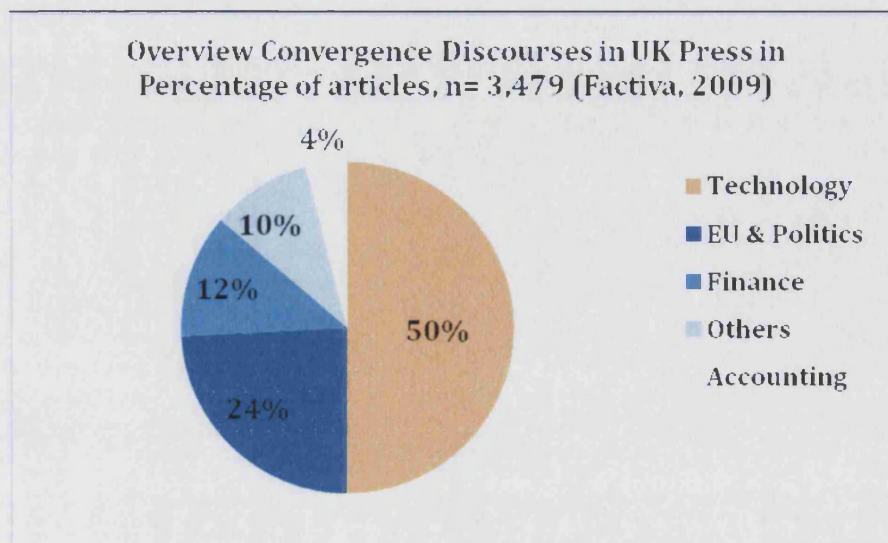
Figure 6-7 Overview Convergence Discourses in the UK Press

This poses the immediate question of why technology, and why in particular ICT? What are the characteristics of information and communication technology that provide the conditions for connectivity (*Anschlussfaehigkeit*) to the notion of convergence? Furthermore, what is the role of technology in the ICT convergence paradox? Even more specifically, what is its role in the context of mobility? This section seeks to develop answers to these questions from the case study on mobile VoIP.

If we take the conceptualisation of technology as functional simplification and closure from chapter four as the starting point, it becomes evident that technology and convergence are themselves in a paradoxical relationship. Technology is built up on tight couplings, and through its closure offers itself only for limited connectivity. Kallinikos (2005) draws on the example of railroads and airports, which can be linked only to a certain degree, but cannot be made fully interoperable. Tilson (2008) observes a similar limited connectivity in the context of analogue technologies. He sees the primary reasons for this limited flexibility in the tight coupling between the design of transmission, storage formats, and the processing devices. Despite these constraints, a few converging technologies have still emerged, in particular through gateway technologies like modems and audiocassettes.

What changed this situation was digitisation. In this context digital technologies have two very specific characteristics. On the one hand, digital technologies increase both

transmission and storage capacity. For example, the introduction of the E1 PCM system in the 1960s increased the transmission capacity from one to 30 channels (Huurdeman 2003). On the other hand, digital technologies have the characteristic that they can easily be combined with each other. Kallinikos (2006a: 43) refers to this characteristic of ICT as functional unification. In theory, ICT has become interoperable since all technologies are eventually based on the binary code of 0s and 1s (Marton 2010). ICTs, formerly based on the operation of functional simplification and closure, have all become connected to each other.

However, in the mobile telecommunications sector, a wide technological convergence similar to the fixed-line sector has only very recently taken place, despite its early digitisation through GSM. The reason for this was that early digitisation was primarily built on the same principles as analogue, in particular to keep its backward compatibility. As Tilson (2008) points out, "the service offerings of 2G based systems were still modelled largely on their fixed telecommunications counterparts (i.e., telephony, fax, and low-speed circuit-switched data)". Hence, despite the digitisation of the networks, the architectures of both fixed and mobile telephony infrastructures were still based primarily on the circuit-switched paradigm. This changed with the introduction of TCP/IP. Tilson (2008: 361) called this capability of TCP/IP *upwards* and *downwards flexibility*. However, as he points out, this flexibility "was not in itself sufficient to unlock the flexibility of digital representation and transmission" (p. 365). This theoretically unlimited interoperability and recombination is achieved only by the programmability of the digital computer. Kallinikos (2006; 2009) calls this characteristic of digitisation *computation*. Computation renders "interoperable aspects of reality (e.g., different systems or applications, sound, image, text) that despite the spectacular advances of materials technology in modernity remained separable and part of different technical landscapes" (Kallinikos 2009). Mobile VoIP offers this computation since it makes it possible to mix and match sound, text, and video. Google Voice, for instance, offers the possibility to convert a voice call into a SMS or an email while Fring has started to offer Video telephony via its mobile VoIP client. Hence, it is not technology, but rather digitised technology, that provides the conditions for connectivity to the notion of convergence.

Prior to entering a detailed analysis, it is important to ponder the question of who observes mobile VoIP applications as "converged" and what expectation structure this implies. IP technology breaks up formerly tight couplings, which is the essence of the convergence paradox of VoIP technology. One particular coupling is the one between infrastructure and voice service. In the 1980s, UK regulators had initially demanded an organisational separation of voice service from the network, and voice service and network had to operate until the late 1990s in separate organisational entities. However, the convergence of mobile telephony networks and the Internet provides new tight couplings. IP technology provides an increasing likelihood for convergence, in particular through increasing the horizon of potential connections. This provides new challenges for the mobile infrastructure system, indicating the paradigm shift from control to contingency (Kallinikos, 2006; Marton, 2010). Viruses, spam, and undesirable technologies like non-operator controlled mobile VoIP applications emerge from this tight coupling between mobile telephony networks and the Internet. If the point of observation is shifted to the mobile infrastructure, these challenges are what can be observed in relation to mobile VoIP. This dissertation follows Kallinikos (2006:39) in believing that these developments challenge the existing boundaries. However, it is less a question of "beyond boundedness", but rather the question of new boundaries.

To abstract to the level of distinctions, the technological convergence paradox results from the observation that convergence aims to reduce a difference whereas wherever technology controls, it draws distinctions. This dialectic of technology has been illustrated by the notion of steering and control technologies (Luhmann 1990). Control technologies maintain differences, whereas steering technologies aim to reduce differences. If the point of observation from mobile network operators is shifted to the mobile VoIP company, a different kind of control technology can be observed:

> "Through Voxbone, Nimbuzz, running on all Internet-capable mobile phones, detects when the handset is out of Wi-Fi or 3G range and conveniently steps in, requesting permission to automatically dial a local access number and route the call over the Internet. Such calls are free except for the low charge (if any) to the local access number. The Nimbuzz software client determines the correct access number to dial from the user's Nimbuzz profile." (Nimbuzz, Press Release, June 2009)

Technology has to function. The promise of technological convergence is therefore often linked to the notion of *seamlessness*. However, technological convergence, as the findings suggest, happens – if at all – at the linkages, the gateways. Linking two infrastructures together puts much of pressure on the link – i.e., the technology. In the case of mobile VoIP, this applies, in particular, to the mobile VoIP client software. Hence, fluctuations in the environment might produce long latencies that cannot be handled by the technology. Another promise of technological convergence, analogue to functional simplification, is often simplicity. However, making a phone call from a mobile VoIP client is often substantially more difficult than a normal call. These two examples show the tensions between technology and convergence.

One final remark on the distinction between social and technology: one characteristic identified in relation to ICT convergence has been the social/technical dimension. However, from a systems-theoretical perspective, it might be argued that the distinction between nature and technology, humanity and technology, and in the near future social and technology has become less useful over time. Luhmann (1997: 237) argues that technology has rather become second nature since it is less and less understood, and society has made itself increasingly dependent on technology. This observation might increase in importance; however, with regard to mobile VoIP this distinction still holds. For example, the mere existence of a protocol like SIP does not reduce the difference, because the implementation of it is also a factor. Interviewee 19 said that the implementation of SIP is like reading from the Bible: there are so many interpretations that understanding each of these implementations is difficult. Technological standards can provide the basis for convergence. However, what can be observed is a divergence in the interpretation of the standards, which again needs another difference-reduction programme.

6.1.7 Fashion Analysis

If fashion is observed from a systems-theoretical perspective interesting properties are revealed. Firstly, a study on fad and fashion implies shifting the analysis away from the phenomenon and towards the observer. Furthermore, fashion is in itself reflexive since it is based on observations of other observations. A study on fashion, therefore, leads to at least a second-order observation (Esposito 2004). A second-

order observation is interested in how the discourse on the phenomenon is taking place, its dynamics, and its function.

Convergence discourses are both social and technical, and focus on the reduction of a social or technical difference. The function of convergence as difference reduction also allows it to appear as a fashion. Its open form provides enough space for new difference-reduction programmes to emerge as well as a clear starting point for a functional system to start with its own operations. Another property that convergence shares with fashion is that its open form provides continuity. Summarised, while a fashion's function in society is solely the operationalisation of contingency (i.e. to start a selection), convergence has a function in reducing differences. It is therefore an important steering mechanism (Luhmann 1997) that cannot be reduced to a mere fashion.

The analysis of 30 years of convergence articles shows clearly that convergence cannot be regarded as a short-lived management fad based on the criteria put forward in the literature. Even in the context of mobility, the notion has been, despite the hyperbole of the last three years, well established since 1987, and still is used by practitioners in job descriptions and job titles. A closer look, however, reveals that the convergence discourse does have some characteristics that make it appear to be a fashion. In particular, it shows similar developments such as differentiation of the concept, and it seems to work as a pre-code for functional systems. The rhetorical use has for example been pointed out in Vodafone's response to Ofcom's latest mobile sector assessment consultation:

> "There is a real risk that casual, rhetorical use of the term convergence obscures what sort of convergence is being considered and what relevance, if any, it has to the policy issue at hand." (Vodafone 2009, p. 4)

Divergence strategies like the initial product design of the Blackberry or the demerger of TimeWarner and AOL show this. The code in the economic system requires that a certain decision needs to make economic sense. The idea of convergence has also been questioned if it does not make economic sense. The notion of ICT convergence has differentiated into many different forms, which also have changed over time, in some cases substantially. However, the findings from the systems-theoretical analysis show that the notion of convergence offers more than just fashion. It implies the reduction of a difference. The reduction of a difference is

not just a pre-code for functional systems; it is an important steering mechanism (Luhmann, 1997).

In summary, the analytical strategies have revealed a couple of interesting characteristics and dynamics in the discourses concerning mobile VoIP, which will be used for an initial systems-theoretical conceptualisation of ICT convergence in the following section. Table 6-3 summarises the key findings from the analysis in relation to the four convergence dimensions as well as from the analysis of the convergence/divergence paradox and convergence as fashion.

Table 6-3 Findings from Analysis

Themes	Analytical Strategy	Key Findings from the Systems-Theoretical Analysis
Process / Vision	Semantic Analysis	• Mobile VoIP challenges all main ICT convergence distinctions for mobile information infrastructures • Clear asymmetry between convergence and divergence • Conceptual shift along the temporal dimension between convergence as vision and being "here and now" • The concept condensed a large variety of different meanings • Fragmentation and divergence as counter-concepts
Convergence / Divergence	Form Analysis	• Convergence as phenomenon of multiple contingencies that offers different perspectives to multiple observers • The form of convergence itself suggests divergence (observer-dependent) • Convergence as difference-reduction programme • Counter-concept of convergence is difference-maintenance
External/Internal	Systems Analysis	• Internal convergence sustains boundaries, external convergence as unspecified threat or opportunity • Maintenance of the difference key operation for mobile network operators • Self-reinforcing convergence discourse or "the urge to converge"
Differentiation / Unification	Coupling and Differentiation Analysis	• Convergence challenges existing differentiation, leads to a functional decoupling of services and infrastructures • Emerging control systems keep couplings between service and infrastructure together • Increasing structural coupling between mobile networks and the Internet
Social / Technology	Technology Analysis	• Paradoxical relationship between technology and convergence • Not technology but digitised technology that provides condition for connectivity between technology and convergence • Seamlessness and simplicity two main promises of technological convergence but difficult to achieve
Fashion	Fashion Analysis	• Convergence has fashion characteristics but is more than just a pre-code for functional systems

6.2 TOWARDS A SYSTEMS-THEORETICAL CONCEPTUALISATION OF ICT CONVERGENCE

The previous section has laid the ground for an initial conceptualisation of convergence from a second-order observation. The following section builds up on the findings from the analysis developing a preliminary systems-theoretical description of ICT convergence.

6.2.1 Convergence as Difference-Reduction Programme

The idea of convergence builds upon distinctions – for example distinctions between mobile and fixed-line, mobile networks and Internet, voice and data, or IP and circuit-switched. Thus, it may be argued that differences are a precondition for any form of convergence. This conceptualisation of convergence as difference-reduction programme needs to be unpacked further.

Difference-reduction programmes play an important role in Luhmann's Theory of Social Systems. He conceptualises the reduction of a difference in the notion of *steering*. Luhmann (1994: 140) offers the metaphor of steering a car, where steering is "the reduction of a difference in the direction of a movement". It is also possible to change the direction through steering, through the introduction of another difference. This difference is introduced through observation. Luhmann concludes that steering is a very special type of observation, an operation that is "the attempt to reduce a difference", and that "difference-minimising programmes" take place in all systems of society.

The findings from the analysis suggest seeing ICT convergence as a two-sided process of interoperability and alignment. Both operations – alignment and interoperability – aim to reduce a difference. In the case of alignment, the operation reduces the difference between different social parties (e.g. through a standardization process), whereas in the case of interoperability it reduces the difference between two technical systems (e.g. through the implementation of gateways).

From this perspective, ICT convergence may be observed as a difference-reduction programme, and therefore as steering. It must be noted that convergence as a

difference-reduction programme does not mean ONE vision of a fully connected world (e.g. Mark Weiser's [1991] closely related notion of *ubiquitous* computing). This conclusion is problematic, since it fails to acknowledge that there are numerous difference-reduction programmes based on convergence that are running in parallel, and are based on different distinctions. However, it may be argued that the main impetus for convergence, as defined above, stems from a general motivation to bring elements together. This motivation also establishes the asymmetry that is an essential feature of any difference-reduction programme (Luhmann 1988). Without this asymmetry, the difference-reduction could aim for the midpoint between the two elements, or perhaps even divergence (e.g. the development of separate networks instead of convergence).

With these initial considerations on convergence as steering, this section can proceed with the investigation on how these "difference-minimising programmes" work. Here, it has to be distinguished between convergence as first- and second-order operation. Convergence as a first-order operation *aims* to reduce a difference, whereas as a second-order operation it *observes* the reduction of a difference. As second-order operation it reveals the blind spots of the first-order operation, namely that the operation leads simultaneously to a difference-increase.

What happens if a convergence programme is successful and the distinction has been removed? The semantic analysis has shown that convergence in the context of mobility in the 1980s was related to the difference-reduction between different mobile telephony networks to make interoperability and calls between these networks possible. Hence, convergence becomes taken for granted, at least until the implicit assumption of sameness breaks down (see e.g. the denial of T-Mobile to connect to Truphone numbers, which eventually led to the famous court case between Truphone and T-Mobile).

6.2.2 Limits of Convergence

What are the limits of convergence? This question can be approached from different directions, differentiating between factual, temporal, and social boundaries. In observing when practitioners question convergence can help to identify the social

boundaries. In the interviews with practitioners, convergence was mostly questioned when it was not clearly defined, i.e. the underlying distinction was black boxed. Appelgren (2004) suggested that the times of convergence as a holistic concept are over, and that it is primarily used in niches, i.e. specific distinctions.

By using the counter-concept of divergence, Hacklin (2007) asks if convergence will eventually reach an endpoint after which it moves back to divergence. This brings us to the temporal dimension and to the intriguing question of when does convergence end. This question however raises two counter questions: How does an observer observe when observing a beginning and an end of convergence? And who observes a beginning and an end of convergence in a specific event and who does not? Luhmann (1990) suggests the observation of beginning and end is based on the distinction before/after. As we have seen convergence is not a linear process.

Analytically, the limits of ICT convergence are set by its counter-concept. Again, it might be useful to re-introduce in this context Luhmann's notion of steering. Steering always constrains or influences something that happens in other parts of the system, which may be observed as so-called unintended consequences or side effects. Therefore, Luhmann argues against the understanding of steering as an action that requires a subject, an object, and the intention (Mayntz 1987:93). The focus on action does not allow the observation of three distinct limitations of steering:

- Unexpected/undesired side-effects
- deficits of execution, and
- self-defeating prophecies.

Self-defeating prophecies are predictions that prevent themselves from happening, whereas both unexpected side effects and deficits of execution are related more to the fact that a very large number of other operations are happening simultaneously. The reader may ask, why only self-defeating and not self-fulfilling prophecies have been included. Self-fulfilling prophecies suggest successful steering, and therefore do not constitute a limitation of steering. Luhmann further points out that the observation of steering and the operation of steering usually make different distinctions, which in particular may build up tensions between control as backward looking (in the sense

of comparison for monitoring or evaluation) and steering as forward-looking. The former is projected as an interesting metaphor, namely the steering of a car by looking in the rear view mirror. Luhmann (1994) argues that his conceptualisation of control as steering from a systems-theory perspective enables the observer of a difference-reduction programme to focus on these three limitations to steering. In the case of mobile VoIP several examples when the convergence machine reached these limits were identified.

Firstly, the initial convergence programmes introduced by the operators have produced some *unintended consequences*. Small start-up companies flourish, motivated by open standards, and develop new voice and messaging services competing directly with the traditional ones offered by the established operators.

Secondly, *failures of execution* in many of these programmes can be observed, for example in the case of unsuccessful Instant Messaging or IMS implementations (Morris 2009). Execution deficits of *internal convergence programmes* like instant messaging or IMS have led to a re-description or control of the internal convergence programmes. In the case of instant messaging, operators started to collaborate with one another on a common instant messaging platform supported by the GSM Association.

Finally, *self-defeating prophecies* may also be observed. The actual idea of ICT convergence has led in many cases – on both the network and the services levels – to divergence, and not convergence. This becomes particularly evident if the point of observation is shifted from the mobile network operator to the user. The user is confronted with a choice of multiple networks (WiFi, 3G, Edge, 2G), multiple voice services (provided by MNO and mobile VoIP company), multiple bills, and multiple devices, all of which provide the possibility of initiating a mobile call (mobile phone, Play Station Portable, IPod Touch).

The conceptualisation of ICT convergence as a difference-reduction programme based on a systems-theoretical perspective sheds a different light on its limitations. The second-order conceptualisation of ICT convergence as a difference-reduction programme questions the taken-for-granted assumption of ICT convergence and

shifts the focus towards its limitations. This new conceptualisation enables the observer to observe the underlying dynamics of ICT convergence in respect of unintended consequences, self-defeating prophecies, and execution deficits. These limitations of ICT convergence are usually excluded in the traditional schema of seeing convergence as a simple linear process, with a subject, object, and an intention. Studies that use traditional schema might suggest that the convergence process can either be "managed" (Hacklin 2007) or not (Ciborra 2000), but this schema limits the analysis to the process and excludes the three limitations of ICT convergence.

Summarised, ICT convergence does have limits. These limits can be traced back along the three dimensions of meaning. However, as pointed out in the analysis above, convergence and divergence seem to be just two sides of the same coin. A further unfolding of the convergence paradox will be conducted in the following section.

6.2.3 The Convergence Paradox

Like systems, paradoxes exist. Paradoxes are unities of distinctions. Many paradoxes are invisible and only become visible when the observer asks about the unity of the distinction (Luhmann 2002). However, paradoxes lack connectivity (Luhmann 2000). They need to be *unfolded*, i.e. to refer to a different perspective or layer (Luhmann 2002). Unfolding is the process of making an existing paradox invisible through a new distinction (Luhmann, Bednarz et al. 1995). The process of unfolding is, according to Luhmann, the only way to deal with paradoxes. No observing operations, even logic, can avoid paradoxes or indeed "solve" them. Paradoxes have to be unfolded. The distinction between a paradox and unfolding a paradox may be seen as an analogy to the distinction problem and problem solving (Seidl and Becker 2005).

It is important to note, that this process does not ontologically change or dissolve the paradox. The paradox is there and cannot be changed. The new distinction just makes the paradox invisible again. So what is gained by unfolding the paradox? New distinctions can help to "untangle concepts and refine thoughts" (Eve, Horsfall et al.

1997) and provide a "fruitful" ground for further analysis and therefore connectivity (Luhmann 2002). In other words, "to unfold a paradox is simply to shift the observer's blind spot to a place where it is less troublesome" (Seidl and Becker 2005). However, sometimes the unfolding of distinctions can have diminishing returns and it may be more productive to go back to questions related to the underlying unity of the paradox (Eve, Horsfall et al. 1997). The key question is therefore can the convergence paradox be unfolded differently?

Luhmann (Seidl and Becker 2005) argues that this unfolding cannot follow a logically controllable path, but rather has to rely on what he calls "creative intuition" or scanning the object of study. The literature review in chapter two suggested the following propositions:

- Divergence is a part of the convergence process, both co-exist and co-evolve (Nyström 2008)
- Divergence and convergence are both separate processes, which can run after another or in parallel (Appelgren 2004)
- Divergence and convergence are two processes, which constitute each other and are based on digitalisation (Delgado Gomez 2007)
- Convergence under pressure leads to fragmentation (Ludes 2008)

The convergence paradox had been explicitly mentioned in one of the first interviews conducted. The interviewee pointed out that

> "So I think any of the issues you see in convergence, if you actually look over the last 30 years when people have talked about convergence, what we've actually had is divergence. The technology is creating more and more options, people can do the things they want to do plus do new things, but what technology also does is allow everybody to get into each others' business. And what that then does is expose the places where regulation has created economic distortion, for it creates business opportunities that exploit those economic distortions, like mobile VoIP." (Interviewee 4 - Former Chief Technologist - Regulator).

The above quote brings up a number of important issues. The literature review showed that some researchers explicitly contrast "convergence" against a counter-concept (this was primarily "divergence"). The unity of the distinction between convergence and divergence could be described as "mutual dependencies between elements". Jansen and Nielsen's (2005) understanding of convergence is based on a

similar distinction. They call the unity "co-evolution". It indicates that convergence itself is not inevitable, and that there might be other trajectories to follow. A close analysis of this distinction shows that processes called convergence by some observers, is labelled divergence by others.

When considering convergence between mobile telephony networks and the Internet it is possible to observe both increasing interoperability, but at the same time decreasing alignment between the different actors, namely the infrastructure and service operators. Convergence is divergence, divergence is convergence – it depends upon the observer. In what seems to be an asymmetrical relationship between convergence and divergence, the empirical data shows that the perception of convergence is much more prominent, and in many cases people have used the term convergence while they actually mean divergence:

> "Of course, the users were still having to maintain their existing contract with their existing service providers, which basically means two bills. (...) Basically, it's a different phone number and it's a different bill and a different service provider and a lot of people weren't prepared to do that, at the time. Divergence played a big part in that."
> (Interviewee 7 - Director Business Development - Mobile VoIP C)

Following Luhmann, there are two possible ways of dealing with a paradox like convergence as divergence (Luhmann 1991). The first and more common way is to replace the paradox with a new distinction; the second is to observe the paradox from a second-order perspective, and to describe both sides of the distinction. In the following analysis, this dissertation will initially look at the latter.

If the distinction of convergence/divergence is kept but the observer moves to a higher level of observation, he might now be able to observe how the paradox unfolds. The observer may ask why convergence became such a widely used concept among practitioners and many other observers. How does society deal with this paradox? What mechanisms does society establish? More relevant in this context, how do designers of information infrastructures take this into consideration?

In the context of ICT convergence of mobile information infrastructures, it may be observed that there is the problem of a huge variety of players competing over network resources, from traditional infrastructure operators to service operators, content providers and even hardware manufacturers. Each of these players is trying to

introduce his own mechanisms for control. This phenomenon has already been identified from a computer science perspective by Clark et al. (2002), who defined it as "tussle", where "different stakeholders that are part of the Internet milieu have interests that may be adverse to each other, and these parties each vie to favour their particular interests" (Clark, Wroclawski et al. 2002). Regulators, mobile operators, device manufacturers and software vendors, all have to make decisions on how to incorporate responses to this increasing number of conflicts into their design of regulation, infrastructures, devices and applications (Clark, Wroclawski et al. 2002). In the mobile VoIP case this was apparent in very small examples like embedding a functionality for automatic network selection depending on availability, performance, battery power, and of course costs.

Jacucci (2005) introduced with "tension" a similar concept to "tussle". Furthermore, on the other side of the distinction, the residual category of divergence has been mostly relegated to the sidelines. As the high-level bibliographic analysis of business press articles has shown, divergence is only mentioned in a few cases. Thus the notion of convergence is asymmetrical and the structural couplings between itself and divergence are often ignored.

The findings challenge the prevailing distinction in the literature between convergence and divergence. Instead different competing guiding distinctions emanate from different observers. Convergence is divergence, divergence is convergence – the unfolding of this paradox suggests that information services and infrastructure design for ICT convergence should take into account subsequent conflicts whenever and wherever different stakeholders with different views engage.

6.2.4 Unfolding the Convergence Paradox

As mentioned previously, paradoxes are unfolded by the introduction of a new distinction. This distinction can be based on three different dimensions of meaning: functional, temporal, and social. The functional dimension is based on the distinction between system and environment, the temporal between past and future, and the social between alter and ego.

The data from the case study shows potential routes for unfolding the convergence paradox along all three dimensions. Based on the functional dimension, the paradox could be unfolded for example through differentiating between networks and services. Networks might converge, however services diverge. Another distinction has been made based on the idea of the same service running over multiple networks reproduced on multiple devices, e.g. Skype running over DSL, 3G, and Wifi on the TV, mobile phone, or laptop. This distinction follows the idea of differentiation. This form of unfolding has been suggested in previous studies on convergence (Nyström 2008). Nyström's study on convergence suggests that both convergence and divergence co-exist, and that divergence is in fact one dimension of the convergence process. Some participants also articulated that convergence and divergence could happen at different points in time. Some interviewee pointed out that they see the time at the moment as some sort of transition period, with more divergence than convergence:

> "It is a brainstorming going on in the market. Perhaps we are facing a divergence stage right now."
>
> (Interviewee 9 - Senior Engineer - Mobile Operator A)

The above quote brings up a number of important issues. What the interviewee described as "brainstorming" is the disruption in the mobile telephony market based on the introduction of the mobile Internet. Furthermore, ICT convergence as a vision might be first, while divergence follows. Appelgren (2004) made a similar observation while studying convergence processes in the newspaper industry. She points out this paradoxical relationship between convergence and divergence. However, it is not clear if she sees convergence and divergence as consequences of each other, or if it just happens on different levels of analysis.

However, all of these findings are still focused on the factual dimension, and do not consider the social and the temporal dimension. The social dimension distinguishes between "us" and "them". It is therefore closely related to the dimension internal/external. An increasing number of actors are developing mobile VoIP applications, which are observed by mobile network operators as external. However, this observation has led to increasing internal convergence affords as the recent OneVoice initiative and the increasing number of partnerships between mobile network operators and mobile VoIP players suggest. These internal convergence

affords have been further increased through the gradual shift in the temporal dimension. While mobile VoIP has been for many years a distant vision, mobile VoIP applications are now widely available. Visions have the advantage that they can easily block out the other side of the distinction, namely divergence. However, the messiness of the presence leads a higher visibility of fragmentation and divergence.

Both developments become relevant in regards to the convergence paradox through an observer. Different observers can observe the same phenomenon differently. What could be convergence for the network operator, might be divergence for another observer like the user. This distinction based on a social dimension would suggest that the reason for this paradox is rather built upon the emerging conflicts between different parties. Convergence requires the building of structural couplings. However, some systems could deny these couplings. Such denial may result in a conflict as seen in the context of mobile VoIP applications and MNOs. If the information infrastructure provider does not allow, as evident in the cases of MNOs blocking VoIP applications, then convergence comes to a stop. It is this tension, which the following section will built upon to develop a new conceptualisation of convergence.

6.3 A NEW GUIDING DISTINCTION: CONVERGENCE VS. CONTROL

Since their emergence in the 1980s, mobile operators have defined themselves as service providers for voice calls and messaging. However, the convergence of the mobile telephony networks and the Internet challenges this prevailing view, and suggests that mobile network operators move from being service companies to utility companies. Hence, the idea of ICT convergence challenges the very identity of mobile network operators. The boundary between the MNO and the environment is continuously recreated by representations of what MNO means. Each communicative operation reproduces this distinction, and creates self-reference and eventually identity. The identity of a system is always based on differences (Luhmann, 1984: 251). However, convergence challenges some of the existing differences and hence the identity of the system.

According to Luhmann (1984), the reproduction of a system is the maintenance of the difference between identity and difference. Hence, a difference-reduction programme like mobile VoIP challenges the identity of the mobile network operator.

This identity struggle for the mobile network operator has led to the establishment of mechanisms at its system's boundaries with the aim of sustaining the existing boundaries. What this analysis presupposes is that the emerging control systems aim to maintain the boundary, which is eventually a question of identity.

6.3.1 Relationships between Control and ICT Convergence

Control, like convergence, is a fairly ambiguous concept, primarily as a result of its multiple meanings in the English language. According to the Oxford English Dictionary, the term "control" has its origins in the French word "contreroller", which was based on the medieval Latin verb "contrarotulare", meaning "to take and keepe a copie of a roll of accounts" (Oxford English Dictionary). This "counter-roll" or duplicate register helped in medieval times to check, verify, and regulate payments and accounts. Its meaning therefore signified not only comparing and processing information, as Beniger (1986) suggests, but also, as Mulgan (1991) points out, establishing a counter-balance to the power of the treasurer "so that actions can be called to account" (Mulgan 1991). The meaning of control gradually expanded from its origins as society differentiated the word to varying degrees of intensity, so that nowadays the word 'control' is used in everyday communication to describe any degree of influence aimed towards a predetermined goal – from giving guidance to total domination (Beniger 1986). While predetermination is common to all definitions of control, the degree of influence varies, and encompasses the full spectrum – from absolute control to any purposeful behaviour.

The different understandings of control when related to ICT may be conceptualised in four different schools of thought: the cybernetic school, the management school, the power school, and the surveillance school.

Cybernetic School: The idea of control in the context of ICT has a long tradition. One of the earliest perspectives was provided by Norbert Wiener (Wiener 1948), who viewed the concepts (or provenances) of control and communication (along with emergence and hierarchy) as the fundamentals of the field of cybernetics. While working on anti-aircraft weapons systems during World War II, Wiener acknowledged the importance of feedback mechanisms that incorporate both control

and communication. He suggested that similar feedback mechanisms might be found in nature. Building on this idea, Simon (1969) sees information processing as key to controlling the environment, and Beniger (1986) suggests that both information processing (comparison) and communication (feedback) are essential for control. According to Beniger (1986), due to its goal orientation, a basic feature of control is the continuous comparison between the present state and the goal, as well as the communication of this data back to the controller (feedback). The cybernetic approach has been particularly influential in describing processes of decision-making (Simon 1969).

The Management School: Yates (Yates 1989) defines managerial control as "the mechanism through which the operations of an organisation are coordinated to achieve desired results". The management school is therefore very closely related to the cybernetic school. A plan needs to be defined with predefined goals. Control is then exercised through information processing and feedback to achieve this goal. In the context of ICT, Ciborra et al. (2000) give the example of business and IT alignment.

The Power School: Control as power in the context of ICT has been studied primarily in the debate on centralization versus decentralization. One key work in this school has been that of King (1983), who points out the importance of the political dimension, and the power play between the centralised and decentralised forces surrounding information systems in organisations. Mulgan (1991) differentiates between four different types of control, based on two main distinctions. The first distinction is between exogenous and endogenous control. Exogenous control is imposed centrally in a hierarchical form, whereas endogenous control is linked to self-control and is distributed horizontally. The second distinction is between control to achieve given ends, and control to become an end in itself (Mulgan 1991). He sees control as merging the actions of looking, interpreting, and acting (Mulgan 1991).

The Surveillance School: The fourth perspective linked to the concept of power is the surveillance school of control. These studies on ICT and control primarily use Foucault's ideas on disciplinary power (Foucault 1977). Zuboff (1988) uses the idea of the panopticon to describe the constant visibility, and the possibility of

surveillance through information systems. Poster (1990) extends this by referring to network marketplaces as "Superpanopticon", and Deleuze (1990) even talks about a "Control Society" in which Jeremy Bentham's notion of a panopticon is no longer limited to a physical architecture, but rather is ubiquitous in society.

The relationship between ICT convergence and control has been observed in previous studies through several different lenses, highlighting different links between the two concepts (see figure 6-8):

Management
Perspective
Convergence $\longleftarrow$ Control $\longrightarrow$
Cybernetic,
surveillance,
and power
Perspective
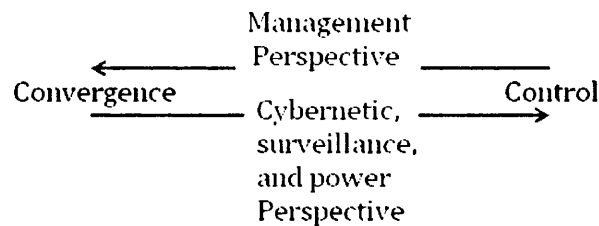
Figure 6-8 Overview Relationship Convergence and Control (Own Figure)

The primary focus in the literature has been the managerial lens, namely seeing convergence as a process that somehow needs to be managed. Research using this lens has usually been conducted from the perspective of single organisations (Hacklin 2007), and from a regulatory perspective (Shin 2006). The managerial view assumes convergence to be an issue that needs to be controlled by either managers or regulators; and that implicitly assumes some sort of aim, goal, or intention. Consequently the normal conceptualization of the relationship between convergence and control is based on the traditional schema of control as an action that requires a subject, an object, and an intention (Mayntz 1987). However, there is another perspective that posits convergence itself as control. Beniger (Beniger 1986) states the following:

> "Most important in social implications has been the progressive convergence of all information technologies – mass media, telecommunications, and computing – in a single infrastructure of control at the most macro level."

Scholars acknowledge that ICT does aim to introduce structure and thereby transform uncertainty into risk (Demetis and Angell 2007) so that a system's relationships to its environment can thereby be managed (Kallinikos 2005). However, the particular view suggested by Beniger is seen by some as problematic, since it reduces the

inherent uncertainty of reality to being simply exceptions to the normal state (Hanseth and Braa 2000).

A different relationship between ICT convergence and control has been suggested in a theoretical paper by Benkler (1998) that discusses the way that ICT convergence concentrates or distributes control over the production and exchange of information in society. This is related to the power perspective mentioned earlier, but it is also embedded in a managerial perspective on how to manage the convergence process as a regulator.

Fortunati (2008) argues that convergence assumes a model of control that is absolute. She gives the example of the mobile 'phone, which might also be used a purse, a diary, and a watch. In contrast, she argues that control in the Western experience should be diversified so as not to put 'all the eggs in one basket' (Fortunati 2008). This relationship between ICT convergence and control suggests a link to the concept of risk (or rather hazard, since 'taking a risk' also involves opportunity), based on the assumption that diversification means lessening the risk of "putting all your eggs in one basket" – a vernacular warning that is equivalent to Ashby's Law of Requisite Variety (1958). Risk as a counter-concept to control (Luhmann 1991) has also been discussed by Hedley (2000), who argues that society should aim for more divergence, and stand out against convergence due to the increasing risks that come with increasing interconnectivity.

Finally, a large body of literature deals with different aspects of boundary-management, and several useful theoretical concepts like trading zones (Geertz 1973) or boundary objects (Star and Griesemer 1989) have been developed. But this research stream focuses rather on how to balance organisational boundaries, in particular in collaborative ventures using converging technologies, and less on boundaries of infrastructures.

Ciborra et al. (2000) point out that one of the prevailing views in the literature on information infrastructures is control as management or planning. This view deals with the management of the infrastructure namely the alignment of corporate infrastructures to business strategy. Nielsen and Aanestad (2006) argue that this view

of control appears very narrow, and might lead to control as "an aim in itself". It also excludes the possibility that the infrastructure itself may be a means of control, as suggested by Beniger (1986) and Foucault (1977).

More recently, some scholars have attempted to open up the "black box" of control in the context of information infrastructures. Jacucci (2005) primarily focuses on Mulgan's distinction of exogenous and endogenous control, to study the conflict of centralization/decentralization. He suggests viewing the distinction, not as a dual, but as interdependencies between exogenous and endogenous control (Jacucci 2005). Finally, Woodard (2008) suggests looking at architectural control points in information infrastructures that constrain other system components. He suggests that despite of increasing openness and interconnectivity, control points are still important to consider.

Luhmann (1989) argues that the dichotomy of centralization/decentralization assumes a "channelling of the communication flow that does not exist nor can even be produced", and that "every formation of a subsystem is nothing more than a new expression for the unity of the whole system" (p. 106). He agrees that social systems distinguish themselves by the way they combine centralization and decentralization, but he also points out that the dynamics and interdependencies cannot be understood from this distinction. Therefore, it seems more fruitful to analyse instead the idea of control related to the boundaries of these social systems. As Kallinikos (2005) states, "control is after all an exercise in boundary drawing and boundary management".

6.3.2 Control as Counter-Concept of Convergence

Convergence as steering poses the question towards its counter-concept. Luhmann sees control as the counter-concept of steering. Luhmann's treaty of the relationship between control and steering is distributed over a large number of articles and book chapters. However, an excellent starting point appears in his chapter on modes of communication and society in "Essays on Self-Reference" (Luhmann 1990). There Luhmann points out the important distinction between the German and the English usage of the term *control*. In English, *control* may have three primary meanings: namely, control as comparison, as steering, and as domination (Luhmann 1990).

As Luhmann points out, control as comparison - not of *input to output* or *input to goals*, but comparison of *input to memory* - is the traditional meaning of *control*, and is common to both German and English. Luhmann draws explicitly on this etymological origin of *control* in his analysis of the economy as a functional sub-system (Luhmann 1988), where he makes the same distinction between *control* as the memory-related comparison of texts, and *control* as goal-oriented steering.

This distinction between *control* in the sense of comparison, and *control* in the sense of steering, plays an important role in many of his articles. Luhmann brings both ideas together in his working paper "The Control of Intransparency", where he offers an analytical distinction, based on time, between control and steering (Luhmann 1997). Steering is future-oriented, dealing with the decision premises or assumptions of the system: what Luhmann calls "oscillators" (Luhmann 1997). Oscillators do not determine the future, but they focus the communication about the future on certain distinctions (Luhmann 2006). Human beings base their descriptions of the future on distinctions they make, and the crossings (or to use Luhmann's concept of "oscillation") from the marked side to the unmarked side (i.e. from convergence to divergence and back) of the distinction.

Control as the comparison of *input to memory* is related to the past, not to the future. It means looking backwards. Luhmann sees the increase in the capacity to control through writing, printing, and (nowadays) computing as one of the most influential structural changes for society (Luhmann 1990). The increased capacity to compare incoming with stored information does not increase our capacity to reach goals, but rather may lead either to disappointment or, in the best case, to the evolution of ideas (Luhmann 1990). Steering, on the other hand, deals with the future (Luhmann 1997).

He sees the relationship between steering and control as a special case of the concurrence of past and future (Luhmann 1997). Steering deals with the intention to change specific differences, but control may rewrite this distinction as soon as attempts to steer have occurred. He argues that attempts at steering are continuously under pressure to show consistency, and that decisions have to be made about whether the steering should be continued or discontinued.

Secondly, the distinction between control and steering provides a lens through which to study the role of technology in the relationship between ICT convergence and control. Most of the literature on ICT convergence focuses not on the technology, but on contextual factors (e.g. industry convergence [Hacklin, 2007]).

Instead, from a systems theoretical perspective, it can be argued that the idea of ICT convergence suggests an increase in control capacity (i.e. to compare input to memory). An increasing number of computer systems or even other objects (e.g. SIM card-enabled streetlamps) can communicate with each other[4]. This dramatic rise in M2M connections and the resulting interoperability leads to more opportunities for comparing and checking, therefore increasing the capacity to control. However, this effect might lead to the illusion of increased steering capability for decision-makers and systems designers.

The emerging control system encompasses a wide range of elements organized in sub-systems based on technology, economic, legal, and social elements (Murray and Scott 2002) aiming to sustain the boundary of the mobile infrastructure its environment (see figure 6-9).
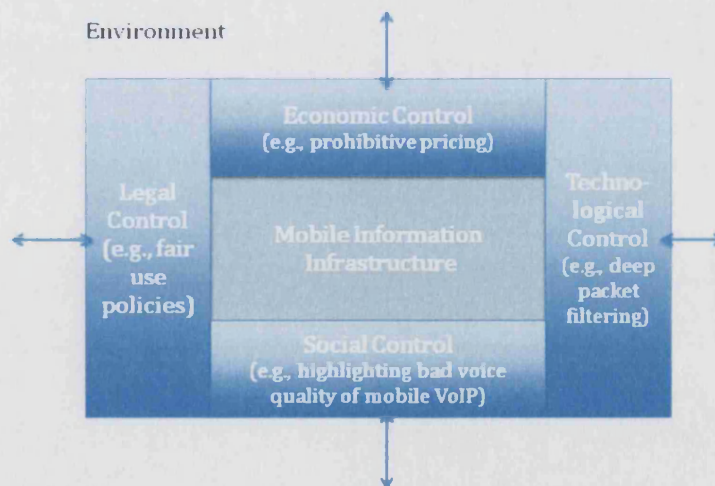

Figure 6-9 Control System around Mobile Information Infrastructure (Own Figure)

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[4] According to ABIresearch (2010), the market for cellular machine-to-machine (M2M) connection services will rise from 71 million connections in 2009 to 300 million connections by 2015.

Legal control is exercised through fair use policies that restrict the usage of the mobile phone contract to a limited amount of data, or prohibit the use of VoIP services specifically. Since June 2009, more and more European MNOs have begun explicitly to allow VoIP because of regulatory pressure.

All of these efforts at control aim to protect the infrastructure from an "unwanted" difference-reduction programme like mobile VoIP challenging its identity. The technological controls are no more limited to just deep-packet scanning and packet blocking at the GGSN and compression server. They have expanded over the traditional boundaries of the infrastructure and are embedded in mobile operating systems where VoIP capabilities are disabled or in application stores that only allow the download of WiFi-enabled mobile VoIP programmes (and exclude the functionality of 3G support) like in the case of Apple's appstore.

However, the protective cocoon these technologies provide for the infrastructure is challenged by the complexity in the environment. Deep-packet scanning is rendered useless through virtual private networks; packet blocking is made difficult if the users change ports; and the 3G functionality can be enabled through making the control technology emulate WiFi.

What can indeed be observed is an increasing fragmentation of networks, services, and devices as well as an increasing conflict system emerging from the dynamics of difference-reducing and difference-maintaining operations. Hence, the additional technologies that have been suggested as remedies, like firewalls and network address translators (NAT), have their own undesired consequences (Angell and Ilharco 2004).

Furthermore, this dissertation agrees with Woodard (2008) that architectural control still plays a role. However, as the example of mobile VoIP shows these control mechanisms are very often only a placebo and not a remedy. Even worse, they may become harmful, as the reactions from regulators in the US and EU and is shown with the calls for net neutrality for mobile Internet. The use of these technologies might ultimately result not in protecting the information infrastructure from external convergence programs, but instead demolishing the boundary altogether. Sooner or

later, mobile operators need to reinvent themselves, and either accept that they have become a "bit pipe" or, as one of the interviewees suggested, build up

"a new identity around their brand and customer experience"

(Interviewee 32 - CEO - OS vendor).

The conflicts between difference-reducting and difference-maintaining operations emerge in the context of mobile VoIP around specific elements, which may be called control points (Trossen and Fine 2005; Woodard 2008; Herzhoff, Elaluf-Calderwood et al. 2010). The idea of control points has been used in the context of architectural design (Woodard, 2008; Trossen and Fine, 2005). The Value Chain Dynamics Working Group at the MIT has applied the concept of control points extensively in case studies on various technologies like online music stores or RFID. They define control points broadly as points at which management can be applied. Any functional element can be a control point. According to Trossen and Fine (2005), control points are defined by four parameters: interchangeability, demand, value, and time. The value of a control point depends on interchangeability and demand. Time affects all three parameters. Control is exercised via business, regulatory, and/or technical means. Woodard (2008) focuses on a very specific type of control points, namely architectural control points. He defines architectural control points as "system component whose decision rights confer architectural control over other components" (p. 361). This effect can be small but also powerful influencing the whole architectural landscape. Woodard (2008) specifically suggests the applicability of the concept of control point in the context of system industries like the mobile ecosystem.

The notion of control point suggested in this dissertation is somewhere between these two perspectives. While this dissertation does not consider just anything that can be managed as a control point, it also does not limit itself to just architectural components. In fact, it is argued that the idea of control points can be enriched through Lawrence Lessig's modalities of regulation (Lessig, 1999). Lessig identifies four modalities of regulation: (1) law, (2) social norms, (3) markets and (4) architecture, e.g. code (Lessig 1999). Hence, control points do not only encompass business, regulatory, or technical means but also social norms. While Lessig applies these modalities only in the limited context of regulation, Murray and Scott (2002)

argue that the modalities of regulation are not limited to regulation but are part of any form of control system.

Table 6-4 shows the 29 control points identified from the interview data during the analysis. Each of these control points differs in terms of interchangeability, demand, and value, and have changed over time. For example, the application store has been low in demand and value for many years. However, it became one of the most prominent control points for mobile VoIP services with Apple's appstore. It can be argued that at the same time the WAP portals of the operators have lost in demand and value. However, it can also be observed that some control points lose importance over time. A good example for this is the iPhone operating system. The iPhone operating system distinguished between WiFi and 3G and did not allow certain applications like VoIP or video streaming software to use the 3G connection. However, this control point lost some of its value when the regulator in the US demanded to change this practice. Finally, the control points are based on different modalities. In particularly, the infrastructure system not only gained through structural couplings indirect access to multiple control points over mobile VoIP, but these control points are also covering all four modalities as suggested by Lessig (1999), being technical, social, economical, and legal. While some of the legal and economical control points are highly visible (e.g. fair use policies), some of the technical control points are hidden (e.g. prioritization of packages).

Table 6-4 Identified Control Points Relevant to Mobile VoIP

Infrastructure	Service	Regulation	Use
Compression server (T)	Delivery (T)	Inter-connection charges (E)	Device
Prioritization (T)	Contract (E)		- Firmware (T)
Contract (L)	Subsidies (E)	Regulation on emergency numbers and VoIP tapping (L)	- Button (T)
Subsidies (E)	Authentication (S)		Reflash (T)
Handover (T)	Billing (E)	Competition law (L)	- Chipset (T)
Billing (E)	Interconnection charges (E)		Configuration (S)
Authentication (T)			Update (T)
Gateways (T)	Roaming Agreements (L)		OS (T)
Router (T)	Application Store (T)		Cell information (T)
	Portals (T)		
	Quality perception (S)		
Modalities: of Control Points: T = Technical, E= Economic, S=Social, L=Legal			

6.3.3 Convergence, Fragmentation, and Control

The case of mobile VoIP shows that the form of convergence communicated primarily leaves out the observer. The search for this blind spot shifts the view to the other side of the distinction. The analysis suggests that the counter-concept of convergence (difference-reducing) is not divergence (difference-increasing) but rather difference-maintenance, or in other words control. This point shows that it is not sufficient to take into consideration just convergence (Lyytinen and Yoo 2002), nor convergence and divergence (Tilson, Lyytinen et al. 2010b) but also the emerging tensions between these two and the forces maintaining status quo.

The tensions between difference-reduction and difference-maintenance result from the "no" articulated through difference-maintenance. In the context of mobile VoIP, this tension can be observed from mobile networks, which are still tightly coupled with the voice service. All three operations (difference-reducing, difference-increasing, and difference-maintaining) influence the design of new mobile services like mobile VoIP. Mobile VoIP bridges the difference between mobile telephony and Internet as a difference-reduction programme. Ludes (2008) argues that convergence under pressure leads to fragmentation. From the analysis in this dissertation, this is not a generally accepted statement, but rather depends more on the observer and the distinction that is reduced. In the case of mobile VoIP, differences are reduced and

put under pressure through difference-maintenance programmes. These conflicts between these two forces have direct implications for the design of digital information infrastructures.

6.3.4 Discussion of the Implications for Systems Design

There have been calls within the IS research community to conduct research on the challenges facing new information infrastructures and services (Lyytinen and Yoo 2002) and in particular design- related questions (Hevner et al. 2004; see also special issue on design science in MISQ Vol. 32, Issue 4). The findings of this dissertation suggest that the design of information infrastructures should take into account the subsequent tussle when different stakeholders with different views engage. The following sub-section will sketch out some of the implications of such an approach.

Before proceeding in the critical discussion of the link between convergence and conflict, it is necessary to lay down some basic assumptions on the very important distinction between competition and conflict. Many studies including the work by Clark et al. (2005) lack the conceptual clarity to differentiate between these two concepts. Schmidt and Kochan (1972) argue that this mainly results from the fact that both competition and conflict have the perception of goal incompatibility as a necessary precondition. According to Bartos and Wehr (2002) these incompatible goals can either result from contested resources, incompatibility of roles, or incompatibility of values.

However, competition is very distinct from conflict. There are four different schools of thoughts on how the distinction between competition and conflict plays out. The first one, represented by Boulding (1962), makes the distinction based on awareness. Boulding (1962) sees conflict as a situation of competition in which parties are aware of their incompatible goals. The second school of thought, represented by Simmel (Simmel 1955) and Dahrendorf (1959), focuses on how competition is regulated. According to them competition becomes conflict if it goes beyond the limits of regulatory norms. The third school of thought bases the distinction on behaviour (Schmidt and Kochan 1972). Two parties might be in competition and interacting. Incompatible goals might motivate conflicts but are not sufficient. For a conflict to

emerge, there needs to be some sort of motivation to interfere. According to Fink (Fink 1968) the difference can be described as one of parallel striving (competition) and mutual interference (conflict).

The fourth school is based on Luhmann's systems theory (Luhmann, Bednarz et al. 1995). Competition is here seen as projected by one party as a descriptor for the environment of the organisation but a direct interaction is not a necessary precondition. However, if direct interactions take place the possibility emerges for one party to communicate a "no" (Luhmann 1997). It is this negation, which may lead to the emergence of a conflict or tussle system (Figure 6-11).

Infrastructure

Service   Use

Legend
→ Tussles *between* socio-technical systems
Tussles *within* a socio-technical system
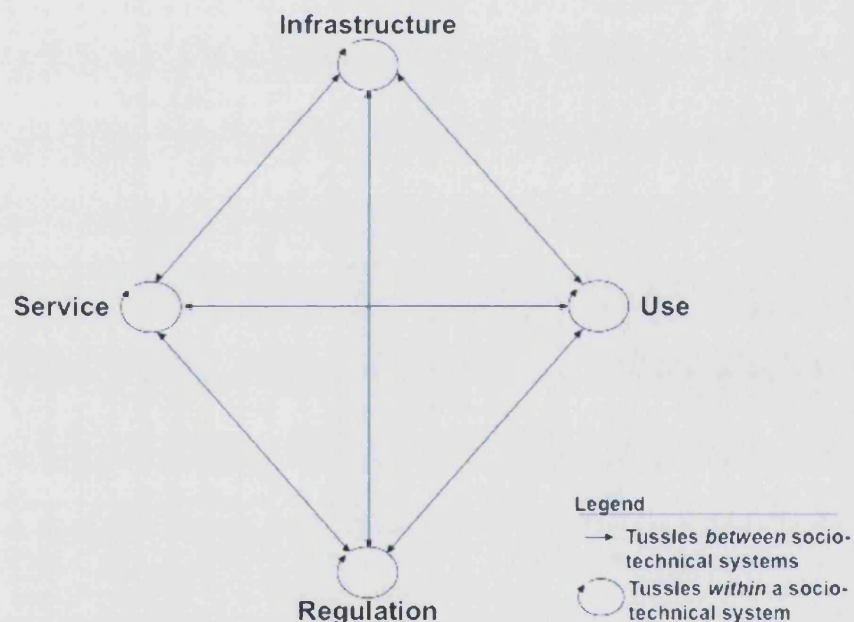
Regulation

Figure 6-10 Tussle Systems (adopted from Herzhoff et al. 2010)

However, both distinctions based on awareness and regulatory norms have too much conceptual ambiguity to be useful. The main difference between competition and conflict lies in the "realm of interference", or blocking activities (Seiler 1963). Luhmann sees conflict as an immunisation for society. Conflicts test the potential for resistance (Luhmann 1997), and are important for the immunisation of society and for its evolution. On the other hand, conflicts often go out of control.

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According to Luhmann (1997), conflicts are systems within systems. They emerge if one party engages in a negation. The conflict system develops a life of its own and feeds itself from the host system. Society has developed three ways to deal with conflicts. Firstly, it can resist conflicts by establishing a structural asymmetry. Through this asymmetry it is easier to say "no" without risking a conflict. Secondly, conflicts can be allowed, but they will be reduced through social regulation, i.e. a third party. Finally, society deals with conflicts through the differentiation between reasons of conflicts and conflict issues.

However, a very important key learning here is that conflicts do not need to be destructive or in fact at all negative. In fact, conflicts test resistance potential, and are important for the immunization of society and for its evolution.

Convergence as interoperability on the other hand deals with the technical bridges or gateways among the converging elements (e.g. networks, services, or functionalities). However, both processes are not free from conflicts. While the different actors tussle in the standardisation arena, migration and continuous upgrades can lead to tussles around the gateways.

Table 6-5 Tussle System Matrix for Mobile VoIP (adopted from Herzhoff et al. 2010)

Tussles between...	Infrastructure	Use	Regulation	Service
Infrastructure	Handovers			
Use	VoIP prioritization fair use policies	Notification messaging (OS)		
Regulation	Net neutrality	Emergency numbers	EU vs. national regulation	
Service	App Store offers no 3G support, deactivating SIP support	Quality of service, accountability	Emergency numbers, call tapping	Termination fees, number database

This conceptual link between the process of ICT Convergence and conflict can also be observed throughout all five perspectives mentioned above.

The third stage of Mobile VoIP revealed a large variety of different conflicts between actors in the mobile ecosystem. The first step of the analysis is to move from an actor

to a functional systems view of the mobile ecosystem. One of the findings from the mobile VoIP case is the growth of the conflict system between 2007 and 2009. It has escalated from a small tussle between the infrastructure and the service system to a large-scale tussle covering all four socio-technical systems. For example device manufacturers as well as operating system vendors started to play an increasingly important role in these tussles. Examples of these tussles between but also within the four systems are given in table 6-5.

Tussles happened not only *between* the systems but also *within* a system. For example, the court case between Truphone and T-Mobile was in its first instance not a tussle between the infrastructure and the service system but rather a tussle between two similar services within the service system. The T-Mobile voice service did not allow Truphone an interconnection with its customers. This tussle was fought using the technical means of blocking the Truphone number range. However, it is interesting to observe how both parties viewed this dispute. While T-Mobile regarded it as just negotiations with a competitor, Truphone argued that it was a refusal by T-Mobile to connect their customers with Truphone customers.

Tussles can, furthermore, be either *direct* or *indirect*. *Direct tussles* between service and infrastructure system became obvious in the fair use policies published by the network operators excluding VoIP calls. However, most of the tussles observed in the case of mobile VoIP were in fact indirect. *Indirect tussles* are based on structural couplings between two systems. For example, service and infrastructure system have over the past been heavily intertwined with each other through both organisational and technical arrangements. Although virtual mobile network agreements may be regarded as a first step of decoupling these two systems, mobile VoIP provides the threat of a decoupling on a much larger scale. Hence, some of the tussles around termination rates and number databases (such as the court case between Truphone and T-Mobile) for call routing between mobile VoIP companies and MNOs may also be regarded as indirect tussles between the infrastructure and service system. Further structural couplings are handset subsidiaries. Handset subsidiaries enable the infrastructure system to gain influence on the use system. Examples for tussles related to this were the hidden SIP capability in Nokia N95.

Summarised, the initial findings from the case study suggest that tussle systems – if not managed well – can increase in size and go well beyond the initial boundaries of the tussle, increasing complexity. Furthermore, tussles can span over different socio-economic systems. On going back to the initial problematic of tussles, it can observed that the tussles between mobile VoIP and MNOs has lead to a further increase in the heterogeneous nature of the mobile ecosystem. Instead of providing a superior service through partnerships and collaborations between mobile VoIP companies and MNOs, these tussles have produced further inefficiencies through deployment of several parallel voice service and messaging architectures often incapable of communicating with each other. This may be regarded as another indication that it is less convergence but rather divergence, which needs to be considered in the design of information infrastructures and services.

6.4 CHAPTER SUMMARY

If mobile VoIP is envisioned as a difference-reduction programme, the first question that arises is which difference does it reduce. Based on the empirical findings of this study, mobile VoIP aims to reduce at least four distinctions: (1) between mobile networks and the Internet, (2) between mobile and fixed telephony, (3) between voice and data, (4) IP/circuit-switched. The developers of these applications are motivated by the perceived need of users, both to have all their services in one application and to be given the opportunity of open interfaces. The mobile VoIP companies develop not only applications bridging different networks, but also different services (e.g. instant messaging and social networks).

However, the main finding is that while ICT convergence treated as difference-reduction programme challenges the existing "identity" of the infrastructure, the primary role of control is to maintain this difference. The dynamics between these two operations seem to lead to the emergence of further fragmentation. Hence, this dissertation agrees with the observation by Wareham et al. (2009) that persistent fragmentation "suggests that claims of 'convergence' might be overstated" (p. 141). The tension between these two processes needs to be further explored in future studies to find appropriate answers for how to design systems in an environment, which is both characterised by increasing convergence and fragmentation.

7. Conclusion, Limitations, and Suggestions for Future Research

This dissertation started with a brief description of the painting *Convergence No 10* by Jackson Pollock. Pollock has given the painting a quite puzzling description, which has not yet been addressed. He sees convergence as "a unifying process that eliminates chaos". This is puzzling in two ways. First, it seems to be in stark contrast to the painting itself, which appears to most observers as highly chaotic. Second, the description itself is paradoxical since chaos as pre-order (Angell and Demetis 2010) is always in the background of our distinctions, categorisations, and structures. It cannot be eliminated, but only covered by distinctions. These distinctions impose order. Convergence, conceptualised in this dissertation as difference-reduction, does not eliminate chaos; rather, it aims to eliminate distinctions. Hence, it could be argued instead that convergence does not eliminate chaos – it uncovers it. However, what the analysis has also shown is that convergence discourses are always observer-dependent and thus, asymmetrical. Furthermore, these discourses produce in the interaction with difference-maintenance forces new distinctions, i.e. new order.

This closing chapter aims to tie together the loose ends of this dissertation. It does this in four steps. The first section revisits the research questions posed at the beginning of this dissertation and links them to the findings from chapters five and six. The second section presents and discusses the overall contributions of this dissertation for theory, methodology, and practice. The following section takes a third-order perspective and reflects on the blind spots of this dissertation – limitations, generalisability of the findings, and ethical issues. The final section takes the debate on ICT convergence one level further, and opens up an agenda for future research projects.

7.1 RESEARCH QUESTIONS REVISITED

The dissertation started with a very basic research question: what is ICT convergence? An initial literature review has shown that convergence is a very ambiguous and ambivalent concept. The prominence of convergence in many discourses of functional systems in society shifted the question from a first-order to a second-order observation: how do practitioners in the mobile telecommunications industry observe convergence? In order to explore the idea of ICT convergence further, an extensive literature review had been conducted. One of the findings from the literature review has been a multitude of contradictions inherent in the notion of ICT convergence. First, it needed to be understood whether there is space for a more theoretical development of this concept in the information infrastructure literature, or whether convergence is just a meaningless buzzword, a rhetorical device to convey just another management fashion. Second, the characteristics of ICT convergence, which make it appear as divergence, needed to be understood. Third, the limits of ICT convergence had to be investigated as well as the role of technology in this contradiction. Therefore, the research questions were revised, and five sub-questions were identified. The following sub-sections will deal with each sub-question individually before focusing on the over-arching research question related to the convergence paradox.

7.1.1 Is ICT Convergence Just a Fad or Fashion?

This question has been addressed throughout the dissertation. The literature review has shown that many academics still regard ICT convergence as just another buzzword without any deeper conceptual meaning. The bibliographic analysis of convergence articles, however, showed that convergence has been used in the context of mobility since the early 1980s. Furthermore, it showed that convergence as related to mobility has been with a share of more than 50% the most important ICT convergence discourse in the UK business press since 2006.

The data from the professional network XING showed that telecommunications experts still use this notion to describe their work, at least for recruiters and peers. Similar observations were made during the practitioner conferences attended by the researcher. Thus, convergence does not seem to have the ephemeral character that is

so typical of a management fashion. However, a closer look reveals that the convergence discourse does have some characteristics that make it appear to be a fashion. In particular, the notion of convergence has differentiated into many different forms, which also have changed over time. Furthermore, convergence appears to work, similar to fashion, as a pre-code for functional systems. For example, several interviewees from mobile VoIP companies confirmed that convergence has been an important signalling notion for the communication with venture capitalists. However, the decision of investment/not-investment is based on the economic code. Thus, the question was re-phrased to: What makes convergence appear to be a fashion? This has been analysed in more detail from a systems theoretical perspective. The findings from this analysis show that the notion of convergence offers more than just fashion. It implies the reduction of a difference. The reduction of a difference is not just a pre-code for functional systems; it is an important steering mechanism (Luhmann 1997). This might be one of the reasons why convergence does not show the typical ephemeral character of a management fashion.

7.1.2 What are the Convergence Discourses around Mobile VoIP?

Convergence is, first of all, an observation of a distinction. However, it is a specific form of observation. It signals the reduction of a difference. In the case of mobile VoIP, the identified convergence discourses emerged around four core distinctions: mobile/fixed, mobile/Internet, voice/data, and IP/circuit-switched. These four distinctions are based on established technical as well as socio-economic arrangements that have existed for 20 years, like, for example, termination rates between fixed- and mobile-networks (Bomsel, Cave et al. 2003). The convergence discourses evolve around these distinctions. All four of these distinctions are asymmetrical, and it depends on the observer which side of the distinction is marked. It was also observed from the perspective of a mobile network operator that all four distinctions made a re-entry into the system of the mobile network operator.

7.1.3 What are Characteristics of Convergence Discourses around Mobile VoIP?

One of the key objectives of this dissertation was to provide an initial conceptual clarification of the notion of convergence. In the second chapter, five archetypes of

convergence were identified, based on an analysis of usage of the notion of convergence in the IS literature over the past ten years: alignment, interoperability, optimization, correspondence, and recombination. These five archetypes are based on three dimensions of convergence: the social/technical, the process/vision, and the unification/differentiation dimension. The empirical study has identified a fourth dimension, which is worthwhile including in this conceptualisation, the distinction between internal and external convergence. The systems-theoretical analysis showed, however, that all dimensions of convergence lead to one core, which is that all convergence programmes aim to reduce a difference. Furthermore, convergence programmes are relative to an observer, and, hence, can be both convergence and divergence at the same point in time. Finally, its characteristic of a fashion has already been discussed.

7.1.4 What are the Limits of ICT Convergence?

One important requirement for a conceptualisation of a notion is to identify its boundaries. The systems theoretical analysis demonstrated that the limits of ICT convergence in particular become visible through unexpected/undesired side effects, deficits of execution, and self-defeating prophecies. However, its key limitations come from its counter-concept. While the boundaries to the initial counter-concept of divergence as shown in the context of mobile VoIP are blurring, the limitations of convergence become clear when replacing the distinction convergence/divergence with the distinction convergence/control.

7.1.5 What is the Role of Technology in the Convergence Discourse?

Information and Communication Technologies (ICTs) have a strong connectivity with the notion of convergence. However, this is at first puzzling since technology is usually observed through *functional simplification and closure*. Taking this conceptualisation of technology as a starting point, it became evident that technology and convergence are themselves in a paradoxical relationship. Technology is built on tight couplings, and through its closure offers itself only for limited connectivity. The metaphor often used in this context is the one comparing a Swiss army knife, a device providing numerous functions, to a digital mash-up, which recombines digital

information in many different ways. However, this dissertation argues that it is the digital character of modern ICTs that provides this connectivity to convergence.

This dissertation followed Orlikowski and Iacono's advice not to take the IT artefact for granted (Orlikowski and Iacono 2001). The analysis of the artefact showed that the artefact of the mobile VoIP client itself exemplifies the paradox between convergence and divergence. Initial attempts to include functionality to react to this paradox can also be seen; the auto-roaming feature in the Truphone application that switches between WiFi or local GSM calls (whatever is available) is an example of "design for tussle". Fring uses a similar auto-roaming feature, but also considers 3G, which introduces another level of complexity.

7.1.6 The over-arching Research Question: The Convergence Paradox

After having dealt with the five sub-questions, it is now time to return to the over-arching research question this study aimed to address: how can we conceptualise the notion of ICT convergence using second-order observation to understand the contradictory discourses around convergence in the case of mobile VoIP in the UK?

ICT convergence rests, according to the literature review, primarily on the core distinction of convergence and divergence. However, the findings from the empirical study challenged this assumption and pointed towards a paradox: Convergence is divergence, divergence is convergence – it depends on the observer. The four second-order dimensions of ICT convergence were examined in relation to this paradox through the use of analytical strategies based on Luhmann's Theory of Social Systems. The findings of the analysis further uncovered the paradoxical relationship between convergence and divergence. Through the course of this analysis, several conceptual shifts have been identified that might have put further pressure on the tensed relationship between convergence and divergence:

- There are indications that ICT convergence has been moving slowly from a vision to an on-going process.
- Increasing digitalisation of information infrastructures has led to both increasing unification and differentiation.

- More and more observers participate in the convergence discourse and hence amplify this effect through increasing external and internal convergence reference.

It may be argued that these developments put increasing pressure on the underlying core distinction of convergence and divergence. Hence, the findings from the empirical study were scanned for ways of how to unfold this paradox, i.e. to identify a different core distinction that can help to provide more "fruitful" ground for further analysis. Based on the findings from the semantic analysis, the initial approach was to unfold the convergence paradox along the three dimensions of meaning: factual, temporal, and social.

Through oscillating between two points of observation, namely the mobile VoIP companies and the network operators, another distinction emerged. Mobile VoIP as a difference-reduction programme is not limited by difference-increasing but rather by difference-maintaining forces, i.e. control. This dissertation argues, that the distinction between convergence and control or difference-reduction and difference-maintenance offers a more fruitful ground for future studies. More specifically, this shift of guiding distinction puts emphasis on how to design information infrastructures that take into account the subsequent tussle when different stakeholders with different views engage. The analysis has shown that in the case of mobile VoIP, these tussles emerge around specific control points.

Summarised, the key findings from this dissertation are:

- The ICT convergence discourse is based on four dimensions
- It is observer-dependent
- The counter-concept of convergence shifted from divergence to control
- Convergence has to deal with typical problems of difference-reduction programmes

7.2 CONTRIBUTIONS REVISITED

This dissertation makes several contributions to both theory and practice. While the key findings emerged from a case study on mobile VoIP in the UK, this study aimed to contribute not only to studies on mobile VoIP, but also to the wider IS literature and to the information infrastructure literature in particular. The first sub-section presents the contributions to theory, and links directly to the problematisation of the theoretical contribution in section 2.4. The following sub-section shows the contribution of this dissertation to methodology. Finally, the contributions to practice are presented. Most of the ideas discussed in the dissertation have been presented at conferences and seminars like the European Conference in Information Systems, Global Mobility Roundtable, Open Research Forum of Social Sciences and Information Systems (ORF SSIT) as well as at research seminars in the Department of Management at the London School of Economics. Some of the work has already been published either alone or in collaboration with other researchers at the LSE (see Appendix 1).

7.2.1 Contribution to Theory

At the outset of this dissertation, the literature review showed that the IS community has relegated the notion of ICT convergence to the sidelines. Only recently, there have been calls within the information infrastructure community to include convergence as one of the drivers for the design of new mobile infrastructures and services. However, a systematic analysis of the idea of ICT convergence is still missing. A wider discussion of the literature and the empirical study showed that the notion of convergence is full of contradictions. Thus, the main contribution of this study has been to develop a theoretical framework for understanding ICT convergence discourses, and particularly the convergence paradox in the context of mobile information infrastructures. Thus, this dissertation contributes to the established literature on information infrastructures and the emerging discourse on the role of ICT convergence in this field.

Going back to its objectives, this research project aimed to develop a conceptual framework to describe convergence discourses and to understand better the paradoxical relationship between ICT convergence and divergence in the context of

information infrastructures using mobile VoIP as an example. Based on this objective, this study aimed for three theoretical contributions. First, it hoped to provide an initial conceptual clarification of the ICT convergence discourse from a second-order perspective. Second, it aimed to provide a systems-theoretical unfolding of the identified core distinction of convergence and divergence - the convergence paradox. Finally, the role of technology in these discourses was examined.

This dissertation identified a framework of ICT convergence discourses based on four dimensions:

(a) process/vision,
(b) social/technical,
(c) unification/differentiation, and
(d) external/internal.

In particular, the distinction between internal and external convergence is a new dimension for articulating convergence and seen by itself as a contribution. The framework is a first framework attempting to incorporate the second-order dimensions of ICT convergence.

Furthermore, the systems-theoretical perspective suggests seeing convergence as a difference-reduction programme. From this systems-theoretical perspective one contribution is the conceptualisation of the mobile telecommunications sector as the environment of four self-referential socio-technical systems. Furthermore, more importantly, this perspective adds the missing observer into the debate on ICT convergence.

The empirical study on the convergence discourse in the context of mobile VoIP confirmed that the proposition to view convergence as a double process of alignment and interoperability was the main condition for convergence communication. However, the findings also challenged the prevailing distinction in the literature between convergence and divergence.

Thus, the main finding is that while ICT convergence treated as a difference-reduction programme challenges the existing "identity" of the infrastructure, the primary role of control is to maintain this difference. The dynamics between these two operations seem to lead to the emergence of further fragmentation. Hence, this dissertation agrees with the observation by Wareham et al. (2009) that persistent fragmentation "suggests that claims of 'convergence' might be overstated" (p. 141).

The main theoretical contribution of this dissertation therefore is a theory for analysing the relationship between convergence and divergence, the convergence paradox (Gregor 2006). Drawing on Gregor (2006), the usefulness of this type of theory may be evaluated for its completeness, distinctiveness, and simplicity. The conceptualisation of ICT convergence as a difference-reduction programme does fulfil these criteria. First, it is complete since it also incorporates the other side of the distinction. Furthermore, it is distinctive since it is the first systems-theoretical conceptualisation of convergence in the academic literature. Finally, it fulfils the criteria of simplicity.

Beyond its contributions to the information infrastructure literature, this study contributed in a wider context to the body of literature on applying Luhmann's Theory of Social Systems empirically. Thus, this study can be seen as a contribution to an empirical opening of Luhmann's Systems Theory (la Cour, Vallentin et al. 2007).

Although Luhmann's Systems Theory is used quite frequently in German-speaking countries, there are calls for more empirical studies on the international stage (la Cour, Vallentin et al. 2007). As with all grand theories, there have been difficulties in applying it in empirical contexts (la Cour, Vallentin et al. 2007). Some empirical studies in organisational science show, on the other hand, some promising applications of Luhmann's theories (la Cour, Vallentin et al. 2007). While General Systems Theory and Parsonian functionalism has been applied quite frequently in IS Research (Markus 2004) the Luhmann variant has only found its application recently (Kallinikos 2006; Demetis and Angell 2007). Therefore, this PhD dissertation also contributes to this emerging body of literature that applies Luhmann's concepts to empirical problems.

Finally, most studies on convergence have focused on general ICT or, in the context of mobility, primarily on mobile TV. Hence, the detailed case study on mobile VoIP in the UK can be regarded as another minor contribution of this dissertation to the field of information systems and convergence studies in general.

Summarised, the theoretical contributions of this dissertation are threefold. First, it initiates a path-clearing of the convergence jungle in IS. Second, it provides a second-order description of ICT convergence. Third, it provides an unfolding of the convergence paradox and suggests instead a new guiding distinction based on convergence and control.

7.2.2 Contribution to Methodology

This study introduced a couple of methodological innovations to the field of information systems. First, the study is, based on the researcher's knowledge of the literature, the first study in information systems that links Grounded Theory with Luhmann's Theory of Distinction (see the analysis of the literature on ICT convergence in the IS field in chapter 2.1). This approach has merits since it encourages the analyst to look not only at similarities but also at differences. Second, critics of discourse analysis point out the problem that studies applying this method only give imprecise and implicit suggestions regarding how to carry out discourse analysis (Kallinikos 2006; Demetis and Angell 2007). This dissertation suggests Luhmann's discursive analytical strategies (Andersen 2003) as one possible guidance and added technological and fashion analysis to the increasing number of analytical strategies based on Luhmann's Theory of Social Systems.

Finally, in the context of data collection, this study contributed through taking data from the professional network LinkedIn for studying fashions. The dataset is particularly relevant for the telecommunications industry, since more than 50% of telecommunications practitioners in the UK have been registered on LinkedIn. However, longitudinal studies are restricted by the limited search functionalities within the web application. Furthermore, this study contributed also through using interview data in a systems theoretical study. Only a few studies have used it, and

even fewer have thoroughly reflected on this. In addition, during the process of gaining access to organisations, a few innovative tactics have been developed. One of the most effective tactic has been the usage of professional social networks like XING and LinkedIn to identify potential interview candidates and contact them through the network itself.

7.2.3 Contribution to Practice

One relevant question often posed today in academic discourses as well as by research funding bodies is the question of practical relevance of the study (see, e.g., the newly introduced economic impact statement required by the UK-based Engineering and Physical Science Research Council). Luhmann argues that the distinction between practice and academia is a rather new development and traced it back to the 19th century (Luhmann 2006). Before this time, there was a clear distinction between practice and theory.

Therefore, before the contribution to practice can be illustrated, it is necessary to ask a more reflexive question: What impact does the study have for practice? However, this leads indirectly to a more subtle question, namely, how can the imagination be controlled, i.e., where do we draw the boundary for our contribution?

This dissertation sees a twofold direct practical impact: on the interviewees, who will receive a copy of this dissertation, and on the Mobile VCE project. By drawing this line, we can move one level up to the question of what impact the study has for practice.

A contribution to practice is to facilitate regulatory and design decisions on convergence by providing an alternative path for understanding convergence, which might encourage a less superficial usage of convergence and more thoughtful discussion, thereby changing assumptions on convergence itself. For example, organisations as social systems observe themselves, their environment, and their relationship to other systems in their environment through concepts (Andersen 2008). These concepts determine what an organisation can and cannot see.

In particular, it might be useful to consider the insights from the study as foundational work for "design for tussle". This has already been initiated within the Mobile VCE project and resulted in two internal reports (see Appendix 1).

7.3 THIRD-ORDER OBSERVATIONS: LIMITATIONS AND REFLECTIONS

One important aspect of a systems-theoretical study is that it is built on the assumption that second-order observation has blind spots. These blind spots can only be revealed through the shift towards a third-order observation. Thus, the aim of this section is to provide an initial third-order observation of this study based on the knowledge that this requires another level of observation to be reflected upon, which will be left to another observer.

7.3.1 Limitations of this Study

Blind spots are related to the distinctions we draw. A study can have different kinds of blind spots. This sub-section follows the categorisation already used in the contributions section and distinguishes between theoretical, methodological, and practical limitations. However, this section will only focus on the key limitations, since limitations have already been addressed at the end of the relevant chapters.

A. Theoretical Limitations

One of the key strengths but also main theoretical limitations of this dissertation has been the decision to use Luhmann's Theory of Social Systems for the theoretical framework. Systems Theory is a meta-theory and, hence, confronted the author with considerable difficulty when applied in empirical studies. To overcome these constraints, this study used only well-tested and understood systems theoretical concepts and analytical strategies. Furthermore, meta-theories often impose the risk that the researcher attempts to follow them dogmatically. While this study stayed in the framework of systems theory for consistency purposes, a pragmatic approach has been followed on several occasions. For example, Luhmann has never used interview data in his work. However, based on the work by la Coeur et al. (2003), this study made a clear case for using interview data in a systems theoretical study. Another example is the occasional inclusion of other frameworks, such as Lessig's modalities of regulation (Lessig 1999) and Murray and Scott's (2002) control system

framework. Luhmann himself used many different theories as foundation for his Theory of Social Systems. Finally, the choice of Luhmann's Theory of Social Systems also limits the accessibility of the dissertation, since it introduces a very complex terminology.

Summarised, from a theoretical standpoint, the choice to use Luhmann's Theory of Social Systems has the advantage of seeing the world in a very specific way, in particular focusing on distinctions and self-referentiality. On the other hand, this denies the chance to see the world in other ways, such as in terms of power relations (Willcocks 2006). This might be a potential avenue for future research. In methodological terms, the case study and Luhmann's Theory of Social Systems have been useful for the analysis but also came with a few limitations, listed in the sub-section below.

B. Limitations of the Research Design

The focus on the notion of convergence instead on the phenomenon had both an advantage and a disadvantage. The advantage was that the topic itself is not highly political and that most practitioners have an opinion on convergence. However, it was sometimes cumbersome to follow the advice by la Coeur, Knudsen et al. (2003) to steer the interview towards convergence communication. While it was fairly straightforward to obtain opinions and perceptions on convergence from the interviewees, it was much more difficult to make them reflect on how convergence is used as a concept within their organisations. For this, a future study might take a closer look at one specific organisation and analyse internal reports and documents as well as conduct direct observations. Instead, this study rather focused on popular self-descriptions by practitioners in the telecommunications sector, often directed to an "outside" like investors, regulators, or the mass media.

Can the system be national? It may be argued that the boundaries between different national systems are also blurring and that some unifying system like a world society has to be considered (Luhmann 1997). It may be seen as one limitation that this study focuses only on one country. However, despite globalization, there are still many forces that are highly national, such as Ofcom, the demand, and the media.

7.3.2 Generalisability of the Findings

The findings of this dissertation are based on a single case study, and hence statistical generalizability is very limited. However, it is argued that through theoretical generalization (Seale 1999), the developed conceptual framework of ICT convergence may be also be useful for other convergence discourses in the domain of information infrastructures.

The notion of convergence has not been limited to the UK context. In fact, the media analysis showed that many observers in other countries, in particular the US, have used this notion in the context of mobile telecommunications to describe technological change. Hence, it might be worthwhile to examine the relevance of this study in this context. Furthermore, the notion of convergence is not limited to the ICT sector. For example, one of the areas where convergence has been used lately is the area of NBIC (Hacklin 2007).

7.3.3 Ethical Issues during Empirical Fieldwork

Two ethical issues emerged during the course of the fieldwork. One was related to the naming of names and companies in the dissertation, and the other one was related to staying impartial during the "VoIP wars". In regards to interviewee names and the companies they worked for, it was decided to keep both confidential. While Liebenau and Smithson (1993) suggest that revealing names could help to validate the findings better, this dissertation inclines more towards agreeing with Hirschheim and Lyytinen (1994) about not mentioning these. For example, two of the mobile VoIP companies interviewed experienced major restructuring. In regards to impartiality, the researcher had to be careful not to be instrumentalised in the battle between mobile network operators, regulators, and mobile VoIP companies. This was particularly important since the study was conducted from 2007–2009, which was the most intense time as outlined in chapter five.

7.4 SUGGESTION FOR FUTURE RESEARCH

The next step in this research is to start envisioning how to take the study further. There are a couple of potential routes toward improving the existing piece and exploring new directions. For the former, it might be interesting to conduct research

in other domains of ICT convergence, such as IPTV, to see how the convergence communication is taking place there, which archetypes are used to condition it, what the guiding distinctions are, and what the conditions of the convergence paradox are and how it can be unfolded. Furthermore, the research could also look into another geographical domain, such as the US. For the latter, future research might also look more deeply at the relationship between ICT convergence and control. Furthermore, it might be worthwhile to investigate the power relationships in this discourse, for example, by applying Foucault. Another theoretical route might be towards an understanding how the idea of ICT convergence and other ideas and artefacts become a network. Teubner (1996) provides here an interesting path combining Luhmann's Theory of Social Systems with Latour. The aim of this type of analysis could be to demonstrate how convergence leads to a growth of power in a network (Andersen 2003: 125).

Finally, the findings from this study might be further used to refine the relationship between the social and the technology within the realm of Luhmann's Social Systems Theory.

The presented framework integrates the four second-order dimensions of ICT convergence. A next natural step would be to use the identified blind spots of first-order ICT convergence conceptualisations to stimulate an evolution of existing first-order ICT convergence concepts. This might also lead in the future to a potential integrative first- and second-order framework.

Along this path, it might also be worthwhile to investigate how the findings from this study might be helpful in the issue of "design for tussle". The tension between these two processes of difference-reduction and difference-maintenance needs to be further explored in future studies to find appropriate answers for how to design systems in an environment, which is characterised both by increasing convergence and fragmentation.

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Appendix 1: List of Publications

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