Developer Platforms and Communities in the Telecom Industry

Trend Report 2010

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Marie-Luise Lorenz · Christian Menkens · Julian Sußmann
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Preface

Even though the Internet has turned into something that virtually no one today would want to miss, infrastructure operators are uneasy about it. The majority of their revenues does not come from the Internet access business; it comes from a massive business, the phone business, that – all over the world – is steadily declining. Even mobile revenues are subject to the change: once sufficient data rates are available, voice connections turn into just one variant of traffic the IP protocol is capable of carrying; and also here, voice business starts its decline.

Although Telcos understand these developments and prepare to migrate their telephone networks to IP, there are further challenges to their business: the migration might make them loose even more customers and it is costly as well; every increase in bandwidth is paralleled by falling prices. At the same time value creation on top of the transport networks rises and rises. In short, the often quoted 'dumb bit-pipe' might run a sound business, but one that is driven by a constant need for more bandwidth in exchange for less money. Growth takes place on top of the networks but doesn't yield a share to the bit-pipe operator automatically. No wonder operators are looking for alternative revenue sources.

Often Telcos seem helpless compared to web players. Some of them can attract millions of users in days; some seemingly compete with services that used to be worth millions – now offered for a mere display of advertisement banners. The fact that VoIP service providers like Skype have not entirely wrecked the Telco's voice business already, tells that turning opportunities into business, isn't easy even for agile 'over-the-top' players. There is little reason to believe, though, that sophisticated mobile and home devices with ubiquitous IP connectivity will not replace the good old telephone service in the end. But there is more time for operators to prepare than many would think.

The 'two-sided business model' or 'Telco 2.0' concept seems to be a good choice for Telcos to not only participate in – but rather contribute to – the development of the Web, and thus might be more than appropriate to make good for the doomed telephony business. The idea is simple: take some of the assets created over the decades and open them to re-use through Web 2.0 developers who seem so much more creative than any old school corporation. Telcos all have made their experiences in Web services, portals and commerce – virtually none of them seems to rank high in the lists of successful web businesses.

'Enabling' others, thus, is the theme of the day in telecommunications research and strategy and it really holds promises to Telcos, web-players, entrepreneurs and developers alike. The question still is what to expose and how to sell it? Exposure of Telco's 'enablers' takes place via Application Programmer Interfaces – APIs, and these, e.g. in the case of well-known web players, are exposed by Google or facebook to the entire web community. The case for Telcos with their regional networks and marketing focus is fundamentally different.

Fragmentation of technologies across the landscape of operators and suppliers makes adoption difficult for web developers; all existing web programming works across the Internet – and, thus, basically around the globe. Developers are catered to by first developer portals of operators like Deutsche Telekom's Developer Garden. Perception, however, is regional and the APIs offered across the industry roughly implement the same functionality, but they are widely incompatible. Standardization, thus, plays a crucial role in the appeal of the whole telecommunication industry to the web.

To overcome these obstacles, a few initiatives started throughout the operator industry. The GSM Association has started standardizing – and recently piloting – a set of specifications for SMS, MMS, payment and location services. In early 2010, twenty-four leading mobile operators started the 'Wholesale Application Community' making use of OneAPI standards and concepts of other groups as JIL (joint innovation lab) and OMTP to jointly expose APIs to the developer community. While many of these initiatives seem to be driven by mobile operators, they are by no way meant to be limited to these. In fact, even the GSMA specifications clearly support non-SIM operators. It is hard to strike the balance between opening up, standardizing and still being distinct from competitors. As the status, however, is more defined by fragmentation than by harmony, every such step should be highly welcomed.

There are many open questions though, and it speaks for the trend seminar series at the Center for Digital Technology & Management (CDTM) that they have taken up the challenges and created a host of interesting approaches and insights over a remarkably short timeframe. Technological trends are the ones operators know pretty well if they have already learnt to read the signs from the Internet community. But every day new types of devices and new industries become networked, and thus contribute to the complexity of the technology landscape. This has a tremendous impact on the consumer. Not only computer geeks, but even the most average buyers of a HiFi sound system have to consider digital data standards, network connections and music service integration today.

Market development as described before involves many complexities. How will value chains change? In how far do they differ across industries? Can there be universal business models for the universal Internet? Do we need specific ones for specific industries or services? More and more often political decision-making influences the options that Telcos have available. Despite the contradictions between national regulation and global challenges, this is one source for the trust position that operators hold in most countries. Thus, many of the concepts developed in the project teams circle around the concept of commercial functions being exposed and re-used. Exposing networking functionalities has been practiced for a while now; globalization of these – and adding trust and payment functionality to the Internet, might just give it the innovative twist that big businesses can lend to the creativity out there. The CDTM team has tapped the creativity and expertise of their students, and succeeded to produce many original, and yet sound concepts in this complex environment.

Berlin, Summer 2010

Jörg Heuer
Project Field Lead Exploration and Enabling Technologies
Deutsche Telekom Laboratories, Berlin

Within this general topic, 25 students of the CDTM conducted a trend and scenario analysis together with academics and practitioners to explore the future of Developer Platforms and Communities in the Telecom Industry. The five interdisciplinary teams started with a short summary of the status quo in order to then identify trends for the topic. Each team looked at the subject from a different perspective, covering technology trends, market and customer trends, legal and regulatory developments as well as trends for emerging business models. Building on these trends, the main drivers for the topic and their interrelations were identified to form scenarios of the future. Based on this understanding of the future framework for Developer Platforms and Communities in the Telecom Industry, the students developed product and service ideas in the fields of ICT Devices of the Future, Telcos as Platform Providers, Enterprise Services, Ubiquitous Computing Services and Converged Multimedia Services. The results of this seminar are wrapped up in this report providing visionary ideas for future products and services in the area of Developer Platforms and Communities in the Telecom Industry that are designed to meet the requirements of the future customer.

For more information about the CDTM and its related projects,
please visit http://www.cdtm.de

The entire trend report was written by CDTM students in 2010. The papers compiled here do not claim to be scientifically accurate in every case; they are rather meant to give a structured and broad overview of trends relevant in the internet context.

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Nomenclature

3G	Third Generation
4G	Fourth Generation
ACTA	Anti-Counterfeiting Trade Agreement
AI	Artificial Intelligence
API	Application Programming Interfaces
ARPU	Average Revenue per User
B2B	Business-to-Business
BEREC	Body of European Regulators of Electronic Communications
BITKOM	Federal Association for Information Technology, Telecommunications and New Media
BMWi	Federal Ministry of Economics and Technology
BNetzA	Federal Network Agency
BPaaS	Business Processes as a Service
BTOP	Broadband Technology Opportunities Program
CCIF	Cloud Computing Interoperability Forum
CD	Commercial Developers
COPPA	Children’s Online Privacy Protection Act
CRM	Customer Relation Management
CSP	Communication Service Providers
DCF	Dispersion Compensating Fibers
DGINFSO	Directorate General for Information Society and Media
DRM	Digital Rights Management
DSL	Digital Subscriber Line
DVB-T/S/C	Digital Video Broadcasting-T/S/C
EC	European Commission
ECPA	Electronic Communications Privacy Act

EDFA	Erbium Doted Fiber Amplifiers
EPC	European Patent Convention
ERG	European Regulators Group
ERP	Enterprise Resource Planning
EU	European Union
FCC	Federal Communications Commission
FTC	Federal Trade Commission
FTTH	Fiber-to-the-Home
GCC	German Constitutional Court
GMG	Health Insurance by Law
GSA	Global Mobile Suppliers Association
GSM	Global System for Mobile Communications
GSMA	GSM Alliance
GUI	Graphical User Interface
HDD	Hard Disk Drive
HIPAA	Health Insurance Portability and Accountability Act
HSDPA	High-Speed Downlink Package Access
IaaS	Infrastructure as a Service
ICT	Information and Communication Technologies
IDL	Interface Description Languages
IDMS	Digital ID Management System
IETF	Internet Engineering Task Force
IMS	IP Multimedia Subsystem
IP	Internet Protocol
IPTV	Television over IP
IPv4	IP version 4

IPv6	IP version 6
ISDN	International Subscriber Digital Network
ISO	International Standards Organization
ISPs	Internet Service Providers
ITU	International Telecommunication Union
JIL	Joint Innovation Lab
Kbps	Kilobits per Second
LBS	Location-Based Services
LMA	State Media Authority
LTE	Long Term Evolution
MIIT	Ministry of Industry and Information Technology
MIMO	Multiple Input and Multiple Output
NCD	Non-Commercial Developers
NGA	Next Generation Access
NGN	Next Generation Networking
NGO	Non-Governmental Organization
NIST	National Institute of Standards and Technology
NRA	National Regulatory Authority
OECD	Organization for Economic Co-operation and Development
OFDM	Orthogonal Frequency-Division Multiplexing
OLED	Organic LED
OneAPI	Open Network Enabler API
OS	Operating System
OSA	Open Services Architecture
OSI	Open Systems Interconnection
OWL	Web Ontology Language

PaaS	Platform as a Service
PDA	Personal Digital Assistant
PMP	Portable Media Player
QoS	Quality of Service
RDF	Resource Description Framework
REST	Representational State Transfer
RFID	Radio Frequency Identification
RoF	Radio over Fiber
SaaS	Software as Service
SARFT	State Administration for Radio, Film and Television
SDK	Software Development Kit
SDP	Service Delivery Platform
SigG	Signaturgesetz
SIP	Session Initiation Protocol
SLA	Service Level Agreements
SME	Small and Medium Enterprises
SOA	Service Oriented Architecture
SOX	Sarbanes–Oxley Act
SSD	Solid-State Drive
TCPA	Telephone Consumer Protection Act
TKG	Telekommunikationsgesetz
TMG	Telemediengesetz
UC	Ubiquitous Computing
UMTS	Universal Mobile Telecommunications System
UNDA	UN Development Agency
USP	Unique Selling Proposition

UWB	Ultra Wideband
VATM	Association of Telecommunications and Value-Added Service Providers
VoIP	Voice over IP
WAC	Wholesale Applications Community
WiMax	Worldwide Interoperability for Microwave Access
WLAN	Wireless Local Area Networks
WoM	Word of Mouth
WSP	Web service providers
WTO	World Trade Organization

Part I

Trends

Chapter 1

Technology Trends

Florian Birnthaler, Simon Eumes, Martin Fink, Swaroop Nunna, Jan-Paul Stein, Tim Tetzlaff

Established Communication Service Providers (CSP) are currently deploying Service Delivery Platforms (SDP) as a means to differentiate against an increasingly diverse set of competitors. This effort is highly affected by the never slowing evolution of technology. In this paper, we employed a three-level model to investigate both status quo and trend technologies related to SDPs.

Today's technological environment features a mostly heterogeneous and diverse portfolio of technologies throughout all three levels. While first advancements towards integration can already be perceived, 2015 will see a holistic approach to a much more homogeneous technology environment. The convergence of media services, next generation access technologies, inter-compatible platforms, next generation mobile multimedia devices and the advent of ubiquitous computing are apt examples illustrating this development.

SDPs will serve as an aggregator of the mentioned developments resulting in a plethora of not yet conceivable applications. In this scenario, CSPs will profit from the implementation of SDPs if they manage to create a thriving developer ecosystem and thereby leverage third party innovation.

1.1 Introduction

CSPs are facing an increasingly intense competition. Internet companies like Google, Apple and Facebook are continuously expanding their service offerings, entering domains previously uniquely serviced by CSPs. CSPs are threatened to become mere bit pipes - providing basic data transfer but no additional services. One means to prevent this scenario is to leverage differentiation by implementing a SDP. In combination with the CSP's operating experience in billing and the access to a wide number of clients, SDPs may represent a major success factor for the future of CSPs.

A SDP is embedded in a complex environment, influenced by multiple technological aspects. A broad set of state-of-the art service integration offerings is crucial to attract the utmost number of third party application developers. However, to harness the full potential of an SDP, an all-embracing analysis of SDP related technologies is essential. In order to structure the description of both status quo and trends in this report, a framework consisting of three consecutive technology levels has been designed. Applying a bottom-up approach, the network and protocol level is first explained. Consecutively, technologies related to the application and service level and further the user level are outlined. Figure 1.1 depicts this model.

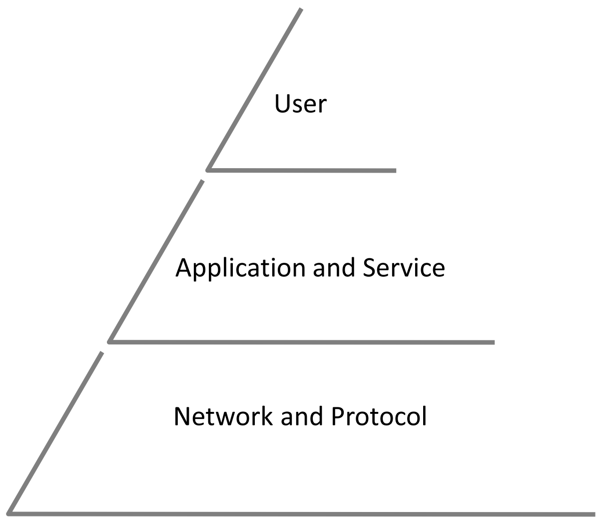

Figure 1.1: Three level technology model
Source: own illustration

1.2 Status Quo

The following section provides a structured overview of the current deployment of SDP related technologies. These technologies are categorized according to the three level technology model.

1.2.1 Network and Protocol Level

This paragraph features the model's basic level. The network infrastructure as well as protocols and communication standards form the foundation for modern day ICT world.

1.2.1.1 Communication Network Infrastructure

The best known network today is the Internet. In 2009, 1.7 billion users were connected through the Internet [311]. The topology of the Internet is clustered by different Internet Service Providers (ISP) which offer Internet access to private customers. The ISPs are interconnected by optical fiber or satellite connections with high bandwidth forming the backbone of the Internet [418, p. 412].

In the 1990s the first Wireless Local Area Networks (WLAN) were developed. They allowed the connection of computers without a cable. The usage of WLANs grew steadily resulting in a dense coverage, especially in metropolitan areas. Examples for wireless connection technologies are the IEEE 802.11 family (WiFi), Bluetooth and ZigBee [290, pp. 18-21].

Also widely used is the telephone network. In 2008, 1.3 billion main lines were in existence worldwide [116]. They can also be utilized to access the Internet with lower bandwidth.

In 1979, the first generation of mobile telephone networks was launched in Japan [379]. Important technologies and protocols in this area are GSM (Global System for Mobile Communications, 2nd generation), UMTS (Universal Mobile Telecommunications System, 3rd generation, mostly used today) and LTE (Long Term Evolution, 4th generation).

1.2.1.2 Protocols and Communication Standards

A protocol or communication standard can be defined as a set of established rules governing information transmission over a network. Figure 1.2 presents the hour glass model of commonly used protocols over the Internet. The International Standards Organization (ISO), International Telecommunication Union - Telecommunication Standardization Sector (ITU-T) and Internet Engineering Task Force (IETF) are some of the major international bodies responsible for standardizing and documenting protocols [43, 44, 42]. Open Systems Interconnection (OSI) jointly established by ISO and ITU-T categorizes data communication into 7 different layers [482, pp. 425-432]. Every protocol and communication standard can be identified with one or more of these layers. In this section, we briefly describe Internet Protocol (IP), International Subscriber Digital Network (ISDN) and Digital Video Broadcasting-T/S/C (DVB-T/S/C) which revolutionized modern day Internet, digital telephony and television. Figure 1.3 illustrates the 7 OSI layers.

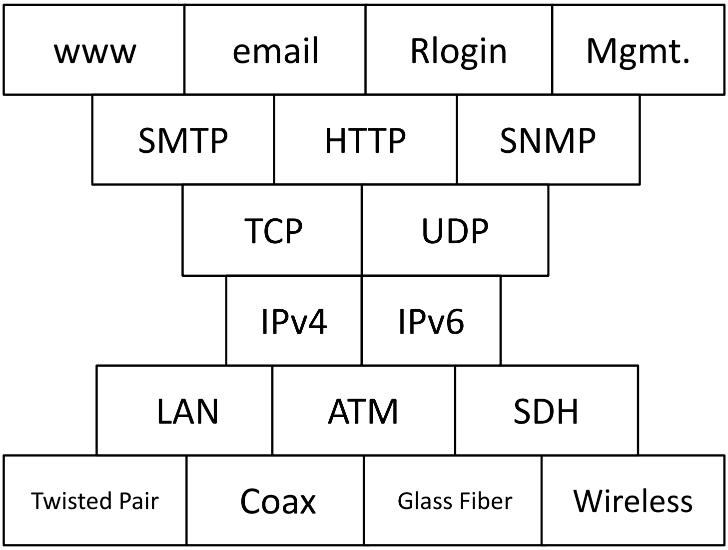

Figure 1.2: Hour Glass Model of protocols over the Internet
Source: own illustration

IP

IP forms the crux of the modern day Internet. IP version 4 (IPv4) which is currently in wide use was released by IETF in 1981 [365]. IPv4 employs 32-bit address space and is predicted to be exhausted by 2013 [125]. To address this issue, IP version 6 (IPv6) which has 128-bit address space was released as a successor of IPv4 by IETF in 1998 [140].

ISDN

ISDN is a set of digital communication standards introduced by ITU-T in 1984 and played a key role in revolutionizing digital transmission. Although ISDN connections have been declining in recent years, Deutsche Telekom alone in Germany has 8.3 million connections as of 2008 [143].

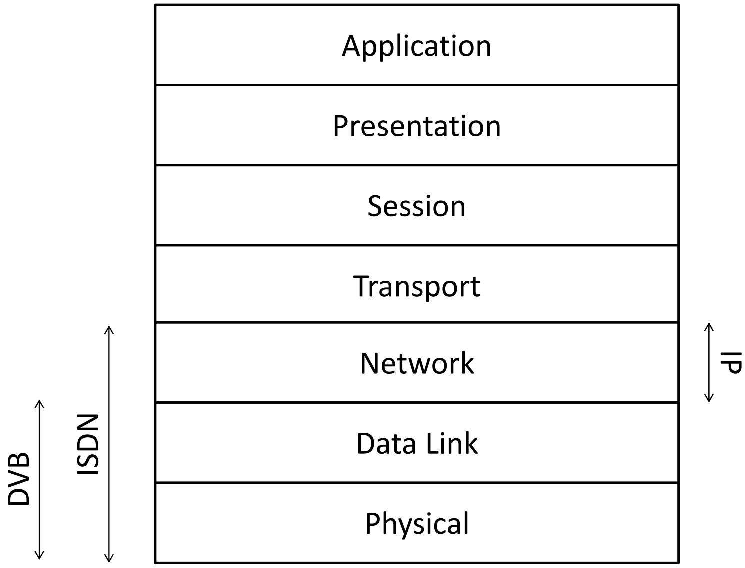

Figure 1.3: OSI Model for Layered Communication
Source: own illustration

DVB-T/S/C

DVB is a widely accepted standard for digital television transmission and consists of the variants Terrestrial (T), Satellite (S) and Cable (C) depending upon the system of data distribution. In 2005, the EU commission recommended all its member states to cease analog television transmission by 2012 and completely digitize it [171].

1.2.2 Application and Service Level

Having outlined the basic level of the technology model, we subsequently explain applications and services relevant to SDPs. Topics such as application hosting, service-oriented architecture, programming interfaces and languages and service integration models have a vital impact on SDPs and are therefore addressed in detail.

1.2.2.1 Application and Service Hosting Platforms

Server based hosting and cloud computing are the two major paradigms for application and services hosting.

Server Based Hosting

Server based hosting has evolved from the client-server model in the 1980s and is currently adopted extensively on the WWW. In 2009 top hosting companies ran approximately 200,000 web servers alone in North America [327].

Cloud Computing

Cloud computing can be described as a type of distributed computing that includes features of e.g. grid computing, Internet computing and autonomic computing as can be seen in Figure 1.4.

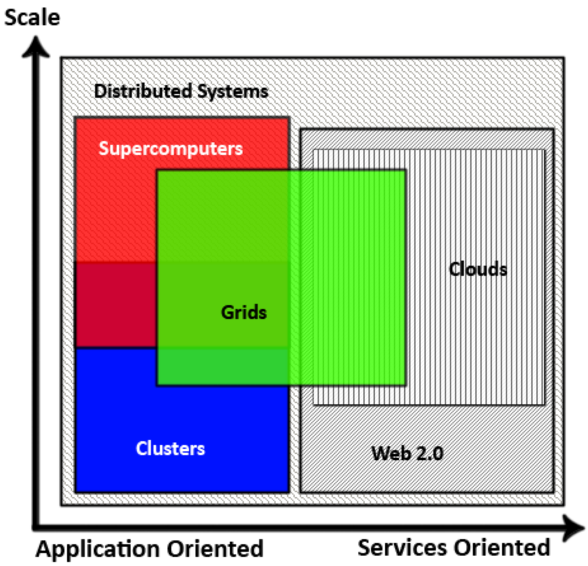

Figure 1.4: Cloud Computing Compared to Other Hosting Platforms for Applications and Services
Source: Foster et al. [196]

Virtualization of hardware and software as well as service mash-ups (Web 2.0) are the key technologies. They provide a distributed computing environment with a single virtual machine and a uniform interface to services. Users are able to access these services without the need for understanding or controlling internal processes [133]. Besides having low entry barriers, cloud computing features high scalability, flexibility and reliability [281, pp. 1-2]. As a result of a service-centric focus, cloud computing provides the four general types of resources available on the Internet as a service: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS) and Business Processes as a Service (BPaaS)[455]. IaaS offers e.g. storage space for backups or computing power in general. PaaS provides platforms and tools for the purpose of development, designing, testing and deployment. SaaS refers to delivering software applications via the Cloud. Web applications such as Google mail or Google docs are popular examples [481, p. 1]. BPaaS, still being in a stage of infancy, generally implies outsourcing of business processes to the Cloud such as employee on-boarding or resolution of product related problems [457, 274, 267]. In March 2010, Amazon's S3 storage service hosted more than 100 billion objects [310].

1.2.2.2 Service-Oriented Architecture

Developer platforms rely on the concept of Service-Oriented Architecture (SOA) as a software architecture to develop new applications.

In SOA developers offer their programs as so called services. Services have defined interfaces that can be published to service catalog websites. From these the developers can gain access to the services. Out of different services a developer is then able to compose a new application by plugging them together in a building blocks style. This accelerates the creation of new pieces of software, since not every part of the software has to be created from scratch [166].

Main principles of SOA are reusability, modularity, composability, componentization and interoperability [238].

Communication between services is made possible by the use of Representational State Transfer (REST) or SOAP.

1.2.2.3 Programming Interfaces and Languages

Today's SDPs offer a wide variety of programming languages and interfaces. The user can decide on the development environment that best suits his individual preferences and furthermore choose a programming interface that encompasses the required functionalities for his application.

The most popular and widely used programming languages for developing applications are Java and Microsoft's .NET framework. However, PHP, Ruby on Rails, Python, Flash and JavaScript also play a major role and further diversify the portfolio of technologies. Since the availability of such Software Development Kits (SDK) varies among SDPs, Table 1.1 illustrates which programming languages are supported by major SDPs in Europe [28, 30, 460, 13, 23].

Application programming interfaces (API) provide the developer with basic functionalities and information about the underlying system. Typical for Telco API offerings are services like text and instant messaging, location determination or voice call. The mentioned functionalities can easily be integrated into third party applications and thus give the developer the opportunity to create new applications that innovate the traditional way of writing text messages and meet the customer's demand.

SDK	Orange Partner Network	British Telecom Ribbit	Vodafone Betavine	Telefonica Litmus Beta	Deutsche Telekom Developer Garden
Java	✓	✓	✓	✓	✓
.Net	✓	✓		✓	✓
PHP	✓	✓		✓	✓
Ruby	✓		✓		
Python	✓		✓		
Flash		✓		✓	
JavaScript		✓			

Table 1.1: SDKs among telecommunication SDPs
Source: data from Orange, British Telecom, Vodafone, Telefonica, Deutsche Telekom [28, 30, 460, 13, 23]

1.2.2.4 Service Integration Models

Today, a lot of services can easily be accessed over the Internet and integrated into one's own developments. We distinguish between Inside-Out and Outside-In. Inside-Out is the provision of internal services for the general public. Outside-In is the act of integrating external services.

Inside-Out
Publishing core business processes through a standardized API for the public is called Inside-Out. For various reasons, these services still have a level of abstraction. This guarantees security for the internal network and restricts access. For the third party developers this approach allows for an easy use and integration into their applications. Examples for these services are Telco APIs that provide services like initiating telephone calls or conferences and sending text messages. The number of Telcos offering these services grew over the past years and there are ambitions to provide a standardized cross-telco interface. As referred to in Table 1.2, all APIs offer the same basic functionalities with some providing additional services. These additional services can be a central calender or the ability to retrieve the current network speed and type of the user [158].

Outside-In
Adding services from third-parties is called Outside-In. An example would be the integration of Twitter, YouTube or Facebook into one's application or website [441, 39, 25]. This is done by using freely available APIs provided by third-party vendors. These APIs offer the possibility to add a great variety of functionality to an application and combine miscellaneous services in one

SDK	Orange Partner Network	British Telecom Ribbit	Vodafone Betavine	Deutsche Telekom Developer Garden
Call	✓	✓		✓
Messaging	✓	✓	✓	✓
Conference	✓	✓		✓
Location-based	✓			✓
Personal	✓	✓		

Table 1.2: Supported inside-out services among Telco SDPs
Source: data from Orange, British Telecom, Vodafone [28, 30, 460, 23]

application. Classical services like Google Search also offer these alternative ways of usage[1].

1.2.3 User Level

Technologies linking the user to the application and service level are subject to this section. In this paper, the term 'user' incorporates both developers and end users.

1.2.3.1 Developer Community Communication Tools

The application of Web 2.0 technology allows users to change the content of a web page through an 'Architecture of participation' and aims at information sharing and collaboration among users. Typical Web 2.0 websites featuring such functionalities are wikis, blogs, forums, chats, podcasts and social tagging/folksonomy [344, p. 1]. These tools are widely used by developers to provide content such as code snippets, practical programming advice, web development trends and, from a more general perspective, facilitate collaboration and documentation [229, 154]. The two most recent and most popular developer communication tools are wikis and blogs.

Wikis
A wiki can be described as a compilation of web pages that are connected via hyperlinks. They can be edited by any user in his/her web browser with a record being kept. A wiki serves as an ever evolving archive for knowledge and lives from user participation with the English language version of Wikipedia being the most prominent example (68 million monthly users in January 2010)

[1] http://code.google.com/apis/ajaxsearch/

[229, 38]. As of 2007 wikis are employed for documentation and coordination purposes, but not yet programming purposes in the developer community [473, p. 1]. Corporations have adopted wikis (e.g. TWiki) in their intranet as a knowledge management system [229].

Blogs
The definition of a blog is a website that shows postings of one person (individual blog site) or a group of persons (community blog site) in reverse chronological order and usually allows adding comments. Community blog sites feature a higher degree of group collaboration and discussions and are therefore similar to forums [51]. In March 2008 there were 346 million people on the globe who read blogs. Sharing technological expertise is one of the top reasons for blogging and one of the biggest demands as mirrored by 1.8 million subscribers to the TechCrunch RSS feed (January 2009) [234, 401].

1.2.3.2 ICT Devices

The following section illustrates the current diffusion of SDP relevant Information and Communication Technology (ICT) equipment. This includes phones, television sets, computers and portable multimedia devices (e.g. the Apple iPod Touch).

Phones
Built upon one of the most technologically advanced communication systems in the world, approximately 82.3 million Germans operate 51.5 million landline telephones [115]. At the same time there are 107 million mobile phones distributed among the total population. Out of these, the percentage of smartphones grows ever faster with sales of 3.1 million in 2008 and 5.6 million in 2009 [115]. However, smartphones usually run different mobile operating systems. Among the most popular of these are Google's Android, Symbian, iPhone OS and Windows Mobile.

Television
In Germany there are 35 million households with at least one TV set, covering 72 million people [66]. Out of these a percentage of 33 has access to digital television [67]. IPTV is mainly provided by ISPs like Deutsche Telekom (T-Home Entertain) and Alice (Alice IPTV). However, in 2008 still less than 1 percent of German television households (roughly 350,000) were using IPTV [108, p. 325].

Computers
82 percent of households in Germany own at least one computer and 65 percent of these have access to broadband Internet [91]. The sales of mobile computers including laptops, netbooks and tablet computers are projected to increase by 11 percent to 9.7 million in 2010 while sales of stationary desktop computers

stagnate at about 4.3 million devices [88].

Portable Media Players
Also widely used to consume digital media content are Portable Media Players (PMP) with large hard disk drives with up to hundreds of gigabytes of storage capacity. Some models also include features like wireless Internet access and a large OLED (Organic LED) screen for video playback. In 2008, 41 percent of German households owned at least one PMP. Sales for 2008 totaled at approximately 7 million units and were slightly declining compared to previous years [86].

1.3 Trends

Taking into account the preceding description of the status quo the following section identifies the most important technology trends that are relevant to Service Delivery Platforms. Again, the previously introduced pyramid model serves as an underlying structure for clustering the different trends.

1.3.1 Network and Protocol Level

Increasing bandwidth and an advancement towards an all-IP next generation network are the major network and protocol level trends which the next two paragraphs will elaborate on.

1.3.1.1 Diffusion of Next Generation Network Access Technologies

Projected bandwidth requirements of fixed home and mobile users are as high as 1 Gbit/s and 30 Mbit/s. This can mainly be attributed to 'Triple Play' services which include data, video and voice transmission. These are the major triggers for new data transmission technologies that are often referred to as Next Generation Access (NGA) [463, 341, 118].

Furthermore, government guidelines e.g. in the United States (100 million households with 100 Mbit/s by 2020) and in Europe (30 Mbit/s for all households by 2020) focus on increasing bandwidth [273, 289].

Optical Fibers
Made of fused quartz or plastic, optical fibers transfer information by transmitting light signals from semiconductor lasers at frequencies of several hundred THz. Due to dispersion losses, Dispersion Compensating Fibers (DCF) are employed in combination with Standard Single Mode Fibers (SSMF). The system also embraces Erbium Doted Fiber Amplifiers (EDFA) and a photo diode as a receiver. In this combination, optical fiber systems feature high signal quality over long distances of several 1000 km, small size, reliability and low level of maintenance [268]. Data rates as high as 10 to 40 Gbit/s are typical, however,

lab tests even feature rates up to 15.5 Tbit/s. Bandwidth can virtually be increased infinitely by using multiple optical fibers in parallel [53].

Long range cable data transfer relies mostly on optical fibers. Germany alone featured roughly 376.000 km of optical fiber cables in 2008 [108, p. 325]. However, the last few hundred meters to the end user are usually covered by copper wires and thus represent a bottleneck. [225]. Concepts like Fiber to the Home (FTTH) and Radio over Fiber (RoF) are possible solutions. FTTH suggests an optical fiber connection directly to the end user, which is costly but still offers the highest bandwidth and is employed in areas with high population density. RoF refers to gaping the bottleneck via wireless technologies like Worldwide Interoperability for Microwave Access (WiMax), Ultra Wideband (UWB) or UMTS. Although radio signals are analog and the optic digital signal has to be transformed, RoF is a cheaper alternative due to less infrastructure and thus adequate for rural areas.

LTE

Increasing bandwidth is also a major target in wireless communication. Figure 1.5 illustrates major wireless technologies according to their data rates. The UMTS supports data downlink rates up to 384 kbit/s and can be enhanced up to 14.4 Mbit/s by using High-Speed Downlink Package Access (HSDPA) or 40 Mbit/s with HSDPA+ [390].

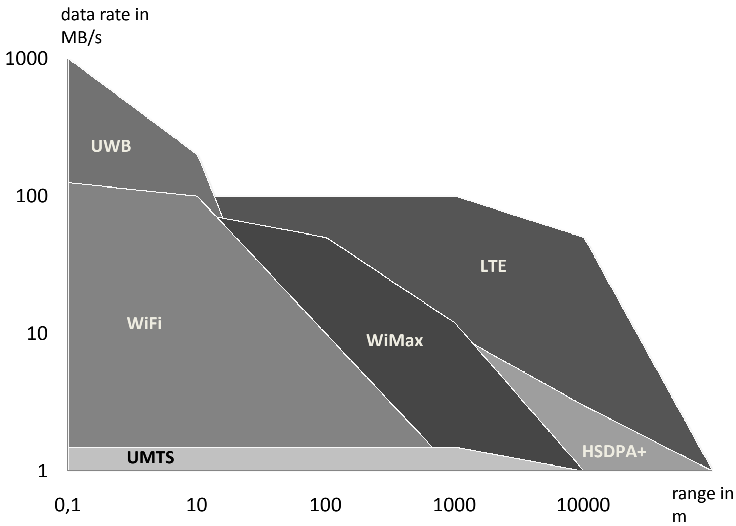

Figure 1.5: Overview over wireless technologies, data rates and range
Source: own illustration

LTE has been developed in parallel to UMTS and HSDPA and provides even higher rates of 50 Mbit/s uplink and 100 Mbit/s downlink to meet the requirements of 4th generation (4G) technologies. LTE is scheduled to start in 2011 in Germany [201]. To support users with different capabilities, LTE features a bandwidth range from 1.25 to 20 MHz. This can be realized by using multiantenna schemes as Multiple Input and Multiple Output (MIMO) and multiple access technologies like orthogonal frequency-division multiplexing (OFDM) [201].

Hybrid Optical Access Networks

Hybrid optical access networks combine both FTTH and RoF, share a single infrastructure and are an auspicious possibility to provide high bandwidth at reasonable cost in the future [284]. This results in higher traffic on optical fiber networks and points to the second bottleneck: optical-electronic-optical (o/e/o) conversions when switching channels in network nodes. [138]. This second issue can be overcome by employing optical switches that promise to increase network speed by a factor of 16 or even 50 [255, 71]. Figure 1.6 illustrates the mentioned future network.

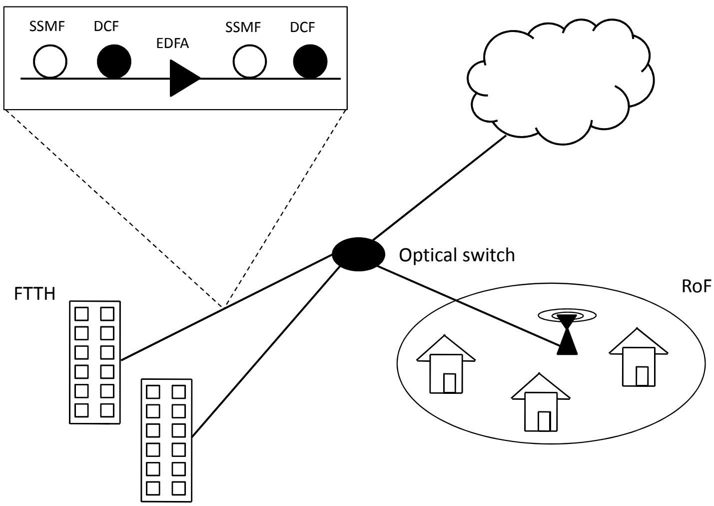

Figure 1.6: Hybrid optical access network and optical fiber designs
Source: own illustration

For Telcos, the installation of a hybrid optical access network is a mixed blessing. On the one hand, it meets customers' and governments' requirements for increased bandwidth and raises the market power of the Telco that is providing the network. Furthermore, the higher data transfer might result in higher revenues for Telcos. On the other hand, however, the establishment of next generation networks requires high investments. Factors such as the decline in price of optical fibers or also financial support from governments hence decisively impact the future of next generation network access technologies.

1.3.1.2 Adoption of IP for Communication and Media Services

Next Generation Networks (NGN) combine existing networks like the ones for television, land line and mobile telephones into a common packet distributing network structure based on IP and the IP Multimedia Subsystem (IMS) [209]. This uniform network architecture results in reduced costs for the development of various communication services since the developer can focus on this one medium and does not have to handle the integration into different networks. It also facilitates the creation of new innovative end-user services like multimedia conferencing. These telecommunication services are easily accessible through fixed or mobile Internet connections. The standardization institute mainly responsible for the work on the NGN is the ETSI TC TISPAN (Telecoms & Internet converged Services & Protocols for Advanced Networks) [167]. In 2005 they finished NGN Release 1 which adopted the IMS standard for Session Initiation Protocol (SIP)-based applications, but could also handle those that were not SIP-based. NGN Release 2 which was finished in 2008 added features like IMS and non IMS based IPTV and integration of home and corporate networks. Currently the group is working on the third release which will incorporate new services for IPTV, network interconnection and Quality of Service (QoS). This is necessary to guarantee a certain transfer quality which is e.g. needed for telephone calls [120] and security enhancements [168].

In the next few years this development will lead to a stronger convergence of media services such as television and telephony into a packet switching network. Telcos need to keep that in mind when providing these services on their software development platforms.

1.3.2 Application and Service Level

The following section provides an overview of the technological trends in the application and service level. These include the decentralization of storage and processing, the rising importance of SOA, the maturation of the semantic web and the need for cross-platform compatibility.

1.3.2.1 Decentralization of Storage and Processing

In the field of decentralization of storage and processing there will be considerable advances in the upcoming 5 years. Looking at the future of cloud computing, the paradigm for this field will shed light on major changes.

Cloud computing as a disruptive technology that offers various resources as a service via the Internet (IaaS, PaaS, SaaS, etc.) will be subject to tremendous growth within the next few years [133, 381]. According to IDC's market research, expenditures for cloud services will nearly triple from 2008 to 2012 reaching USD 42 billion [279]. A US government projection reads, that its expenses related to cloud computing will be more than USD 7 billion by 2015 with an estimated compound annual growth rate of 40 percent between 2010 and 2015 [228, p. 2].

Why is it that Cloud computing is attracting so much general interest and economic support? From a technological point of view the contributing factors are quickly falling costs of hardware, rising computing power and storage space, exponential growth of Internet publishing and archiving as well as an increased penetration of Web 2.0 applications [196]. The appeal of a cloud to businesses rests on its key assets of availability, application integration and support and flexibility. Companies utilize these to control costs and request additional infrastructure according to their current requirements. As mentioned by James Staten of Forrester Research, "Most enterprise data centers are using less than 50 percent of the total capacity of their resources [279]." However, for the cloud computing technology to mature there are still unexploited opportunities to be leveraged and challenges to be confronted as can be seen in Figure 1.7:

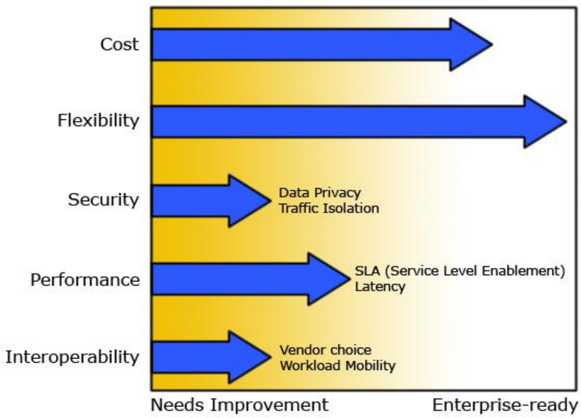

Figure 1.7: Current State of Cloud Computing Technology Development
Source: Lin et al. [285]

Software/Hardware Architecture

The focus of hardware architecture will change from ever growing processor clock speed to multi-core processors with more threads per chip. Software technologies like Google's MapReduce will become increasingly important [153, p. 2]. MapReduce features the simple creation of applications that fully leverage parallel computing of enormous amounts of data [139]. Storage on typical hard disk drives (HDDs) is likely to be replaced by the utilization of solid-state drives (SSDs) and hybrid devices [153, p. 2].

Interoperability
As most clouds are a black box for their users, they may become increasingly irritated over time in the case of access related problems. Such issues can be countered through future high cloud interoperability meaning the possibility to run applications on multiple clouds or to seamlessly shift them from one to another [381, p. 3]. For this reason the Cloud Computing Interoperability Forum (CCIF) is working towards “a common agreed upon framework/ontology” of cloud platforms [22]. New standards are also being discussed in the context of the “Open Cloud Manifesto” [153, p. 3].

Security
Security is the main issue of cloud computing which is, from a technology perspective, mainly due to a lack of physical control over sensitive data that has been transferred to an external cloud. There are the possibilities of outages because of hardware/software failures and clouds generally pose a valuable target for hackers [381, p. 1]. This will be subject to change in the future and one means of improving security is the industry-wide adoption of standards as developed by the US National Institute of Standards and Technology (NIST) [22].

Autonomic Resource Management
Since one of the key features of the cloud computing concept is the system’s flexibility, an autonomic resource management model will be employed in future clouds. As a result new service requests and changes of already running tasks can be managed better [111].

Overcoming the challenges and seizing the opportunities related to the cloud and decentralization of storage and processing in general will, in our opinion, have strong implications for Telcos. Creating their own service for decentralized storage and processing will allow them to move further away from the threat of becoming a sole bit-pipe [281]. As technology evolves and security as well as interoperability issues are resolved, utilizing the processing power of the Telco’s customers’ own hardware to create a “cloud@home” will become state of the art. Leveraging the advantages of decentralized storage and processing will enable Telcos to quickly introduce new services and applications for end-users and thus keep pace with competitors like Google or Facebook.

1.3.2.2 Importance of SOA for Third Party Application Developers and Platforms

Service Oriented Architecture (SOA) refers to a programming paradigm, that relies on modular and reusable application components. SOA is, however, independent from the underlying programming languages and protocols and merely defines an architecture style [347]. Nowadays, the mentioned individual components are mostly web services which can easily be accessed and combined by multiple clients to form agile applications. However, the quality of web services is a major issue. Service Level Agreements (SLA) define functional and non-functional requirements and provide a vehicle to overcome the mentioned problem [346]. This principle is often used to display and implement business processes, which are orchestrated by a higher level definition language like Business Process Execution Language (BPEL) [402].

The number of offered web services will further increase in the future due to the growing third party base, platform providers' willingness to exploit and access new strategic business areas and the competition between platform providers [80]. In order to guarantee reusability and flexible combination of multiple services, SOA as an underlying principle will gain more importance in the future.

On the one hand, the developer can simply integrate web services that are provided by different platforms and create unique mash-ups. Therefore, he can pick those services that best fit his individual needs and is not restricted to one specific platform. SOA further enables the developer to create applications for small user groups in niche markets.

The platform provider on the other hand gains a competitive advantage by employing SOA principles [141]. In contrast to competitors that do not pursue a SOA oriented approach, the platform provider increases acceptance and demand for his own web services.

Considering the potentials both on platform and developer side, we predict that the SOA paradigm will become the de facto standard for application development and service provision.

1.3.2.3 Maturation of Semantic Web Technology

More and more data is migrating online. Whether it is personal video files or huge amounts of governmental data, the general trend towards ubiquitous broadband Internet access is enabling a plethora of entities to upload their raw data to the WWW. This has led to a staggering 60 TB of data added to the web each day, up from a total Internet size of 21 TB in 2002 [96, p. 66].

All this information, which is generally available for anyone who has access to the Internet, creates an abundance of new possibilities for information services, mash-ups and applications. At the same time, however, the complexity of administrating and searching the WWW is exponentially increasing. To tackle this problem, Tim Berners-Lee, the inventor of the Internet, introduced the idea of a 'semantic web'. This new approach to managing online information is building upon existing WWW technology, aiming at making information 'understandable' for a computer [82, p. 34]. Data description languages like RDF (Resource Description Framework) and OWL (Web Ontology Language) enable a computer to add context to data, link it to other online available databases and facilitate search queries [472]. While traditional search engines like Google and Yahoo! specialized in crawling the web for character strings, semantic search engines search context-based. Taking into account the user's available information and the science of meaning in language, semantic search engines will excel in returning highly-relevant search results.

Furthermore, the semantic web technologies will allow to link data which was only available in an unstructured way beforehand:

Think of a personal digital assistant application based on semantic web technology. Installed on a mobile phone this application could link personal data, for instance by integrating information resources from a user's calendar, email and social networking account. Such an application could identify travel plans of the phone user and suggest hotels or cultural events in the vicinity of the destination. These suggestions would be perfectly suited to the personal taste of the user by drawing inferences to his social networking account or browser history.

With regards to communication service providers, the maturation of the semantic web could provide an abundance of possibilities to leverage its SDPs. Companies like Talis.com already harness the potential of remixing, reusing and sharing data on their application platform based on semantic web technology [47]. Integrating the possibilities of linked data sets into telecommunication SDPs will allow for a whole new level of next-generation application development with a high likelihood of positive network effects. These effects are especially convincing when taking into account the telecommunication service providers' prowess in managing and storing customer data, a resource which could be of unique value when opened for combination with other databases.

1.3.2.4 Growing Need for Cross-Platform Compatibility

We identified two trends in the telecom business that allows for mobile applications to be deployed all over the world and communicate with the respective mobile networks through standardized interfaces. Additionally, Telcos team up to push a global standard for running web applications on a mobile device and providing a set of common interfaces.

Standardized APIs for Telecom Services

Even though the idea of offering standardized interfaces in the telecommunication industry is not new, the current implementation is not widely known. In 2002, the Parlay Group, in close cooperation with 3GPP and ETSI, developed standardized interfaces known as Parlay-X [435]. Since then, the specifications were refined further. However, these specifications are not widely known to application developers. Therefore, many network operators created their own platform with specialized services and different interfaces [28, 30, 460, 13, 23]. To counteract these developments, in February 2009 the GSMA (GSM Alliance) launched a new approach called Open Network Enabler API (OneAPI) to promote Inside-Out services [221]. They are based on Parlay-X implementations and published through web services. The objective is to create a well known standardized API supported by major network operators all over the world.

The Parlay-X specification is part of the Open Services Architecture (OSA) belonging to 3GPP [49]. OSA mainly describes how services should be integrated into radio networks. The current specifications include services for calls, messaging, payment and identifying terminal locations. The underlying architecture is based on SOA and published as a web service through SOAP. This allows for an integration into most SDKs via service stubs.

The latest OneAPI initiative is established by the GSMA and mobile network operators. They target to publish OneAPI as a subset of the more mature Parlay-X specification. There will be two different ways to access the API, either via SOAP or REST, allowing the developer to choose a protocol of his choice. Currently the specification is at version 0.91 and a roll out of version 1.0 is planned to be within March 2010 [221]. In further versions it is planned to integrate further services like conference and calling [223]. A testing environment has been set up and is supported by Vodafone, Orange, Telenor, Telecom Italia, Telus and T-Mobile (UK, Austria, Germany, and Netherlands). As of today they support messaging and location services [222]. In Canada, the OneAPI was recently introduced in a commercial pilot phase and is supported by all major mobile network operators including Bell, Rogers and Telus. They support the messaging, location and payment functions [224].

All those efforts in the last years show a clear direction in providing a common standardized set of interfaces for (core) telecommunications functions. Developers gain the possibility to use one API for their applications, regardless of the cellphone service provider used by the end user. In the end, this will result in applications being able to be run and distributed worldwide, instead of being limited to a carrier or country.

Global Marketplace for Mobile Applications

The market for distributing mobile applications is currently dominated by Apple and its iTunes AppStore following by the Android and Microsoft marketplaces [63, 20, 36]. A Gartner study recently presented that Apple is responsible for 99.4 percent of distributed apps [195]. Within this lucrative business model, the mobile network operators are excluded and only provide the network infrastructure. To counteract Apple and its success, they agreed to combine forces in a global initiative called the Wholesale Application Community (WAC) [35].

The WAC was formed in February of 2010 as an alliance to offer a marketplace for mobile application developers. It consists of 24 major mobile network operators (like AT&T, Deutsche Telekom, Vodafone, China Telecom) and three handset manufacturers (LG, Samsung, Sony Ericsson). They try to establish a wholesale market for mobile applications and a central point for developers to submit their developments. The applications have to be web-based and can run on a wide variety of phones. To access core phone features they incorporate BONDI and/or JIL standards [35].

BONDI and Joint Innovation Lab (JIL) are consortiums defining interfaces for mobile phones, which can be accessed from within the web browser [21, 254]. As of today, there are two different standards which the WAC intends to integrate [35]. Through the use of JavaScript, the web application has the ability to access core phone functionalities (e.g. call, messaging or location). To be able to use these interfaces the handset manufacturer has to implement the corresponding functions for accessing the data into the system.

The introduction of the WAC as well as the already established Apple iTunes AppStore and the Android Market show a possible direction, how future distribution channels for mobile applications will look like. Having the WAC only in its early stages and possible other marketplaces to come, there will be centralized stores (possibly fully integrated into mobile handsets) as opposed to the individual distribution of software by the developers or distributors today. But to leverage those stores on a broad basis, the applications offered on the stores must be able to run on a multitude of devices. Locally running web applications (often called widgets) are one of the possibilities for overcoming this problem, even though today the functionalities are still rather limited within the web browser context. In the future it will be interesting to see, which technique is being used for running applications on a device.

1.3.3 User Level

One of the most essential factors for the success of SDPs is the incorporation of as many users as possible. The subsequently named trends are enablers for this objective.

1.3.3.1 Advancement Towards Ubiquitous Computing

Ubiquitous Computing, a term coined by Mark Weiser in 1988, represents the integration of computing into everyday life and is depicted by the presence of a large amount of small networked devices such as smart phones, PDA, etc. This allows for many new types of applications that make use of this interconnectivity to be provided by software development platforms.

Two major paradigms of ubiquitous computing that can be currently identified to be rapidly evolving are 'Internet Everywhere' and 'Context-Aware Embedded Devices'. [275]

The introduction of WiMax and LTE has paved the way for easy mobile high bandwidth Internet access and is thereby leading to a broader Internet penetration and accessibility. In developed countries this results in the phenomenon of providing Internet access as a basic infrastructure in places of high public activity typically known as Internet hot spots. An extreme example of this trend can be the Wireless@SG initiative by the Singapore government, wherein it is sought to provide uninterrupted free wireless Internet access throughout Singapore by 2015 [245]. This trend can be expected to gain momentum in the upcoming few years leading to seamless communication, higher Internet traffic and therefore a need for a better network infrastructure.

Evolution of microprocessors, sensors and sensor networks over the last few years combined with longer battery life have made it possible for a variety of context aware embedded devices to be deployed for continuously monitoring and controlling of complex systems. In a modern car at any point of time there are about 200 microprocessors active. In combination with various sensors that continuously monitor the car environment they contribute to controlling and smooth navigation of the car [197]. With increased automation one can expect a considerable rise in the number of embedded devices in systems like cars, thereby creating a small and dense computing environment. This can eventually lead to the deployment of new and innovative applications and services through new service development platforms custom tailored for these environments.

1.3.3.2 Enhancement in End-User Device Intuitivity

Though PDA's (Personal Digital Assistants) and tablet PCs have been publicly available already for a long time, it clearly have been Apple's iPod Touch and iPhone as well as Nintendo's Wii that gave a rising momentum to the use of touch as an input method. Nowadays most new mobile devices feature a touch screen [269, p. 1] and soon TV sized screens with multi-touch capabilities like NUITEQ's Flat 46+ Multi-touch LCD will be on the market [299]. According to Gartner, Inc. "touchscreen mobile devices will account for 58 percent of all mobile device sales worldwide" by 2013 [355].

These gadgets and their popularity are the harbinger for a new trend of the enhancement of end user device intuitivity. Here we want to shortly present the technologies associated with this trend and what effect they will have within the next 5 years.

Enhancement of end user device intuitivity involves numerous technologies of which multimodal interfaces and sensor technology are the most important ones.

Multimodal Interfaces

Mutimodal interfaces allow for interaction with the device/software using modalities such as speech, touch and gestures [440, p. 1]. Interfaces offering multimodal input fuse modes such as touch, gaze, speech, pen, manual gestures and head and body movements. Multimodal output is e.g. achieved through visual and auditory messages, but the trend is towards also incorporating touch [230] and possibly even peripheral vision or olfaction. Advantages of multimodal interfaces are speed [345], redundancy and a higher bandwidth. However, in environments that require very little attention of the user, a multimodal approach might lead to the disadvantage of overwhelming the user due to e.g. intensive interface management [391, p. 2]. Therefore multimodal devices that decide according to certain criteria which multimodal input and output features to utilize in a given situation [276, p. 1] emerged as a trend. Also depending on the users' behavioral patterns future software might individualize those decisions.

Sensor Technology

Sensor technology is the key enabler for multimodal interfaces. The range of sensor devices that are e.g. used in mobile phones includes cameras, microphones and accelerometers [130]. The iPhone also features a noise sensor (through the microphone) and an ambient light sensor [292] whose signals can be used to determine which modes of input and output suit the current user needs best. Another near future technology is a sensor that causes mobile phones to spring "into action at the point of a finger" without the necessity of touch [198].

As multimodal interfaces and sensor technology evolves, integrating the signal of various sensors will rise in importance for application developers. The implication for Telcos and their SDPs is to provide developers with easy to use means of doing so. One possible future use of multimodal interfaces focuses on a home media center leveraging input through gestures, speech and touch with a smart phone as the sole input device. It is possible to completely control the content of digital television as well as a new type of electronic program guide [440, p. 2].

1.3.3.3 Demand for Secure Identity Management

With ever increasing penetration of the Internet and cyber activity into daily life, security and privacy are evolving as major concerns for the end-users. In addition, with the availability of a multitude of network-centric content services (e.g YouTube) and social-networking services (e.g Facebook) one often finds oneself concerned with online multiple identity management. In this section, we provide a brief insight into the situations that these concerns might evolve into in the next five years.

Alone in the first half of 2009 an estimated number of 330,000 users are victims of phishing scams [97]. These security threats are rapidly extending to the smartphone domain and are no longer limited to computers. By 2011, security product vendors are expected to generate annual revenue of USD 5 billion from products installed on approximately 247 million phones [212]. In the next five years, this trend might even evolve exponentially and indicate the possibility that a plethora of mobile security products will become available on the market similar to those for computers. This also points to the fact that smartphones which contain valuable personal data would be highly vulnerable. In future, this might lead to unforeseen security barriers in employing smartphones for confidential data transactions.

Secure identification and verification is undoubtedly a crucial component of secure identity management. In recent years biometrics have proven to be one of the most secure methods for identification and are adopted extensively in the laptop market [423]. This trend has been extending to the mobile market and it is currently projected that by 2011, the mobile biometric solutions will contribute approximately USD 268 million to the total mobile identity and access management market [212]. These numbers indicate that in the near future one can expect most of the mobile devices to be delivered with built-in biometric authentication features thereby paving new ways for identity management.

Multiple online identities for a single user subscribing to different network based services can be considered a common phenomenon as of today. With the growing number and availability of such services, managing these identities can quickly become a tedious task. In recent years, this has led to a rise in the trend of single authentication gateways wherein one can access various different services with a single identity as illustrated in Figure 1.8. The OpenID initiative started in June 2007 and was widely adopted by major Internet players like Google, Yahoo etc. It is a good example for this phenomenon [342]. This trend might soon be penetrating into the smartphone domain and can possibly open new perspectives of identity management in smartphone applications. In this regard, CSPs are especially well positioned to combine biometric authentication features and single authentication gateway mechanisms to provide every user with a single secure identity.

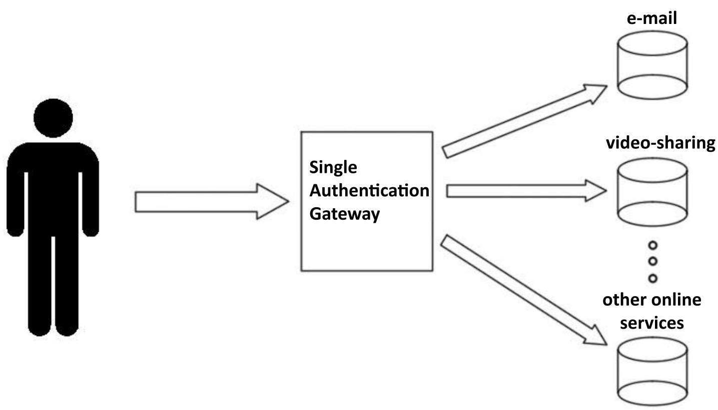

Figure 1.8: User accessing multiple online services through single identity
Source: own illustration

1.3.3.4 Next Generation Handheld Devices

One of the most obvious technology trends is the advancing distribution of media offerings via IP. While the possibilities to listen to webradio or make calls using the Voice over Internet Protocol (VOIP) have been around for some time now, the spread of IPTV is also projected to increase [89]. Fostered by the growing availability of wireless broadband connections, especially the upcoming LTE, the opportunity to gain access to all IP based media offerings with a next generation mobile device has been identified as another major technology trend.

Today's smartphones already boast impressive screen-only, multi-touch interfaces which enable the user to watch his favorite television shows or movies wherever and whenever he wants. At the same time, the introduction of portable tablet computers, like the Apple iPad, which furthermore also offer electronic book applications, point into the direction of a mobile multiple-purpose-device. An economic argument emphasizing this trend is the rising proportion of smartphone sales: While every fifth phone sold in 2009 was a multiple-purpose-device, this quota is expected to rise to one in three in 2010 [90]. The growing demand for mobile computers (including laptops, tablets and netbooks) can also be considered as supporting the hypothesis of a trend towards an extensively capable next generation mobile device [88].

These devices might eventually incorporate all the functionalities which are currently still distributed between phone, computer and television set. While the combination of phone and email client is already ubiquitously present in handhelds like the Apple iPhone and the different Blackberry models, the integration of additional services into the same device is the next logical step. With processing power in mobile devices already having reached a staggering 1 GHz and portable SSDs storing up to 512 GB of data, the technological prerequisites are favorable [438].

Current research also indicates the possibilities of equipping portable devices with projection functionalities, which would circumvent possible negative user-experience effects due to a small screen size [392, p. 68]. The end user could watch his movie of choice projected against a wall at home, while the built-in screen would be used for on-the-go information and entertainment.

Next generation mobile devices will benefit from an ever-present broadband connection and may become the end user's ultimate gateway to all kinds of media content. This is also where telecommunication companies should try to leverage their position as providers of access and content to become the connecting, omnipresent interface between end-user and IP-based media services.

1.4 Conclusion

The threat of ending up as a mere bit-pipe still has to be kept high on the agendas of CSPs. However, a well-elaborated strategic approach towards harnessing the potentials of SDPs might become the decisive factor for the successful future of CSPs.

Due to wireless network accessibility continuously expanding and computer functionalities progressively merging into a single omnipotent mobile device, an abundance of new and not yet conceivable applications will enrich tomorrow's user experience. Furthermore, the advent of cloud and ubiquitous computing will significantly shape the future market environment CSPs have to prevail in. More momentum in the industry will also originate from maturing data management technologies such as the semantic web. If CSPs manage to keep up with respective best-in-class innovators, they are well-positioned to leverage their proximity to the end-user and become the ubiquitous entry portal to IP-based services. Such a portal could build upon the identified need for secure identity management and elevate the CSP to become the trusted partner for customers in an interconnected, all-IP world.

Eventually, CSPs have to integrate the chances offered by prospective technologies into their SDPs and create a thriving developer ecosystem, which might in turn be the starting point for future innovation.

Chapter 2
Customers

Kaspar Hübener, Martin Kliebhan, Paul Laechelin, Katharina Sury, Josias Zimber

In the upcoming years, the telecommunication industry will face challenges from many fields. New technologies, changing market structures, innovative business models and modified governmental regulations will shape future offerings of Telcos. Most importantly, customer needs are also expected to change. Understanding how customer behavior will develop in the next five years will be crucial for all market players. It is expected that many private users will become developers, that an increasing number of consumers will base their buying decision on word of mouth as well as accept digital advertisement in exchange for services, and that increasing mobile working will drastically shape future working environments.

2.1 Introduction

Third party developers only gained access to telecommunication devices within the last few years. Launches such as Apple's App Store in 2007 or Google's mobile operating system Android in 2008 show that mobile phones open up. In line with these developments the telecommunication operators themselves started to provide software development platforms that enable third parties to use their services in order to offer new applications (apps) to end users. In such a scenario it is not always easy to keep track of all the customers that have to be served.

Different groups that are relevant for the platforms were defined and are depicted in figure 2.1. First of all, there are two groups of developers: non-commercial and commercial. Both are building the apps that are offered by the platform and can be differentiated according to the motives driving their work. The second pair of customers are consumers that can be differentiated between private and enterprise. The last group is named indirect customers and mainly refers to companies offering mobile advertisement. Understanding the characteristics of the different customer groups is essential to tailor the platform towards their needs thus attracting and binding a large number of customers. This is crucial, as customers are the most important factor for the economic success of a development platform. Every revenue stream originates from one of the customer groups mentioned and even the most sophisticated business model cannot work if there are no customers. Every product has to be targeted at a certain customer group and digital services are no exception. In order to successfully establish a development platform one needs to know their customers. To gain this knowledge, the status quo was analyzed in the beginning. What are the current motives for engaging with a development platform and what are the needs of the different groups? In a second step changes concerning the customer groups and the effects of these changes on the needs were forecasted.

2.2 Status Quo

In order to assess future developments until 2015 a clear understanding of the status quo of customers in the telecommunication industry is needed. The customer groups identified are developers, indirect customer groups and end users. Developers, as direct customers of development platforms, will be separated into non-commercial and commercial developers. The section of indirect customer groups will focus on advertising companies. End users are customers of communication applications and will be divided into private and enterprise end users. In the following, the status quo of these customer groups will be analyzed according to their characteristics and needs.

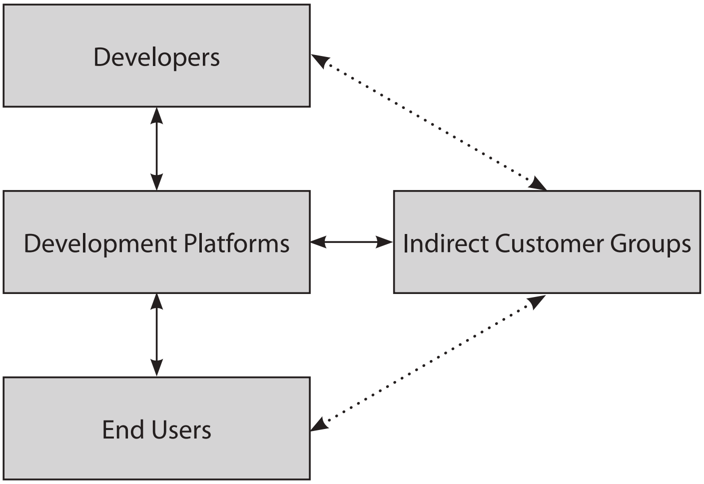

Figure 2.1: Different Customer Groups of a Development Platform
Source: own illustration

2.2.1 Developers

To analyze the developers, non-commercial developers (NCDs) and commercial developers (CDs) are distinguished. Although most of the developers are active in both areas, it is important to look at the groups separately, as they are characterized by different motivations and needs.

2.2.1.1 Non-Commercial

The term "non-commercial developer" is used to describe a group whose monetary interests are not the driving force of their work. In terms of characteristics, this group can be regarded to be identical to the OS community: Over 90 percent of the developers are male, are more or less equally distributed among age groups and about 80 percent of them hold an university degree [260, p. 49].

The motivation of NCDs originates from intrinsic and extrinsic sources [119, p. 524]. Intrinsic motivation is derived from simply doing the task, such as enjoyment of the activity, learning, or ideology [474, p. 155] but also altruism or the feeling of self fulfillment [4]. A NCD's extrinsic motivation is caused by the consequences of the act - examples are the need for specific software, reputation in the community or career considerations [260, p. 55][399, p. 5].

This establishes a framework for the needs NCDs have which can be summarized with "simplicity" on all stages of the development process[1]. First

[1] This information is based on an analysis of the most important development platform

of all, easy access and handling of the software will increase the number of NCDs attracted to the platform. This includes the need for SDKs in different programming languages. If this is guaranteed, NCDs are even willing to pay a small fee to get access to the resources (like Apple's USD 99 fee per year).

After getting started, support for problems regarding the use of SDKs and most importantly a complete and consistent documentation are crucial. If problems arise despite the documentation, NCDs generally do not have the time or capabilities to work everything out by themselves. Instead, they either need full time community managers dedicated to the support, or a support web site, such as Stackoverflow[2], to get timely responses. A forum, however seems not to be a satisfying solution for technical queries as it is too slow and too complicated to communicate over a forum.

Having finished the app, NCDs are keen on presenting it to the community as fast as possible. To facilitate this, a fast certification process and a transparent policy about what apps are allowed and under which conditions an app may be rejected. If the application is running, consistency is the biggest concern as NCDs are not able to constantly modify their app.

2.2.1.2 Commercial

Commercial developers design software as a profession. As examples show, many of them started as NCDs who, driven by the success of their developments, chose to earn their living building apps [76]. During the last years it could be observed that some software development companies from other platforms such as game or app development entered mobile platforms [232]. According to their initial professional approach CDs started either with or without external funding. Founded in 2007, with 750 developers today the company Zynga develops games for Facebook and the iPhone [483].

CDs main driver is the proper monetizing of their effort. Besides, they have certain needs regarding a development platform. While choosing one platform to contribute, CDs are generally looking at its longevity, stability, and market presence. But their specialization to a profitable niche market might be attractive as well. Platforms without a critical mass of contributing developers may not be stable enough to attract CDs [12, p. 4].

Once CDs decided for a platform, they have specific needs during an app's lifetime. During the submission phase CDs are interested in timely responses, a clear framework of rules that lead to approval of their product, and the possibility to control the price. For billing and settlement transparent revenue models are crucial as well as fast settlements. Today's most attractive development platforms Apple and Facebook are giving at least 70 percent of revenues to

forums (Forum Nokia, Apple Support Forum, Facebook Developers) and a personally conducted survey among the users.

[2] http://stackoverflow.com/

developers [127, p. 22]. The apps should be delivered very smoothly to end users and in-life management should give possibilities to update or fix the application. In terms of merchandising and retailing CDs expect to get discovered by their customers through search, premium placements, retailing, or recommendation mechanisms [127, p. 23].

2.2.2 Indirect Customer Groups

Some parties are only indirectly involved in the telecommunication industry: mobile and conventional Internet advertisement, virtual goods distributors and micro payment systems. With a market volume of USD 1.3 billion in 2008, and a USD 320 million share in the US market alone, mobile advertisement is one of the biggest industries and will thus be covered in the following section [164].

Mobile marketing is defined as the use of a mobile channel to provide end users with location and time sensitive, personalized information that promotes goods, services and ideas [321, p. 1]. To distinguish between unwanted messages and voluntarily received ones, two types of mobile advertisement have been created: First, the push-method, or permission-based advertising, which sends messages to end users after having been admitted once. Second, the pull-method, also referred to as incentive-based advertising, where messages are added to requested information as an additional service, which was never asked for [439, p. 68].

Regarding the question what kind of advertisement is send to the end user, new ways are enabled by modern devices. With the constantly increasing penetration of mobile phones, location based services (LBS) offer an innovative approach to address end users. Examples include suggestions about restaurants close by, navigation or weather alerts, all being prevailing benefits for the user. Research states, that perceived usefulness plays a crucial role when it comes to how trustworthy an advertisement is seen as [480, p. 788]. Recent studies show a tendency towards accepting mobile marketing included in third party apps. Finally, a feasible analogy to the online market implies a habituation to exchange free content for advertising exposure [165, p. 11].

With the high level of interactivity, mobile marketing could be considered far more effective than conventional advertisement. By giving the user the possibility to directly respond to the advertisement for example via text message, this two-way communication aims at a user's interest in entertainment [340, p. 6]. In comparison to e-marketing, where click-through-rates measure the attention gained by any advertisement on a website, the mobile phone still lacks a standardized and approved method for evaluating an advertisement's success. Last year, Jaguar and Land Rover invested USD 1.6 million to brand building in mobile advertising [117]. Amongst others that followed was BMW, resulting in 30 percent of all receivers responding positively in that campaign [361].

Advertising companies such as AdMob or Quattro Wireless have recently been acquired for USD 750 million by Google and USD 275 million by Apple [110]. This implies a great impact on future marketing strategies.

2.2.3 End Users

End users are separated into private and enterprise users. Consumers and companies differ drastically in their needs for communication services.

2.2.3.1 Private

Private end users for third party apps vary dramatically depending on the device used, the development platform and most importantly the app itself. The basic requirement for using third party apps is Internet access. In 2009, 73 percent of Germany's households had Internet access and 70 percent of Germany's population used the Internet every day or almost every day. 56 percent of the households that had Internet access used mobile devices for accessing the Internet [411]. About 50 percent of all Internet users used advanced communication technologies such as chat, blogs and forums in 2008 [135, p. 557]. These people qualify especially as end users for third party apps, just as 70 percent of Facebook's active users that use Facebook-platform based apps [184].

In the following section, some relevant characteristics of Internet users are outlined and explained. When dealing with private Internet users in the context of development platforms, their willingness to pay for online services is especially important. A Samsung study showed that 42 percent of people possessing a mobile phone with current features would be willing to pay for apps [389]. However, many people do not want to pay for traditional online content [157, p. 349]. Some platforms recently implemented micro payments in order to incentivize their users to spend money [287]. Additionally, many people today rely on recommendations and word of mouth when they have to make buying decisions [208, p. 242][271, p. 71]. Another common question concerns data storage and connection security. Google recently addressed this by providing Internet users with the possibility to decide which of their data is kept on their servers [272]. Furthermore, people using mobile phones might worry about the fact that a third party program could crash their mobile phone, making it unusable when they need it.

The following needs of private end users are especially important in the context of developer platforms: Distribution channels such as Apple's App Store should be easy to access and not too fragmented. They should assure a certain degree of stability of the applications they hold and protect against viruses or other malicious code. Usability is another issue that matters to private end users at the moment.

2.2.3.2 Enterprise

This section deals with enterprise customers from telecommunications services. Those customers are potentially all companies using apps in the fields of mobility, Internet and/or TV. It is important to notice that, based on technological advances these fields of telecommunication are already converging [107, p. 71].

In 2008, 82 percent of German companies had broadband Internet access and 14 percent had mobile Internet access [408, p. 22]. In 2009, the percentage of companies with broadband Internet access was the same, whereas the stake of those having mobile Internet access was already 39 percent [409, p. 19]. It can be concluded that mobile communication is one very important factor when analyzing customer behavior of enterprises nowadays.

Enterprises' needs differ not only with regard to the size of a company, its industry and location but also according to the activity conducted within a firm. However, there are certain needs which generally apply to all enterprises [6, 253][320, pp. 215-218]. Firstly, the overall cost/benefit ratio most influences the buying decision of enterprises. Secondly, applications need to meet high standards regarding data security and privacy. Thirdly, especially for critical processes, companies demand highly reliable systems. Finally, a smooth integration of new services into the existing infrastructure of a company needs to be guaranteed.

Michael Porter's value chain is a useful framework for analyzing a company's needs for communication services on a more detailed level. Figure 2.2 gives an exemplified view on today's enterprises services according to the activities within a firm [362][397, p. 229]. Mainly driven by business applications, primary activities of a firm such as logistics and sales & marketing have seen great efficiency improvements during the last years. This has lead to a situation where business process software nowadays enables integrated data management throughout the whole company and customer relationship management tools allow for location independent access of customer data.

2.3 Trends

In the following sections, four major trends affecting customers of communication services will be outlined. These trends will be clustered according to the classification of customers in the status quo. Firstly, the growing involvement of private users into the development process is described. Secondly, it is shown how consumers' acceptance of digital advertisement grows in exchange for services. Thirdly, the increasing importance of word of mouth will be covered. Finally, it is covered how the importance of mobile working will shape future working environments. These trends will be analyzed and implications in terms of changing customer needs will be stated.

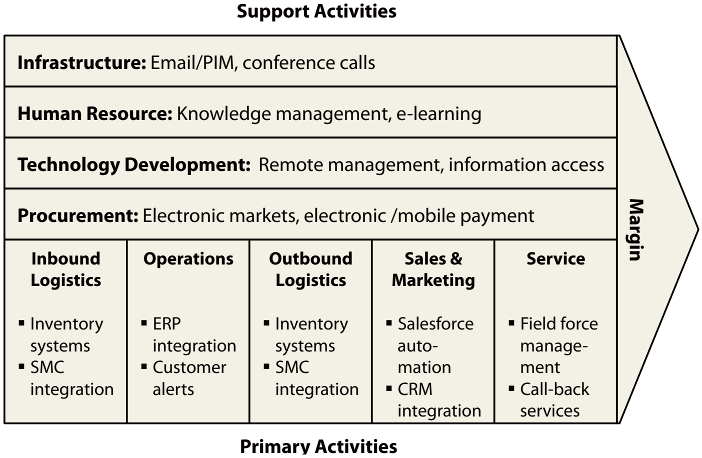

Figure 2.2: A Company's Needs for Communications Services According to Its Activities Within a Value Chain
Source: adapted from Barnes, S.[6]

2.3.1 Involvement of Private Users in the Development Process

By 2015, private users will be more involved in service development processes. This also includes a growing number of private users who develop software on their own and thus personalizing their communication environment such as mobile phones or web applications. The in 2.2 mentioned categories of customers will merge and the boundaries in between will diminish. This trend is indicated by the following movements.

A growing number of the world's population belongs to the generation of digital natives. They grew up with computers, Internet, and mobile phones and therefore feel comfortable using new technologies [370]. Software development tools will be simplified and use techniques such as visual programming. Yahoo Pipes[3] for example lets users build web applications via drag-and-drop without writing source code. Additionally, cross-platform technologies will gain further importance. These developments lower entry barriers and have already been identified as technological trends.

Furthermore, many CDs started as NCDs which are basically private users with a high technological affinity. New platforms will continue to attract these people to play around with new technology and get involved. Directly related is the growing number of applications that address long-tail demands. A rapid

[3]http://pipes.yahoo.com/pipes/

growth of these applications that serve the special needs of small groups will be experienced. To give an example one could think about an application for the developer's local tennis club that easily puts together game schedules for tournaments [388].

This development is not only pushed by NCDs but also intended by enterprises which use open innovation models in order to gather ideas outside of the company [144]. Mass customization processes allow users to tailor products to their own needs and imagination. These developments defined the so-called "prosumer", a person that is both producer and consumer. Within the next years these processes will gain further importance and lead to users who will directly request applications or services from developers or enterprises.

These developments will be reflected in changing needs of the described group of prosumers. Encouraging and supporting these developers will be of highest importance for telecommunication providers. Additionally to current needs, this includes easy accessibility of the platform in terms of registration procedure and fees to pay, but also dedicated support, community functions, how-to manuals or even personal trainings. One might consider addressing this growing segment of prosumers separately in marketing campaigns.

2.3.2 Acceptance of Digital Advertisement in Exchange for Services

In the following section, it is described that digital advertisement, especially when using mobile devices, will be the preferred option to keep digital content accessible. Therefore, conventional Internet advertisements are examined, resulting for example in the prediction that advertisements before video streaming will not only be tolerated, but also consciously considered. Furthermore, mobile advertisement is studied, showing a trend towards choosing advertisement-based structures over paid ones.

Conventional Internet Advertisement

One of the main questions regarding Internet advertisement is where to place it in order to have the biggest reach. Social networks were visited by almost 60 percent of the North American Internet users, more than 70 percent in the UK and about 40 percent in Germany [242, p. 5]. Generally, the US online social network advertisement spending is expected to grow to more than USD 1.6 billion until 2013. However, the fastest growing sector is by far online TV/video. A yearly growth of 53 percent in the US is a development, which indicates that video streaming will steadily grow until and beyond 2015, so that conventional television consumption will be severely impacted [231, p. 2].

Given this shift in placement of advertisements, it is crucial to now look at a users' acceptance. Trust is the most important factor when evaluating advertisements. Regarding advertisement before videos, one third of the consumers said they trusted the advertisement, showing a growth rate of more than 30 percent between 2007 and 2009 [431, p. 2]. What consumers will be looking for in an advertisement in order to build up trust and brand awareness is mostly fun, reflecting their need for entertainment. The increasing amount of user data will allow for a targeted selection of users who will then be exposed to advertisement and feel emotionally touched as well as personally involved, especially shortly before and after video consumption.

Another opportunity to take out advertisements is within search engines. A survey among 25,000 consumers worldwide conducted in 2009 indicates that advertisement served in search engine results is trusted by 41 percent, illustrating an increase of 21 percent compared to two years earlier. The possibility to effectively place advertisements to a specific search, enabled by an analysis of user data, will greatly affect that percentage. Within the next couple of years, neatly tailored suggestions will be perceived as reasonable instead of randomly broadcasted [431, p. 2].

The need but reluctance to pay for digital content can be overcome by advertisement. A clear tendency towards exposure to advertisement so that digital content remains available for free is noticeable. Two thirds of Internet users in the US and Germany interested in online video would prefer advertising-supported models instead of consumer-paid models. Among the 13-24 year old in the US, even three quarters agree [237, p. 19].

Nonetheless, tools that block online advertisements, such as AdBlockPlus or Greasemonkey scripts, have been downloaded more than 100 million times since 2005, with a daily average of 75,000 downloads of AdBlockPlus [318]. An advertiser should consider this when taking out an advertisement.

Mobile Advertisement

As advertising via text messaging was the first mobile marketing strategy, its effectiveness has been examined, with the result that it has the lowest consumer trust out of all advertising channels. In addition to that, personalized text messages are found too intrusive and privacy invasive [266, p. 5]. This leads to intensively targeting modern smartphones with advertisements, since their technologies lead to enhanced possibilities.

Throughout 2009, more than 173 million smartphones have been sold worldwide, which is an increase of 30 percent compared to the previous year [308]. The generation which heavily uses smartphones at the moment has shifted from early adopters, who tend to pay considerably more in order have access to a new technology, to a widespread mass, with a need for entertainment, personalized software and customized information. The latter though is not willing to pay for mobile Internet access as the early adopters do, increasing the need for alternative payment models.

Companies have come up with ideas to attract more attention to advertisement. For example, E-Plus offers a reduced fee to the users after they have agreed to receive a certain amount of advertising messages monthly. Other options are based on vouchers for advertisement exposure or the choice between either releasing user data or receiving advertisement. Both the future end users' reluctance to start paying for content as well as the kind of advertisement suitable for mobile devices (mainly Internet-based) indicate an increasing acceptance of advertisement for monetary incentives until and beyond 2015.

Given this trend, companies have to consider efficient methods of advertisement, possibly where the sharp distinction between advertisement and additional service diminishes. Research shows that perceived usefulness of advertisement is a clear indicator for its success. A movement towards LBS on a push mode can be concluded. Firstly, this derives from saving consumers time as opposed to actively having to look for information. Secondly, this results in a clear advantage over general advertisement by giving them relevant information depending on their location.

As mentioned above, advertisement response depends on placement. With the recent evolution of smartphones and their various applications, the first few studies conducted show that advertisement within applications is far more considered than standard electronic advertisement, regardless of the mobile device [376, p. 3]. This could offer many new options for advertising companies until 2015.

2.3.3 Word of Mouth as Sales Driver

The influence of peer recommendations, also known as word of mouth (WoM) on buying decisions of both private and enterprise customers will significantly increase in the following years.

This development is mainly driven by two factors: Firstly, WoM is perceived as a reliable source of information. 90 percent of people trust recommendations of other users, while only 54 percent trust in advertisements [431, p. 2]. Secondly, an increasing number of smartphones and Internet connections allows more and more people access to the community feedback. A recent example is the iPhone app "GateGuru" that shows restaurant critics for all the restaurants in an airport and is right now one of the fastest selling travel apps for the iPhone [291, p. 1].

An indicator reflecting this trend is the huge increase in WoM marketing. The spending is expected to increase from USD 300 million in 2003 to USD 3 billion in 2013 [367] as shown in figure 2.3. Another indicator is the increasing implementation of social media into companies' websites. Facebook is regarded as the most effective media tool to mobilize WoM [424, p. 12] and by 2012 almost all companies surveyed will have a Facebook fan page. Customer reviews will also see a huge increase as they are perceived as being most efficient in driving sales. While questions and answers, community forums and product suggestion boxes are not widely used yet, they will see the biggest growth in the future and will be used by over 80 percent of all companies surveyed [424, pp. 8-10], as illustrated in table 2.1.

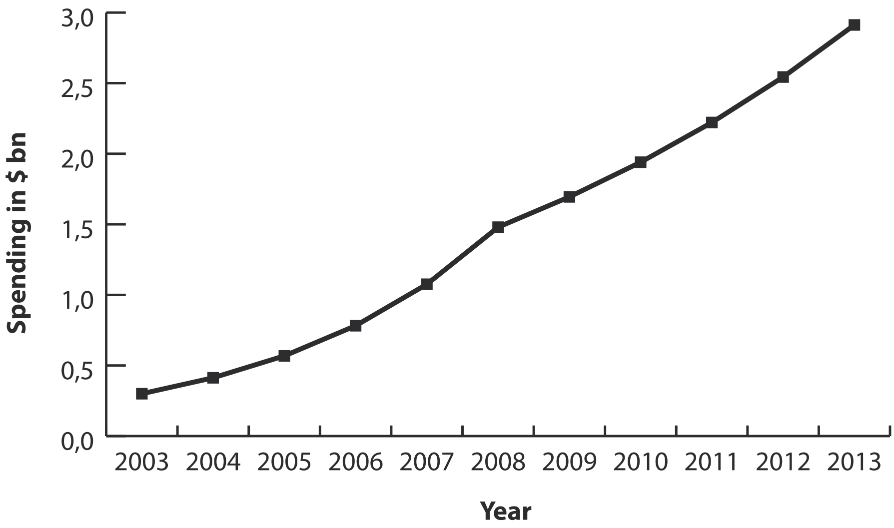

Figure 2.3: Development of Word of Mouth Marketing Spending
Source: adapted from PQ Media [367]

One implication of this development is an increasing level of involvement of the customer in the marketing process. WoM marketing is not conceived as an interruption but as an engagement [329]. As a consequence the interdependencies between consumers, companies and competitors will increase [142, p. 4]. Problems with a product in one country will be recognized all around the world.

Another consequence is an increase in demand for services for the social media platforms employed. When all companies have implemented social media it will be necessary to differentiate from competitors by using the data collected in the most efficient way. Companies will need apps that can filter the feedback given, so that only feedback from consumers with similar characteristics is shown [469].

2.3.4 Mobile Working in Enterprises

There will be a strong increase of mobile working for the upcoming years. This evolution will have significant impact on enterprise needs with regard to communication services.

Mobile working can be categorized in the following framework (see figure 2.4), distinguishing between four different types of collaboration [393, p. 25]. 'Full mobility' is given in jobs that yield a high degree of mobility and frequent changes of the working site. 'Site mobility' describes a situation where the worker

Which community and social networking tools does your company employ today or plan to employ in the next 12 months or beyond?				
	Today	Next 12 months	Beyond 1 year	No plans to employ
Facebook Fanpage	86%	10%	3%	1%
Customer Reviews	55%	26%	13%	6%
Questions and Answers	29%	20%	25%	26%
Community Forums	27%	18%	23%	32%
Product Suggestion Box	19%	26%	20%	35%

Table 2.1: Forecast of Social Media Adaption Among Representative Companies
Source: adapted from The e-tailing Group and PowerReviews [424]

is mobile in geographically restricted areas (e.g. hospitals). The 'multi location workplace' is characterized by work carried out at fixed locations. The worker travels between these fixed locations. The 'networked workplace' describes activities marked by limited physical mobility, such as working collaboratively on many sites.

The first indicator is, as shown in section 2.2.3.2, that the availability of mobile Internet access among German companies has significantly increased over the last three years. These figures indicate a trend towards higher usage of mobile Internet.

The next indicator does not only take the German market into account but also reflects global changes in customer behavior. Based on global sales figures of smartphones last year in comparison to previous years, it can be evaluated how customer demand with regard to mobile services changes. With 14 million enterprise subscribers in May 2009, Research In Motion has the largest global enterprise smartphone installed base. This number is equivalent to a 42 percent increase in the number of subscribers compared to May 2008 [314, p. 180].

There are two additional reasons for the trend that mobile workers will become increasingly common in a large number of enterprises. On the one hand, more and more companies start to offer their employees the possibility to work from home. This corresponds to both the 'multi-location workplace' and the 'networked workplace' in our classification of mobile working. An increasing amount of companies are equipping their employees with laptops and mobile phones instead of workstation computers and landline phones [7, 359]. On the other hand, more companies will have introduced new forms of offices by 2015. Workers in a large number of enterprises will then share desks instead of having their own fixed one. They will choose a different workplace every morning and will sit close to the people they are working together with at the moment. Special rooms for concentrated working, meetings and conferences will be booked upon request. This trend will be partly driven by rising prices

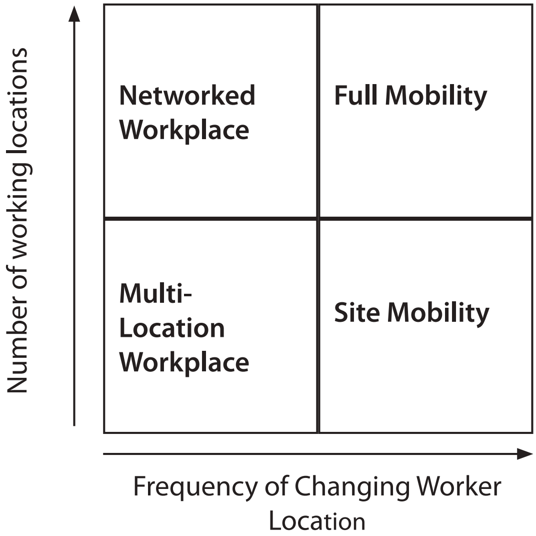

Figure 2.4: Mobile Working Framework
Source: adapted from Schaffers et al. [393, p. 25]

for office spaces in big cities [301, 395]. This is described by 'site mobility' in the mobile work framework.

This section will outline how the needs of enterprises with regard to communication services will change until 2015. Salespersons will require real-time customer information, consolidated into a single place and accessible from anywhere with an Internet connection [314, p. 117]. This idea of unified communication offers high potential in terms of decision making, time saving and high quality customer care. Ribbit, an open platform for telephony innovation which belongs to British Telecom and concentrates on communication enabled business processes, already offers productivity tools which unify voice and text messaging communications, Salesforce CRM, email, and voice-to-text transcriptions [380]. Salesforce CRM means that enterprise users have real-time integration of all communication devices with their CRM databases. Figure 2.5 shows how Ribbit for Salesforce links all critical sales data.

In addition, the increasing number of home offices will foster the need for state-of-the art communication technology that integrates the mobile workers into the corporate network and lets them communicate efficiently. Tools such as 3D video conferences can enable employees to interact with their colleagues as if they were physically present. Furthermore, it is expected that more and

Figure 2.5: Example of Unified Communications for Salespersons: Ribbit for Salesforce
Source: taken with permission from Ribbit Corporation [380]

more people will work from multiple locations ('full mobility'). This could be multiple sites such as hot spots in train stations, airports or any other public place. As a consequence, there will be the need to use these tools efficiently and securely while on the go and without other people being able to overhear the communication. Security will remain a major issue and an overarching need for enterprise users.

2.4 Conclusion

In the upcoming years, the telecommunication industry will face challenges from many fields. New technologies, changing market structures, innovative business models and modified governmental regulations will shape future offerings of Telcos. Most importantly, customer needs are also expected to change. Understanding how customer behavior will develop in the next five years will be crucial for all market players. Studying commercial and non-commercial developers, it can be concluded that they will merge and that they will be intensively involved in the future development process of applications. Other outcomes of this study are that consumers will change their attitude towards advertisements, this will lead to companies expanding to new channels to provide them, and word of mouth will become the most important influence for buying decisions.

Furthermore, the working environment will undergo drastic changes, resulting in the need for services which support mobile working. This changing ecosystem poses opportunities as well as challenges for the telecommunication industry. In order to prevail in such an environment, Telcos will need to adjust their service portfolio according to the changing customer behavior.

Chapter 3

Political and Legal Trends

Daniel Akselrad, Indranil Bose, Philipp Nägelein, Hanna Renz, Claudia Simion

Rapid technological advancements and continuous innovation shape the current information communications technology sector. This creates an atmosphere of constant change within this field. Policy makers and legislators cannot keep pace with this rapid change. This leads to gray areas and insecurities within the political and legal framework. For telecommunications companies it is of vital interest to adapt in order to strengthen their competitive position in the market. They therefore closely observe and track the legislative processes to maximize planning dependability. Governments worldwide aim at harmonizing regulatory institutions and promote affordable broadband Internet access. In the years to come, governments will increasingly focus on end-user rights through stringent policies on privacy protection, data security and net neutrality. With a considerably stricter political and legal framework evolving, platform providers, application developers as well as end-users are affected in equal measure. Although conforming to these regulations affects the flexibility of telecommunications companies to address the implementation of convergent technologies, it allows them to leverage their reputation and trustworthiness to expand their user base.

3.1 Introduction

For many years, the ICT sector has been subject to a sequence of fundamental changes due to rapid technological advancements. At the same time economic and social activities have progressively come to rely on communications services and infrastructure. This background necessitates governments worldwide to establish further flexible structures. In this context, the enhancement of the political and legal framework needs to be discussed. Investigating the developments in political decisions and legislation is extremely important, as they define the frame within which platform providers, application developers and end-users can act and move. In the following, the current legal situation concerning various countries around the world is examined to serve as a basis to then deduce trends and challenges the ICT sector will face in the future.

3.2 Status Quo

In order to understand future developments within legislative processes in various countries, firstly it is worth looking at the current political and legal situation. The following section delves into the influence this imparts on platform providers, application developers and end-users.

3.2.1 Political and Legal Framework

Germany

In Germany, the media and communications legislation is arranged in sector-specific laws that regulate different media content: press, broadcasting and telemedia. The telecommunications infrastructure and markets have been deregulated since 1996. The legal framework is predominantly defined by two laws (see Table 3.1).

Act	Year	Goal
Telemediengesetz (TMG)	2007	for telemedia regulations [151].
Telekommunikationsgesetz (TKG)	1996	for regulation and competition [150].

Table 3.1: Important laws defining German legal framework for media and communications

Source: own illustration

The regulatory activities and the legislative powers are distributed among the federal and state authorities. While the legislative competence for telecommunications and postal services lies on the national level, it is at the state level for broadcasting and press media[1]. Accordingly for regulatory activities, it is the State Media Authority (LMA) on the state level and the Federal Ministry of Economics and Technology (BMWi) [2] with its Federal Network Agency (BNetzA) on the national level [3]. They also coordinate affairs with the European Union (EU) and international organizations.

Industry associations such as the Association of Telecommunications and Value-Added Service Providers (VATM) [18] and the Federal Association for Information Technology, Telecommunications and New Media (BITKOM) [19] aim to create a stable regulatory framework and equal opportunities for all competitors in the market.

European Union

The current rules which govern the ICT sector in the EU were agreed upon in 2002 and revised by the Telecoms Reform Package in November 2009 [170]. It essentially aims to unify Europe's ICT market for all 27 member states. The new directive will now need to be transposed into national laws of the 27 Member States by June 2011. The highest decision-making authority concerning the ICT sector is the European Commission (EC) conducted by the Directorate General for Information Society and Media (DG INFSO) [1]. In the EU there exists a two-tier regulatory structure, consisting of the EC and the National Regulatory Authorities (NRAs).

With the adoption of the Telecoms Reform Package a European regulation authority, the Body of European Regulators of Electronic Communications (BEREC), was established. It is going to replace the loose cooperation between national regulators in the European Regulators Group (ERG) [177] to better coordinate the regulation of the electronic communications at EU level. The BEREC is made up of a board composed of the heads of the 27 NRAs. Its members first met in January 2010 in Brussels. BEREC decisions will be taken as a rule by vote of heads of the 27 national telecoms regulators. The BEREC aims to ensure fair competition and more consistency of regulation in the telecom market [173].

United States of America

In the United States, the highest decision-making authority is the U.S. Congress, consisting of the Senate and the House of Representatives. For acts which are of the utmost importance for the ICT sector refer to the table 3.3.

[1] cf. Art. 30 GG in conjunction with Art. 70(1) GG and Art. 73 I Nr. 7 GG in conjunction with Art. 71 GG

Act	Year	Goal
Telecommunications Act	1996	“to promote competition and reduce regulation in order to secure lower prices and higher quality services for American telecommunications consumers and encourage the rapid deployment of new telecommunications technologies“ [447].
Broadband Data Improvement Act	2008	“to improve the quality of Federal and State Data regarding the availability and quality of broadband services and to promote the deployment of affordable broadband services to all parts of the nation“ [448].

Table 3.3: Important U.S. laws for the ICT sector
Source: own illustration

However, since the American jurisdiction highly depends on case law, decisions on pending court cases can always affect the current legal framework and cause changes to legislation or the different parties' actions. The main U.S. telecommunications regulator is the Federal Communications Commission (FCC). As an independent U.S. government agency, it directly answers to the Congress. Working towards goals e.g. in the areas of broadband, competition, spectrum and media, the FCC is in charge of “ensuring that an orderly framework exists within which communications products and services can be quickly provided to consumers and businesses” [188]. The U.S. telecommunication industry is represented by USTelecom, America's broadband association. Its goals are to unite the industry in order “to advocate on priority issues before Congress, regulators, the courts, the White House and the media” as well as to provide a working platform for companies “to advance the broadband future” [451].

People's Republic of China

Being the world's largest market for both fixed-line and mobile telephony as well as for Internet [248], China is definitely worth taking a closer look at. The highest legislative authority in the People's Republic of China is the National People's Congress which is dominated by the Chinese Communist Party. Table 3.5 shows milestone decisions of the Chinese ICT industry.

Decision	Year	Goal
Restructuring the country's major telecom operators, leaving China Mobile, China Telecom and China Unicom	2008	to create a more competitive industry
Push for convergence between telecom, broadcasting and the Internet	2010	"to break down regulatory barriers between the three industries and allow broadcasters to start offering telecom services, and vice versa" [428].

Table 3.5: Important decisions for the Chinese ICT sector
Source: own illustration

Especially the latter decision has a huge impact on market shares and business models, since Telcos on the one hand and broadcasters on the other hand "are not subject to the same regulators" [428]. While telecom operators are regulated by the Ministry of Industry and Information Technology (MIIT) and may "offer an increasing portfolio of content to their 3G customers", broadcasters are tightly restricted through the State Administration for Radio, Film and Television (SARFT) [428]. Given these inter-ministry rivalries along with "international opinion and the domestic industry (showing) strong opposition", the current legal situation concerning China's ICT sector seems to be rather unstable and unsustainable [283].

3.2.2 Platform Providers

Consumer Data Secrecy

In Germany as specified in the TKG, the data from consumers is considered strictly confidential and is highly guarded. The provider's data processing systems are to be designed and selected in accordance with the aim of collecting, processing or using no personal data or as little personal data as possible[2] [150]. Providers are urged to render persons anonymous, so far as possible, such that the effort involved in doing do is reasonable in relation to the desired level of protection.

Data Retention and Request from Security Agencies

The TKG clearly specifies the extent of adherence on part of the providers to keep customer data files. These file must contain without undue delay the numbers and quotas of numbers allocated to other parties, as well as the names and addresses of holders of numbers and quotas of numbers even where they

[2] cf. § 3a TKG

have not been entered in public directories. Information such as the source and destination of a communication, to identify the date, time, duration, device type and the location of mobile communication equipment is also mandated[3] [150].

Access Obligations

Providers must grant access on a wholesale basis to particular services as offered to end-users, for the purpose of resale by third parties in their own name and for their own account. They must also create the necessary prerequisites for the interoperability of end-to-end communication, including the provision of facilities for intelligent network services, roaming and granting access to operational support systems. This secures fair competition in the provision of services while ensuring the efficient use of existing facilities[4] [150].

Agreement Contract and Liability

The TKG specifies that the provider must conclude an agreement with the developer, who shall be treated as an entrepreneur according to the definition in § 14 of the German Civil Code. On commencement the developer has to be provided the services as agreed upon prior to the agreement, which include

1. provision of the use of developer portal and platform;
2. provision of services for incorporation into customer applications;
3. provision of software development kits to incorporate services into customer applications.

Currently the platform and development environment is provided 'as is', i.e. without any express or implied warranties. It does not guarantee that the platform will be safe or secure. The provider of the platform is not responsible for the actions, content, information, or data of third parties, and is released from any claims and damages arising out of any such third parties. In the event of a loss of data, the provider shall be liable only for the necessary cost of recovering the data in cases where the developer has properly backed up the data.

3.2.3 Application Developers

Handling Personal Information

Providers can offer the developer several options to make their platforms attractive but cannot hand over any personal information to developers unless the end user has explicitly agreed to it[5] [150]. When, for example, offering

[3] cf. § 121 TKG
[4] cf. § 21 TKG
[5] cf. § 28 and § 96 TKG

call services, the provider will not give the developer any phone numbers, but the application will just make the connection between the end-user and the provider, and from then on, the service is handled like a normal phone call. By using an application, the end-user implicitly gives confirmation that the provider can use their personal information to provide the requested service. For example, the consumer can be located and notified through SMS with the appropriate information[6] [149, 150]. The provider is not allowed to save that information though.

Intellectual Property

Patent rights are not homogeneous around the globe, but still applications must not violate any patents or copyrights in any country in order to protect intellectual property. In most countries software cannot be patented [180]. In the U.S. for instance, software as such is not regarded as patentable material because patent law specifically excludes algorithms. But an ever increasing number of software products which implement a business methodology are patented.

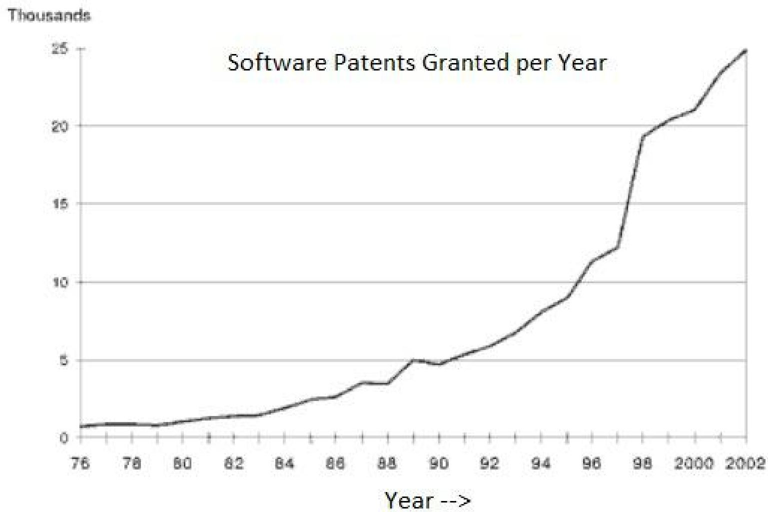

Figure 3.1: Increase in software patents per year
Source: Patents, Innovation and Economic Performance: OECD Conference Proceedings of the OECD [336]

[6]cf. § 13(2) BDSG and § 96(3) TKG

Besides copyright laws also differ widely around the globe [100]. If developers want to use any master recordings, musical compositions or any other content embodied in application, it must be wholly-owned by the developer or there has to be an agreement between the developer and the owner [65, 449].

Abusive Use of Developer Platforms

Due to the terms of use between the developer and the provider, applications must not contain any obscene, pornographic, offensive or defamatory content or materials of any kind [65, 146]. Some application development providers also do not want developers to include any content that could damage the reputation of the platform provider [65]. This opens a gray area where developers cannot be sure if their product is going to be censored. Applications must not contain any legally prohibited and unsolicited information, any material or other services including unrequested and uninvited advertising by e-mail, fax, telephone or SMS, or illegal dialer programs. For example, the German Penal Code requests that there shall be no illegal contacting through communication systems[7] [147].

Distribution and Liability

Providers can decide how developers can distribute their products; either only through the provider's 'App Store' or also allowing the developer to sell their product independently. By not opening mobile devices to other app stores, providers have the power to arbitrarily set the revenue share, as developers can only sell their products through that store. Developers can set the prices for their applications as they please, but there are strict pricing limits governing subscription and telecommunication services.

Developers are not held liable for the correctness of their code (bugs) and as such, are immune to legal proceedings from end-users[8] [148]. Applications consequently do not carry any form of guarantee whatsoever.

3.2.4 End-Users

Data Privacy

Following the terrorist attacks in New York (2001) and Madrid (2004), the U.S. and the EU addressed the data storage issue by passing two laws: The Patriot Act (2001) and the Data Retention Directive (2006).

The EU's Directive requires providers to retain large amounts of traffic and location data (Art. 3 ff., Art. 5.1.) for a period of up to two years (Art. 6), instead of retaining information necessary only for billing purposes. However, many countries have postponed the implementation of this law, such as UK and Sweden. European activists have quickly protested and the German Working

[7] cf. § 238 StGB
[8] cf. § 434 and § 90 BGB

Group on Data Retention (AK Vorrat) filed a class-action suit of almost 35.000 people challenging the German law [79].

In the U.S., the current laws for data preservation are known as the 'Electronic Communications Privacy Act of 1986' (ECPA). Under the ECPA, companies do not retain information unless the government specifically requests that certain data be retained [382]. Thus, most U.S. Internet Service Providers (ISPs) preserve data for a minimum of thirty to ninety days. However, the U.S. law does not demand that the ISPs delete this data in a certain time interval. The 2001 Patriot Act brought small changes to the ECPA, favoring the access of law enforcement to user data and decreasing consumer data privacy [382].

Mobile Marketing

The cell-phone can deliver great incentives for marketing a company's services directly to consumers. However, across the world, the establishment of appropriate laws on privacy and standard principles granting the consumer the choice of opt-in/opt-out marketing, is still under discussion.

For example, in Europe, the Privacy and Electronic Communications Directive (Art. 13) requires member states to prohibit the sending of unsolicited commercial communications by fax, e-mail or other electronic messaging systems, without the prior consent of the user.

Across the Ocean, numerous U.S. states have proposed bills that would potentially regulate text messages, by allowing sending of text messages only with prior permission from the user (including the recipient's phone number). On this matter, the Telephone Consumer Protection Act (TCPA, 2001) prohibits the sending of unsolicited voice and text calls without the consent of the consumer [187].

Mobile Cloud Computing

For the telecom industry, Cloud Computing means that the processing power and data storage can now move from the mobile phone to the cloud, revealing significant opportunities to market a wide offer of new mobile capabilities. Nowadays, the legal framework for the Cloud Computing environment has not been clearly established, as the appropriate government standards are still missing.

In the U.S., legal regulations such as the Sarbanes–Oxley Act (SOX[9]), Health Insurance Portability and Accountability Act (HIPAA), the Gramm-Leach-Bliley, Children's Online Privacy Protection Act (COPPA), and the Patriot Act may prohibit the use of the Cloud for mission-critical applications. For example, HIPAA and the German Act for the Modernization of the Health Insurance by Law (GMG) forbid any disclosure of data to third parties without the patient's explicit agreement. Furthermore, the European Data Protection Directive limits the cross-border disclosure of personal data, a fact which clearly restricts the opportunities of cloud computing [425].

[9] U.S. Federal Law, 2002

In the U.S., attempts have been made to standardizing the cloud, such as the Federal Cloud Computing Initiative in 2009. However, every cloud provider has its own approach to providing security, due to the current lack of clear standards.

3.3 Trends

With a rapidly evolving technological background, regulators have to constantly adapt from irrelevance. Based on the analysis of the current situation the major trends evolving in this field are presented below.

3.3.1 Political and Legal Framework

The whole ICT sector strongly depends on the political and legal framework set by both national and international decision makers. The following section discusses the strategic plans and initiatives of governments around the globe.

3.3.1.1 Restructuring and Harmonizing Regulatory Institutions

The future of the ICT industry depends to a considerable extent on the advancement of its legal framework. Therefore it is crucial to steadily develop the current regulatory situation in order to enable international competitiveness and to create planning dependability for developers and access providers.

In Germany, the establishment of a nation-wide regulatory authority for all media and telecommunications is unrealizable according to existing requirements under the Constitution[10] [348]. Taking those requirements into consideration two other developments are being discussed:

1. Establishment of topic-oriented commissions working across-state level to ensure coordinated supervision and to serve as a nationwide contact for the (ICT) industry [156].
2. Establishment of one common interstate Media Authority interacting with the national BNetzA [233].

In Europe, national regulators have very differently implemented the EU framework. This fragmentation of the internal market hinders effective cross-border consolidation and also pushes the need to harmonize the legal and regulatory structure in order to build a pan-European market [175]. The tendency goes to boost the competences of the European Telecoms Body (BEREC) and to merge it with the existing EU agency in charge of network and information security (ENISA), in order to set-up a European-wide regulation authority [172].

[10]cf. Art. 30 GG in conjunction with Art. 70(1) GG and Art. 73 I Nr.7 GG in conjunction with Art. 71 GG

In the United States, the FCC's Strategic Plan for 2009-2014 is not concerned with regulatory fragmentation. By modernizing the FCC itself the U.S. nationwide regulatory authority wants to be able to respond to Congress, consumers, and the telecommunications industry in a timely manner, become an easier organization to do business with and to create and sustain an organizational culture that encourages continual improvement [188].

The question of who shapes the functional design and content of the Internet cannot be answered within national boundaries. On the international level, therefore, cross-border harmonization and a higher level of interaction increase in importance. In international panels, such as the International Telecommunication Union (ITU) [170], the World Trade Organization (WTO) [471] and the Organization for Economic Co-operation and Development (OECD) [46] national states try to facilitate convergence and define policy guidelines in order to expand the opportunities for global economic, social and cultural development [337].

3.3.1.2 Promoting the Availability of Broadband Access Worldwide

As discussed at the Global Symposium of Regulators in Geneva 2009, "the importance of improved connectivity to economic growth and social cohesion necessarily makes increasing penetration and speed of networks a key element of national economic policy making" [293, p. 21]. Against this background, many countries announced their broadband strategies in 2009.

For example, German BMWi's Breitbandstrategie is to promote broadband access and high speed transfer rates (more than 50 MBits per second) to at least 75 percent of the nation's households by end of 2014 [106]. In the U.S., the Broadband Technology Opportunities Program (BTOP) of July 2009 was funded at USD 4.7 billion. It aims especially at bridging the so called digital divide by bringing broadband to rural, "unserved and underserved areas" where networks are costly to deploy [323].

Despite governments all around the globe pursuing this common goal, their approaches fundamentally differ. "While the European approach seeks to maintain a continuity of regulation through the application of competition policy principles, the larger scale investments particularly in Australasia introduce a new level of politicization of the sector" [293, p. 23]. Since the availability of broadband access will have a major impact on the popularity and usage of platform-based applications, finding the right degree of government involvement will be one of the decisive challenges for the years to come.

3.3.1.3 Moving Towards an Open and Neutral Internet

An open and neutral Internet above all implies that access providers are not allowed to restrict the applications their customers can use over their Internet connections. Governments tend to endorse so called net neutrality because "everyone has the right freely to participate in the cultural life of the community, to enjoy the arts and to share in scientific advancement and its benefits"[11] [442]. Furthermore, the Internet is seen as an "engine for economic growth, for jobs, for investment and innovation" that should not be subject to any restriction [206].

Within the European Union, the EU Telecoms Reform gives national authorities "the powers to set minimum quality levels for network transmission services so as to promote net neutrality and net freedom for European citizens" [170]. The European Commission believes that a sufficient degree of competition among broadband access providers will automatically lead towards net neutrality.

In the U.S., the government plans to guarantee net neutrality by law. Thus, the FCC adopted a Notice of Proposed Rulemaking (Open Internet NPRM) in October 2009. In order to preserve a free and open Internet, service providers shall be prohibited from discriminating against different applications. The proposal states that the rules shall basically apply to any platform of broadband Internet access, but still acknowledges that differences between different Internet access platforms may justify differences in how the Internet openness principles will be applied [190]. More open platforms will facilitate the growth of more cross-platform compliant application offerings from developers, which will ultimately benefit the consumer.

3.3.2 Platform Providers

The mobile platforms are evolving at a rapid pace. This change leads to difficulties in trying to see the bigger picture. The following section delves into detail to find the major trends as viewed from the perspective of the platform providers.

3.3.2.1 Reducing Data Retention on Part of the Service Providers

The current directive of the European Parliament and of the Council [426], on the retention of data specifies that member states have to ensure that communications providers must retain necessary data as specified for a period of between six months and two years. This directive has come under severe criticism from several privacy and civil rights groups [176, 68]. Member states such as Germany, Romania, Sweden and Ireland have led the way for this controversial law to be dismissed.

German legislators had initially implemented the directive in November 2007 [152]. But in December 2007, a constitutional complaint was brought to the Federal Constitutional Court by 35,000 citizens, the largest number of plaintiffs ever involved in a case, at the initiative of the German privacy group AK

[11] cf. Art. 27(1) The Universal Declaration of Human Rights

Vorrat. One of the main plaintiffs was the present Justice Minister Sabine Leutheusser-Schnarrenberger. In March 2010, the Federal Constitutional Court of Germany ruled the law unconstitutional [78, 295]. The court did not annul the legislation entirely but suspended it, asking for the immediate deletion of the data already collected and for the massive modification of the law in order to provide stricter conditions for to the use and storage of the data [109].

The United Kingdom has a put in place a system of voluntary data retention which derives from Part 11 of the Anti-Terrorism, Crime and Security Act 2001 [338]. Telephone operators and ISPs retain some data under a voluntary arrangement with the UK Home Office. Communications data includes data which identifies the users of services, data which identifies which services were used and when they were used, and data which identifies who the user contacted. It does not include the content of communications. For example, in the case of a call from a mobile telephone the data to be retained would include data identifying the owner of the phone, who was called, the duration of the call and the approximate locations of both parties. It would not include what was said during the call.

It can be implied that ever more countries are moving to a lesser degree of data retention on part of the service providers. With even smaller countries such as Romania, Sweden and Ireland rejecting the validity of the law and from the pending court decisions in various countries such as Bulgaria, Belgium etc. who in conjunction with civil liberties groups such as EDRI, AK Vorrat etc. are effecting a major shift in this direction.

3.3.2.2 Compliance to Data Requests from Security Agencies

There has been an increase in the amount of information collected through spying on electronic communications [163]. Security agencies are trying to put in place measures that allow them to wiretap and eavesdrop on the content of the communications of suspects.

In Germany, service providers and third parties operating in conjunction with them shall undertake to keep customer data files from which approved law enforcement agencies can retrieve data by means of an automated procedure. For purposes of data protection control by the law enforcement agencies, the Regulatory Authority shall record, for each retrieval, the time, the data used in the process of retrieval, the data retrieved, the person retrieving the data and the requesting authority. Use for any other purposes of data recorded is not permitted. Data recorded are to be erased after a period of one year[12] [150].

In the U.S. Title II, 'Surveillance', of the Patriot Act of 2001, which was reauthorized by US Senate in July 2005, expanded the scope and availability of wiretapping and surveillance orders. Wiretaps were expanded to include addressing and routing information to allow surveillance of packet switched

[12]cf. § 112 TKG

networks also. Thus mandating service providers to allow for authorities to intercept and share electronic, wire and oral interception information [450].

Though controversial in its current form, the compliance to requests from security agencies is highly prevalent and is considered the root for being able to provide for a composite national security in a world with a high level of threat from terrorism.

3.3.2.3 Platform Uniformity and Open Access

The providers can no longer discriminate against data by virtue of its country of origination or destination, there by preserving a borderless Internet. This view point will be extended to applications provided from platforms of various providers to include interoperability of usage and non-discriminatory availability across platforms [58]. Restrictive policies of exclusivity i.e. 'tying down' applications to particular hardware or environment is being brought down through consortiums of various market players.

The Android platform serves as an example of the growing influence of the Open Handset Alliance. The alliance which consists of 65 firms till date, set in motion for all participating firms a set open source mobile platform standard. With the exception of brief update periods, Android has been available since October 2008 with the entire source code, including network and telephony stacks, under an Apache License [99, 59]. With the Apache License, vendors can add proprietary extensions without submitting those back to the open source community. This lead to more developers willing to work with the platform which in term lead to greater range of applications and value for the consumers.

3.3.3 Application Developers

As developers play a fundamental role in supporting the growth of application platforms, it is crucial to specify legislation that is internationally standardized, unambiguous and that which supports fair competition for all.

3.3.3.1 Stagnation in Software Patents Worldwide

Software patent numbers have increased during the last years in the OECD [336]. However, there are indicators that this trend is not going to continue.

In the U.S. most software patents that are related to developer platforms used to be granted for business methods implemented in software. The Bilski case rules, "that business models can only be patented if they are implemented by a machine or if they transform something into a new or different thing" [443]. Some software patents, especially the ones linked to e-commerce, do not meet those specifications and thus they are void. Concerning other software patents the situation is really vague. The Bilski case is being reviewed by the Supreme Court and a decision regarding software patents is eagerly expected in the first half of 2010. The software industry hopes that the Supreme Court is going to clarify the patent situation for application developers. The granting of software patents is a very slow process. In the U.S., this can take on average three and a half years to complete [445].

Europe's patenting process can take up to four years to grant a software patent [179]. When enforcement of software patents was not a commonplace in Germany for example, a number of software patents were granted to individuals as well as companies. These however have not been enforced over the years and as such the still remaining software patents are expiring without holding companies taking legal action against infringers. Furthermore, according to the European Patent Convention (EPC), programs for computers and methods for doing business are explicitly excluded from any patenting [178]. This trend is not likely to change because the recent introduction of restriction of software patents implies that the European Union's view on software patents is that a lesser number of patents are favored.

With fewer software patents existing, the way of developing applications would change. Application developers will not be obligated to research on existing patents but therefore it is harder to protect their ideas.

3.3.3.2 Governmental Protection of End-User Data from Disclosure to Developers

Governments will increase the protection of end-user data from disclosure to developers. Within the last years, information and communication technologies have developed greatly. This led to new security threats for end-users [293, p. 19]. Some developers of applications get a great part of their revenue through advertisements and information about customers. Zynga for example reportedly takes in close to one-third of its revenue from "commercial offers" [444, p. 6]. Developer platforms and applications for smartphones give developers a great new field of gathering information and gaining money by selling advertisements. For instance within the next years, opt-in marketing is expected to increase. As users feel more and more insecure within the new technologies, regulators need to act [293, p. 19]. In times of modern Internet and communications there are barely borders between states. Therefore an international approach is needed in order to protect users [293, p. 19]. Users expect governments to fix loopholes in legal frameworks due to innovative data collection methods.

3.3.3.3 Arbitrary Restriction of Applications

To combat a flood of applications, providers have to introduce restrictions to developers, as an ever-increasing number of application choices does not necessarily enrich the end-user's experience but merely saturates the already very large application market. This of course does not apply to applications that add value to the market, but to those which could, for instance, be replaced by a website. Drawing this line between useful and useless applications poses a problem to providers as they cannot clearly define what makes an application valuable. Thus, the vagueness in the developer agreements is introduced to cover a broad field of applications that are to be deemed inappropriate at a later stage through developments of the application store and at the same time to nor restrict potential valuable applications from the start. In this regard, as with the censorship of the Stern's application which was removed from the online store due to "erotic content", Apple is arbitrarily strengthening their guidelines from day to day which in turn is leading to them placing censorship on the freedom of speech of developers and content providers [319]. This censorship can be compared to that of China and how the Apple is controlling the flow of information as they see fit. As Apple is the market leader in the mobile application platform, they might serve as a role model to others entering this field. At the present time, platforms such as 'Developer Garden' and 'Orange Developer Platform' are not in the scrutinized by the media as much as Apple and cannot afford to be so restrictive as they simply don't have the same volume of applications as Apple does. As both developer platforms increase in size, the potential danger that they behave similarly to Apple increases.

3.3.4 End-Users

In the future, consumers will rely more than ever on telecom providers to help them in managing and protecting their personal data. Users will become "increasingly concerned about the use and misuse of the data that comprises their digital self" [334]. The following section briefly discusses the future trends and their implications from the end-user's point of view.

3.3.4.1 End of Data Retention Laws

The issue of consumer privacy protection is vitally important, especially in the mobile service industry, where telecom operators may collect large amounts of user data. Due to recent developments in the legal framework of several member states, the retention of telecommunications data without any prior suspicion, as stated by the current EU Data Retention Directive [427], is slowly coming to an end.

In this context, the German Constitutional Court (GCC), in March 2010, struck down a law demanding that the telecom operators and service providers keep records of all communications data (Art. 5.1. in [427]) for six months, without pre-screening or cause. One of the main reasons behind rejecting the law was the fact that it went beyond the EU directive, by allowing the state to recover data not only for pursuing grave criminality, but also for preventive acts and intelligence operations [161]. In fact, the GCC mentioned that the law had violated Art. 10(1) of the European Human Rights Convention [132], regarding the right to freedom of speech in private (including mobile-phone) conversations.

Up until now, six EU member states have still not transposed the Directive into national law. Citizens across Europe have met the EU Directive with strong criticism with respect to the threat to civil liberties and loss of privacy.

3.3.4.2 Non-Intrusive Mobile Marketing

The future of successful mobile advertising services will focus on a strictly opt-in approach, requiring the active involvement of the user in order to enable the mobile device as a marketing channel.

In the U.S., the Federal Trade Commission (FTC) has announced that the COPPA law needs to revisited and that the review will begin in 2010, five years earlier than originally scheduled, in order to establish whether the spread of smartphones raises privacy concerns, particularly regarding children. The connection of "tracking, profiling, behavioral targeting, and impulse buying" to mobile advertising is discussed in the FTC and the "creation of additional mobile advertising standards to address consumer privacy, autonomy, and special issues" [193], is being urged.

One of the rare examples of law-compliant mobile marketing approaches is the Procter & Gamble (P&G) Text Club for its Cover Girl product line. After noticing the company's ad in paper-based media, the consumer can send a text message to begin the opt-in process required to join the club [193]. Then, P&G sends a response to the consumer, indicating how many SMS's the user should expect to receive monthly, requiring the consumer to agree to it or not.

In the FTC [193], the fact emphasized is that "consumers consider their mobile devices to be personal, private devices" and, therefore, it is essential that they "have the ability to opt-in and opt-out of mobile advertising." The future opt-in model and the implied legal settings will provide the end-users with the possibility to control their mobile experience and to protect the privacy of their data [50].

3.3.4.3 Cloud Privacy Protection

Cloud Computing is an emerging model with huge potential in the IT world. However, there is still a long way to go in order to achieve a sustainable Cloud Computing model across various domains of regulation and trust.

In Germany, in a recent strategy meeting with leading representatives from the IT industry, Dr. Bernd Pfaffenbach, State Secretary at the BMWi, has recently addressed the topic of Cloud Computing and its growing importance to companies in all sectors. This subject will be implemented by the Federal Ministry of the Interior in „Deutschland Digital 2015", the future IT strategy of the German Federal Government. Simultaneously, the BITKOM is working on the “Aktionskonzept Cloud Computing in Deutschland“, which will discuss the future implications of this new trend in Internet-based IT services.

In the U.S., Microsoft has recently argued that the Computer Fraud and Abuse Act passed by the Congress in 1984 should be upgraded to include cloud computing regulations. A year ago, in spring 2009, IBM initiated the Open Cloud Manifesto [126] with the support of 170 companies, such as Sun and Red Hat, but with major players such as Google, Microsoft and Amazon opting out. The Manifesto discusses the challenges that must be addressed before Cloud Computing becomes widely adopted. In order to reassure the customers of the security of their data, cloud providers will have to offer a high degree of transparency into their operations. Also they “need to support interoperability standards between data and application systems” [126], so that users can integrate the cloud solutions into their own.

Furthermore, the non-profit Cloud Security Alliance and HP made public in March 2010 their “Top Threats to Cloud Computing Report”, which identifies “abuse and nefarious use of Cloud Computing” as the most important challenge to overcome in wide-scale Cloud Computing adoption [123]. For a wide-scale adoption of the mobile computing paradigm, it is essential to establish legal requirements for the handling of particularly sensitive data, such as health-related data and financial data [235].

The rich enthusiasm for Cloud Computing has so far been tempered by security concerns. As attractive as Cloud Computing and the Mobile Cloud may sound, the technical standards for connecting the various computer systems and pieces of software are, to a great extent, still to be defined.

3.4 Conclusion

As shown above, the regulatory institutions and structures need to be harmonized in order to provide the public with an open and neutral Internet that can be accessed everywhere by everyone. Above all, new laws and policies are to protect those who cannot protect themselves: the end-users. As a consequence, the future regulatory framework implies stricter requirements for platform providers on the one hand and application developers on the other hand. The major challenge for the years to come will be to establish a flexible and commonly accepted framework within which everyone is guaranteed the highest amount of legal security possible. The acceptance of these policies by the telecommunication companies into their business strategy grants them greater clarity in future planning. In addition to this, the trust factor developed over the years through close compliance with the existing legal regime establishes telecommunications companies as the preferred partner to the end-users.

Chapter 4

4 Market and Market Players

David Bellem, Stefan Hopf, Hauke Rapold, Julian Riediger, Mehmet Yilmaz

For too long communication service providers merely provided the bitpipe for web service providers and device vendors such as Google and Apple who currently dominate the market for innovative services and applications. To make up lost ground communication service providers are opening up their formerly closed networks and standard services to enable outside innovation by developer platforms. They find themselves in a dynamic two-sided market with web service providers and device vendors also competing to position their developer platforms and application stores. Changing roles and a subsequent decomposition of the traditional value chain into a value network will shift focus towards complex relationships among market players. Whether communication service providers will play a major role within the future value network around developer platforms and communities thus depends mainly on their commitment to co-creation in complex relationships with diverse market players.

4.1 Introduction

The emergence of developer platforms and communities marked a paradigm shift for the telecommunication industry. A closed and proprietary market is opening up to enable third-party innovation. For too long communication service providers (CSP) have stood aside in walled gardens while web service providers and device vendors such as Google and Apple have driven innovation and dominated the market.

To make up lost ground CSPs try to unfold the entire potential of developer communities. Leveraging this potential requires profound knowledge of the value chain and the diverse market players of the developer platform ecosystem. In addition it is crucial to take into account the characteristics of a two-sided market with developers on developer platforms on one side and end users on application stores on the other side.

This section thus aims at providing a thorough analysis of the market for developer platforms and communities in the telecommunication industry and its development within the next five years. First the status quo of the value chain, market players and markets for developer communities and applications are discussed. Subsequently six key trends that will shape the market and market players in the near future are identified.

4.2 Status Quo

The status quo of the market and market players is analyzed in three steps. First a value chain model is applied in order to look at the individual stages needed to create value for a customer. Then the different market players in the value chain and their respective roles in the market are discussed. Finally the two-sided market is described by presenting an overview of the markets for developer platforms and applications.

4.2.1 Value Chain

The value chain perspective was first introduced by Porter [362, p. 34] and has found broad acceptance in academia and industry.

The value chain for developer platforms and communities in the telecommunication industry is depicted in figure 4.1. In addition the interdependence with the value chains for media content and devices is indicated. The subsequent section briefly describes the individual steps of the value chain.

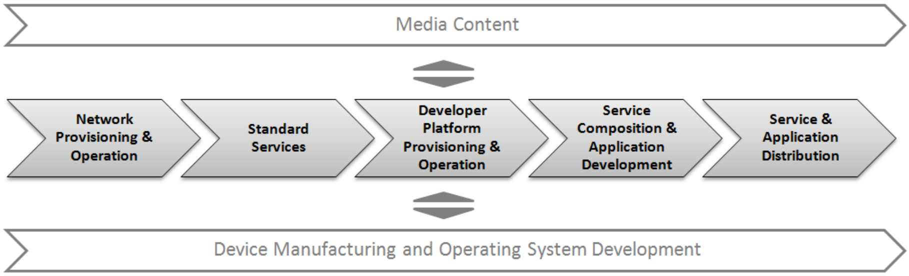

Figure 4.1: Value chain for developer platforms and communities in the telecommunication industry
Source: own illustration based on Barnes [74, p. 93] and Picot [358]

Network Provisioning and Operation

The basis in the telecommunication industry is the network infrastructure connecting a variety of terminals (e.g. telephone, mobile phone and computer) through numerous channels (e.g. landline, GSM, DSL, UMTS and Ethernet). The provisioning and operation of such a network requires in-depth knowledge of the underlying technology and is characterized by large investments and government regulations such as frequency rights.

Standard Services

Building on the network infrastructure a variety of services can be created. For an overview see table 4.1. These services are considered standard services in this value chain analysis as they are the basis for further value creation.

Telecommunication Services	Web Services
Voice	E-Mail
SMS, MMS	Voice over IP
Conference Calls	Instant Messaging
Voice Mail	Social Network
Location Based Services	Business Productivity Applications
IPTV	Media Content Streaming

Table 4.1: Overview of standard services building on the network infrastructure.
Source: own illustration

Developer Platform Provisioning and Operation

Standard services are exposed on developer platforms to enable third-party innovation. The scope and form of developer platforms differs greatly. They range from basic application programming interfaces (APIs) to entire service delivery platforms (SDPs) providing a service oriented architecture and support functions such as billing, testing and certification of applications.

Besides developer platforms for exposed (network) services, many platforms are available for developing user interfaces of applications (e.g. for the Apple iPhone or Android operating system).

Service / Application Development

The possibility to access standard services enables the development of more sophisticated applications and services. This process includes adding of content from other media sources, orchestration of services and tailoring of applications to the needs of a variety of different end devices (e.g. computer, mobile phone) and customers (end-users and business customers).

Service / Application Distribution

The next step in the value chain is offering, deploying, executing and maintaining the services and applications as well as billing and customer care. In some cases certification and content control is also performed at this part of the value chain to ensure a higher quality of services and applications.

4.2.2 Market Players

The ecosystem around developer platforms and applications consists of market players with diverse industry backgrounds and various roles in the value chain (see figure 4.2). The following analysis of market players points out their current intentions, motives, conflicts and relationships to other market players.

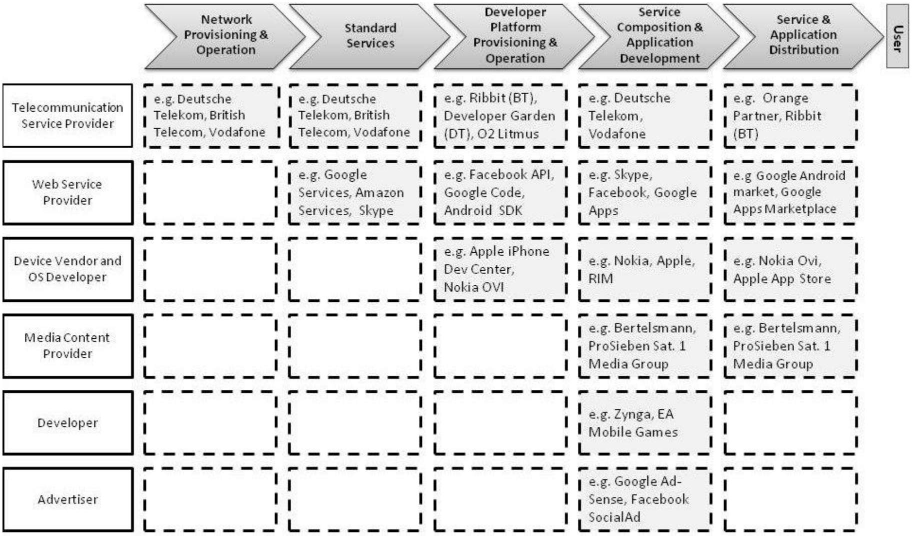

Figure 4.2: Market players and their role in the value chain
Source: own illustration

Communication Service Providers

Communication service providers traditionally offer network provisioning and operation, standard telecommunication services as well as billing and customer care. In addition they often operate points of sale for their services and hence have direct access to a large customer base.

Their role as a standard service provider has been challenged by the evolution of IP-based web services, driven by an ever increasing availability of high-speed Internet access in the last decade [108, p. 38]. Innovative communication, media and entertainment services such as social networking, voice over IP, instant messaging, music downloads and video streaming have shaped an ecosystem with communication service providers serving merely as a bitpipe for these over-the-top services. CSPs intend to address this challenge by opening up their formerly closed and proprietary service infrastructure to third parties via service delivery platforms. Additionally some communication service providers have already launched their own application stores to distribute these third-party services and applications. By these means communication service providers seek to become the linking part of a two-sided market [383] with potential revenue streams from developers, advertisers and customers alike. The strategic importance of service delivery platforms for telecommunication companies is underlined by increasing investments in SDPs over the last years, exceeding USD 3 billion in 2008 [317, p. 5].

Web Service Providers

Web service providers (WSP) offer standard services based on the Internet (see table 4.1). In contrast to most communication service providers WSPs are relatively young companies within a rapidly changing market and hence must have fast adapting business models. WSPs have seen third party integration as a chance rather than a threat much earlier than communication service providers and have already established developer platforms with a large community (e.g. Facebook, Google Code).

Low entry barriers for new web services, decreasing revenue from advertisement [373, p. 4] and - to some extent - new competition from communication service providers have led some WSPs to secure their stance by diversifying their services and expanding their role within the value chain. For instance they have started to distribute the services and applications developed on their platforms themselves (e.g. Google Apps Marketplace) and thus are main competitors for communication service providers in the two-sided market of developer platforms and applications.

Device Vendors and Operating System Providers

By producing cell phones, televisions and personal computers device vendors provide the hardware basis for using applications and services. Device vendors and other companies providing operating systems (e.g. Apple, RIM and Google) are of particular importance to developer platforms and applications. Their software defines the scope of over-the-top services and applications. By selecting pre-installed software or application stores they partly control the distribution of services and applications. Some device vendors and operating system providers (e.g. Apple, Nokia Symbian and Google Android) successfully claim larger parts of the value chain by operating their own application stores and thus having direct customer access and high brand awareness. Their expansion into the value chain can be seen as an attempt to avoid being mere providers of hardware components.

Media Content Providers

Media content providers such as publishers, broadcasting companies and music labels offer information and entertainment services through various off- and online channels. Due to decreasing revenues from traditional channels like advertising in print media [331] and a reluctance to pay for media content on the Internet [434, p. 4] some media content providers intend to gain revenues by offering their content in new formats and through new channels including application stores.

Developers

Developers integrate standard services into their applications using the interfaces of service delivery platforms. Their motives are mainly financial but some also strive for a good reputation and fame within the developer and user community.

Developers can be seen as a key asset of platforms and application stores and are essential to attract customers. The higher the number of developers for a platform is, the higher the chances for customers to find applications serving their specific needs and the shorter the innovation cycle. For platform providers it is therefore essential to consider developers needs by offering attractive revenue share agreements, billing methods as well as store visibility.

Advertisers
Advertisers are a potential source of revenue for developers and service providers. They use applications as an innovative platform to reach their respective target groups. Applications based on telecommunication services are attractive to advertisers due to the availability of user data such as location and user preferences. With their reputation at stake communication service providers need to take users' privacy concerns into account when providing user data to advertisers.

Users
The user is situated at the very end of the value chain. Nevertheless users play a decisive role as they generate revenue streams either directly through the purchase of applications or indirectly from advertisement. Consequently all market players need to consider the needs and interest of different types of users in their business models.

4.2.3 Market Characterization

The market for developer platforms and applications is highly fragmented. Numerous market players along the telecommunication industry value chain enter the market for developer platforms and applications by exposing their traditional services to third-party developers. As the market for developer platforms and applications is a classical two sided market, both sides of the market are individually analyzed in the subsequent sections.

The following figures provide a market overview of developer platforms and applications clustered in operating system based platforms (table 4.2), telecommunication based platforms (table 4.3) and social network and business-to-business (B2B) based platforms (table 4.4).

		Apple App Store	Google Android	Nokia Ovi
General	Launch Date	11.07.2008	22.10.2008	26.05.2009
	Revenue/Year in US$	700m (est.)	20m (est.)	-
	Customer Focus (B2B, B2C)	B2C/B2B	B2C	B2C
Developers	# of Downloads	3.000.000.000	400.000.000	5.000.000
	# of Developers	65.000		
	# of Users	60.000.000	5.000.000	2.000.000
	Revenue Sharing (Platform/Developer)	30/70	30/70	30/70
	Average Price for all paid Apps in US$	3.62	3.27	3.47
	Submission & Registration Fees in US$	free/99	-/25	-/50
	Functionality/Services Exposed	Billing, Distribution	Billing (Operator), Distribution	Billing (Operator), Distribution, Reporting
	Technical Specifications (SDK)	iPhone SDK	Java	Symbian C++, Java
	Geographical Reach (Free/Paid)	77/77 countries	25/12 countries	240/239 countries
	Supported OS	iPhone OS	Android OS	Symbian
Applications	# of Applications	140.000	30.000	6.800
	Billing Types	one-off, Subscription	one-off	one-off
	Billing Methods	In-App billing, Credit Card	Google Checkout, Credit Card	Credit Card
	Ratio Free/Paid Applications	25/75	57/43	15/85

Table 4.2: Developer platforms of operating system providers (Examples)
Source: platform providers [10, 456, 11, 27, 333]

		Orange Partner	DeveloperGarden	Ribbit	o2 Litmus	Vodafone 360/BetaVine
General	Launch Date	15.09.2003	13.05.2009	17.12.2007	19.12.2008	24.09.2009
	Customer Focus (B2B, B2C)	B2B/B2C	B2B/B2C	B2C/B2B	B2C	B2C
Developers	# of Developers	55	1500	20631	-	15000
	Revenue Sharing (Platform/Developer)	individual negotiations	individual (Credit-based)	individual (Credit-based)	30/70	30/70
	Submission & Registration Fees	free	free	free	free	free
	Functionality/Services Exposed	Billing, Distribution,Voice, Messaging, Authentication, LBS	Billing, Distribution,Voice, Messaging, Authentication, LBS	Calling, Messaging, User Mgmt, Authentication	LBS, Device Mgmt, Billing	LBS, Billing
	Technical Specifications (SDK)	Java, Php, Ruby, Python, Micorsoft.net	Java, Dotnet, Php, Ruby, Opera, Typo3, Zend	Java, REST, PHP, Silverlight	Java, Flash, .NET, PHP	JIL Widget SDK
	Geographical Reach (Free/Paid)	4/4 countries	Germany	worldwide	UK only	8/8 countries
	Supported OS	Android OS, Java, RIM, Symbian OS, Windows Mobile OS	Symbian, Opera (Windows Mobile, Samsung)	iPhone OS	Windows Mobile, Symbian, WebOS, Java, Flash Mobile, Blackberry	Multi-platform
Applications	# of Applications	5.000	10	6	731	7000
	Billing Types	one-off, Subscription	prepaid, postpaid	one-off, Subscription	one-off, Subscription	one-off, Subscription
	Billing Methodes	Credit Card, Bank account	Credit Card, Paypal	Credit Card	Bank account	Bank account

Table 4.3: Developer platforms of communication service providers (Examples)
Source: platform providers [244, 29, 24, 31, 45, 34]

		Facebook	Salesforce AppEx	Google Apps Marketplace
General	Launch Date	24.05.2007	12.12.2006	09.03.2010
	Revenue/Year in US$	-	100m (est.)	-
	Customer Focus (B2B, B2C)	B2C	B2B	B2B
Developers	# of Users	300.000.000	55.400	-
	# of Developers	64.052		50
	Revenue Sharing (Platform/Developer)	0/100	20/80	20/80
	Submission & Registration Fees in US$	free	first app for free	-/100
	Functionality/Services Exposed	Facebook API Services	Salesforce API (CRM), Billing	Google Apps API, Billing
	Technical Specifications (SDK)	PHP	SOAP	Java, .NET, PHP
	Geographical Reach (Free/Paid)	worldwide	worldwide	worldwide
Applications	# of Applications	60.000	846	100
	Billing Methods/Types/Media	Credit card	Credit card	Credit card

Table 4.4: Key players of social network and business-to-business developer platforms

Source: platform providers [25, 33, 26]

4.2.3.1 Market for Developer Platforms

Currently numerous developer platform providers are competing to attract developers to their platforms. Their revenue models are quite similar and typically share between 70 and 80 percent of the revenues with the developer. Hence the attractiveness is significantly determined by both the number of potential customers and their functionality. While developer platforms provided by communication service providers are mainly exposing their traditional communication services such as voice and messaging to third-party developers, others are focusing more on offering interfaces to existing handset platforms and operating systems (e.g. Apple iPhone, Google Android). Additionally, a third group of platform providers tries to leverage third-party development efforts to improve their existing B2B applications and processes (e.g. Salesforce AppExchange, Google Apps Marketplace) for small and medium-sized enterprises. In order to attract developers to their platforms, the different market players are trying to keep the entry barriers low by leaving initial cost and effort at a minimum.

4.2.3.2 Market for Mobile and Web Applications

The market for mobile and web applications has been growing in importance as developer platforms have become more sophisticated. “Worldwide mobile application stores’ download revenue exceeded USD 4.2 billion in 2009 and will grow to USD 29.5 billion by the end of 2013” [353]. While industry players discover the new revenue potential within the market and try to establish their developer platforms, customers appreciate the new functionalities of mobile and web applications that also target the long-tail of customer needs.

The most prominent example in the mobile application market is the Apple App Store which was launched in July 2008 [61]. The App Store so far lists 140.000 applications [64] and has attracted 60 million customers [456, p. 22] generating 3 billion application downloads [64]. In 2009 industry analysts estimated that Apple App Store application downloads generated about USD 700 million in revenue [456, p. 22]. Although only about 18 percent of all downloaded mobile applications in the mobile application market in 2009 were paid applications [476].

Compared to the market for mobile applications, the market for web applications mainly targets enterprise customers. The pioneer in this field is Salesforce, a cloud computing company providing a developer platform and distribution channel for easy to use enterprise web applications. In its fiscal year 2010 Salesforce announced USD 1.3 billion in revenues (compared to USD 1 billion in fiscal year 2009) and a net income of USD 80 million. It’s customer base extends over 72,500 enterprise customers and 1.5 billion paying subscribers accessing information on the platform [387].

4.3 Trends

Several trends based on the status quo in the telecommunication industry as well as observable market dynamics can be identified. Abstracting from these trends a macro trend is visible: With new specialized companies and established players from other markets entering the telecommunication market, existing market players face strong competition in their core business fields. Consequently, existing telecommunication market players abolish their traditional walled garden approach and develop expertise in other areas to expand their roles. This expansion of roles leads to a highly fragmented value chain, creating the need for complex relationships among different players in order to provide services to customers. These complex relationships can be described by the concept of a value network linking value creation processes of different market players (figure 4.3). Abstracting from the traditional approach of a sequential value creation process the value network emphasizes the co-creational perspective of value. This concept is supported by the digitization of both content and the traditional value chain, reducing transaction costs among market players and facilitating complex forms of coordination [350, pp. 132-133] .

Figure 4.3 depicts a possible value network that comprises several trends. Various telecommunication companies operate one developer platform together with device vendors and web service providers in order to attract a large number of developers. Thereby the developer platform becomes a driving force for innovation especially for next-generation mobile services. Applications are offered on a device vendor's application store also addressing the growing number of business customers. Media content providers are an essential part of the value network contributing interfaces to their content on the one side and advertisement space on the other side. In turn, advertisers help CSPs to leverage the potential of their comprehensive customer data and enhance their advertisement with context awareness.

In the following sections the specific trends are evaluated and their subsequent market implications are highlighted.

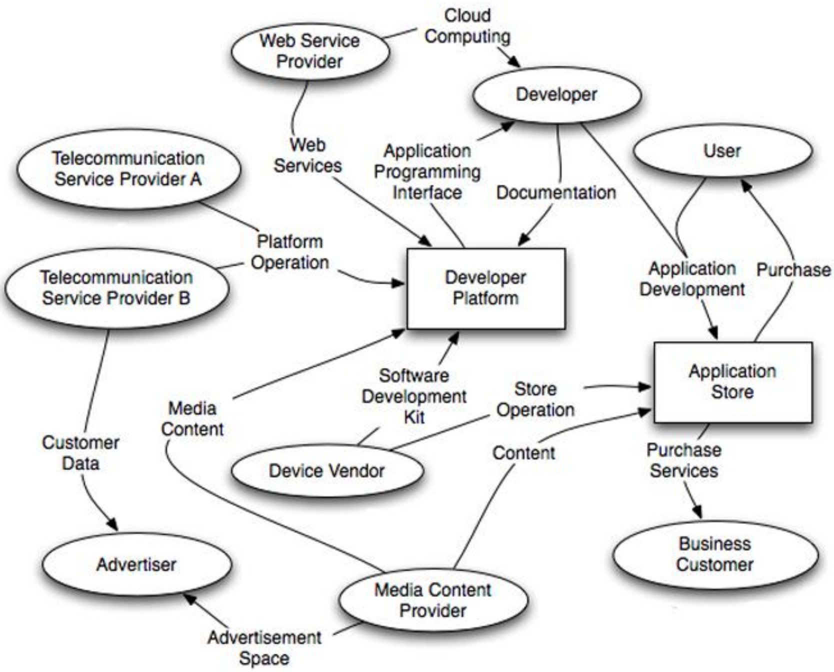

Figure 4.3: Example of a value network in the telecommunication industry
Source: adapted from Peppard and Rylander [350, p. 135]

4.3.1 Emergence of Widespread Next-Generation Mobile Services

Three major trends foster the development of next generation mobile services. First of all, the penetration of mobile Internet increases steadily. According to Nielsen, 9.6 percent of German mobile subscribers actively used mobile Internet in 2009 [432] compared to 7.4 percent the year before [430, p. 3]. This trend is supported by mobile operators increasing their investment in mobile broadband technologies by 15 percent to USD 72 billion in 2010 [220]. Additionally, more households trade their traditional landlines in for wireless cellular services. In the US for example, one fifth of all households are cellular-only homes [433, p. 1]. Second, sophisticated mobile devices such as smartphones (e.g. Apple iPhone, RIM Blackberry, Nokia N97) and media content devices (e.g. iPad, Kindle) gain higher market shares and move into mainstream. Comparing worldwide smartphone sales in 2009 with figures from the year before, an increase of 23.8 percent can be observed. In contrast to that total worldwide mobile phones sales declined by 0.9 percent [354]. Third, developer platforms for mobile applications gain importance as the spread of sophisticated mobile devices shows unprecedented growth. Therefore many communication service providers focus on platforms and mobile application stores in order to integrate their standard services. At the same time established web service providers are adjusting their services and platforms to reach end customers via mobile devices. Facebook for instance announced that 100 million user access Facebook through a mobile device [184], attracting third-party developers to implement standard telecommunication services in Facebook applications.

These three trends can be considered as key factors enabling next-generation mobile services. On the one hand a technology push occurs due to higher mobile Internet penetration and increased availability of more sophisticated mobile devices. On the other hand communication, web and media content providers, follow the market pull as they tailor applications and services to the demand of mobile end-users.

Location-based services (LBS) are one example for a next-generation mobile service. LBSs are business and consumer services accessible with mobile devices through the mobile network making use of the location of the mobile device [5, p. 66]. These services allow users to find other persons, resources and location-sensitive information accessing a spatial database. For instance, the Wikitude World Browser presents the user an augmented reality displaying data about surroundings, nearby landmarks, and other points of interest by overlaying information on the real-time camera view of a smartphone. In 2009 the estimated number of LBS subscribers was predicted to double to 95.7 million while revenue was assumed to increase to USD 2.2 billion from USD 998.3 million the year before [351].

Next-generation mobile services have the potential to have a great impact on market growth for both developer platforms and applications. Simultaneously, the market for sophisticated devices will grow and competition potentially increases [92, pp. 3-7]. As a result revenue margins of device sales might decrease. The CEO of HTC for instance, recently announced to conquer the smartphone market by pursuing a price aggressive strategy [366]. As a consequence device vendors have to develop new business opportunities such as providing developer platforms and application stores. CSPs could lose their predominance on the mobile market as over-the-top service providers enter their playing field. Besides device vendors, web service providers might be main competitors in the future realizing business opportunities emerging from the growth of next-generation mobile services. In order not to be reduced to a sole bitpipe provider as experienced by Internet service providers [350, p. 129], communication service providers might use their existing service infrastructure to offer over-the-top next-generation mobile services (e.g. mobile payment & retailing). Finally, CSPs could partner with media content providers to establish a mutually beneficial strategic relationship. Besides charging end customers for applications and services, these could mainly be sponsored by advertisers in the future. This accounts for a change in spending patterns as early and late majority [384, p. 281] users tend to express a decreasing willingness to pay [353]. Consequently, prices for next-generation mobile service might have to be subsidized by advertisement to make them appealing to the mass market.

4.3.2 Developer Platforms Driving Innovation

With traditional revenue streams decreasing [108], communication service providers are currently subject to increased pressure along the existing value chain. This points out the need for new business opportunities potentially enabled by a continuous innovation process. Since general time-to-market phases are shortened and services as well as products throughout the industry are featuring an increasing complexity while at the same time becoming more user-centric, the challenge in innovation is mainly constituted by the involvement of external knowledge.

Stimulated by the concept of open innovation [453], developer platforms may provide a solution to involve third-party developers in company-specific innovation processes by exposing communication service providers' services as well as data. Building innovative applications and services based on exposed CSP services, developers are creating a value-add for their customers [350]. Besides participation in developer revenues, CSPs may hope for developer platforms to evolve as innovation platforms where new ideas and potential business opportunities might be generated. In fact, actual profit expected by revenue sharing with developers may become less significant compared to developer platforms' huge innovative potential. Even Apple's App Store, the market leader in developer platforms by revenue, contributes with estimated revenues of USD 210 million [456] only a small fraction to the company's total revenue of USD 43 billion [215]. Nevertheless, these efforts increase the attractiveness of their platforms, products and services in general, and help them meet their customers' demand for innovative products and services. External sourcing of innovation [286, pp. 43] becomes increasingly important for an industry in fear of disruption of their traditional business models. While innovation in the telecommunication industry was mainly driven by internal R&D or long-term contracted partners in the past, a shift towards the use of crowdsourced knowledge can already be observed [415]. Examples for this upcoming change in mindset are developer competitions and crowdsourcing activities on existing developer platforms. On its o2Litmus platform Telefónica organizes regular developer competitions, encouraging developers to create innovative applications. The quality of this external input in innovation processes has often been underestimated in the past, however it enjoys rising acceptance nowadays. Netflix, a US-based DVD rental, even successfully organized a crowdsourcing competition asking developers for a significant improvement of their movie recommendation algorithm [328].

Establishing their developer platforms as a major driver for innovation, a war for talent has to be expected. Each developer platform will try to attract as many highly-skilled developers as possible, assuring a steady flow of innovative ideas onto their platforms. This will ultimately lead to a paradigm shift in the CSPs' perception of developers which can already be noticed at some developer platforms today. Facing the challenge of two-sided markets communication service providers will increasingly treat developers as a special group of customers that has to be won and convinced to develop ideas and applications for their platforms [383, pp. 990]. The demand in skilled developers might increase the developers' bargaining power within the value network [453, p. 258]. Following this assumption, the rising importance of the developer's role in the value network has to be compensated by the CSP. Revenue sharing for instance may then shift in favor of the developer, shrinking the CSP's share in application and service revenues. Indicators for this implication can already be observed when looking at Japan's highly developed mobile telecommunications market. Compared to common revenue sharing models in Europe or the US where the developer platform provider collects 20 percent to 30 percent of revenues, in Japan they receive only 10 percent of revenues generated by third parties [200, p. 5].

Eventually, a CSP might even consider buying or licensing a developed application or service featuring substantial innovation and business potential in an early stage of development. The CSP could then use its resources to further develop the idea or application and find an attractive corresponding business model. In addition to its pure innovative potential, a developer platform could be seen as a suitable way of finding business opportunities and companies for vertical integration.

4.3.3 Convergence of Developer Platforms

The markets for developer platforms and application stores are highly fragmented, with Apple's App Store taking a leading role in both markets. In the past, CSPs like other market players primarily launched their own platforms in fear of missing the general trend of opening up their networks and therefore exposing their services to third parties. To date no one has been able to repeat Apple's success and many competitors are struggling to reach the critical mass of users and developers for their developer platforms. This situation is not only unsatisfying for operators of developer platforms and application stores but also for developers and users. Naturally, developers want to address the largest market possible and therefore choose a platform that allows them to create applications that are compatible with a large number of end-devices, operating systems and operator networks.

A major reason for this situation is the existence of network externalities in developer platforms [259, pp. 424-440]. In this context the attractiveness of a platform and a connected application store for a developer increases with additional users, while the attractiveness seen from a user's perspective increases with a rise in developers, implying a bigger supply of applications. This leads to a self-reinforcing loop fueling a platform's success in winning new users and developers.

With regard to developer platforms a consolidation of platforms is expected to take place within the next five years. A strong indicator for this assumption is the announcement of the Wholesale Application Community (WAC), consisting of twenty-four large CSPs as well as device vendors in February 2010. This can be seen as an ambitious first step towards a convergence of developer platforms with regard to the mobile application and service market. The alliance declared to "unite members' developer platforms and create a single, harmonized point of entry to make it easy for developers to join" [467]. Despite the fact that many questions with regard to the business model of WAC remain unanswered to date its creation indicates that CSPs as well as handset manufacturers have realized the need to unite in order to jump on the bandwagon of developer platforms and their connected application stores.

A consolidation of developer platforms and interface standardization for major mobile operating systems reduces the developing effort for applications significantly. This enables developers to create and distribute their applications to a wider audience of customers through a single developer platform. From a value chain perspective this may strengthen the developer's position in the value chain. Consequently, the WAC approach can largely be seen as a means to increase attractiveness for third-party developers. Furthermore, the foundation of WAC points out that strategic partnerships among CSPs and device vendors will gain importance. Existing research suggests that cooperation in terms of standardization is beneficial for all members of an alliance. Although potentially sacrificing parts of their competitive advantage, powerful members might still be able to pursue their specific interests within an alliance [282]. To what extent the process of developer platform convergence will take place in the telecommunication industry mainly depends on the willingness of market players to overcome rivalries that remain in their core business. Given the number of members and their conflicting interests it stays unclear whether WAC will actually unfold the potential it promises. Nevertheless, a general trend of technological platform convergence in terms of standardization is observable.

4.3.4 Importance of B2B Markets for Service Providers and Developer Platforms

The market for services and applications for business customers is expected to continue its growth in the next years. The business productivity software market shows growth rates of 13 percent in Asia and 6 percent in the US in 2008 [83]. Business-to-business process software will grow at an average rate of 10 percent worldwide [296]. But not only the need for applications and services is increasing their delivery is changing as well. Cloud computing has turned from an abstract trend to a revenue generating business with cloud business and productivity applications growing to an estimated volume of USD 95 billion in 2011 [304].

Besides offering their B2B services as cloud services themselves, service providers have started to operate developer platforms and leverage communities. Zoho, offering cloud software services such as a business productivity suite and CRM to more than 1 million customers (2008), has launched a developer platform and marketplace as early as September 2008 [70]. Zanox, an affiliate marketing website, has launched its application store in June 2009 [478]. Realizing the growth potential in the market for B2B web applications Google announced its entry into the B2B application market with its Google Apps Marketplace platform in March 2010. It is a platform for developers to offer their applications based on Google's services (Gmail, Calendar, Docs, etc.) to business customers. Microsoft will follow in April 2010 with its Windows Azure AppFabric platform.

With CSPs such as Orange having entered the B2B market this trend towards leveraging developer platforms and communities to serve business customers can also be expected to occur in the telecommunication industry.

To succeed in serving business customers, CSPs and developers need to acknowledge the differences in serving consumers [356, p. 23]: In contrast to consumers business partners are more willing to pay for services and applications provided online, but often ask for customized solutions and thus need mechanisms to communicate their needs. Their orders tend to be bigger and prices are often negotiated in long-term contracts with complex payment options. Branding plays a minor role, the focus being on product value and partnerships.

The trend towards additional revenue streams from leveraging developer platforms and communities to serve business customers might therefore lead to a focus on relationships. This results in numerous types of service level agreements between the parties involved in the emerging value network. With more players entering the business application market in the near future a fierce reaction of incumbent business software vendors (e.g. SAP, Oracle Hyperion etc.) may be expected as they are being attacked in their core business.

4.3.5 Context Awareness of Services by Leveraging User Data

A major asset of CSPs is their immediate relationship to the customer including access to unique customer profiles and usage data. Integrating this data into context-aware services could provide "location, presence, social attributes, and other environmental information to anticipate an end user's immediate needs, offering more-sophisticated, situation-aware and usable functions" [352]. These services create an additional value for the end-user. They enhance productivity and collaboration possibilities by supplying just-in-time information and offering context-aware options. Anne Lapkin, research vice president at Gartner pointed out that "although the rudiments of context-aware computing have been around for some time now, it is a disruptive technology that has the potential to be a real 'game changer' in terms of competitive advantage" [352].

Compared to traditional context-aware services such as portal personalization, next generation services mash up multiple contextual data elements. Facebook Connect for instance provides third parties with Facebook user information enabling them to tailor content to individual user needs. By using their Facebook credentials to sign up on external websites users grant access to their Facebook user data. The websites can then adjust their content according to the user profile. Workstir.com for instance offers Facebook Connect users a selection of job offers tailored to their area and profile. This example illustrates opportunities for CSPs as they also maintain large sets of subscriber data. In comparison to social networks, CSPs have more precise information on their users, as mobile and fixed line communications still are the most frequently used communication medium. Besides communication data CSPs even have information on current location, billing details, physical address and demographics of their customers. Using this information to provide customers with value added services facilitating their daily lives therefore appears to be a highly feasible opportunity. Context-aware services improve customer experience and build up loyalty which is a major asset for CSPs. A significant obstacle is customer privacy concerns. In case these concerns cannot be overcome they may lead to major failure. As a consequence it will be crucial for CSPs to address privacy concerns with the highest priority and learn from previous mistakes.

CSPs can choose different options to realize the potential of context-aware services. First they can decide to build the entire context-aware service in-house. An advantage of this option is the total ownership of the service along with its revenues. Nevertheless CSPs would have to develop competencies in context provisioning as well as software development. This may result in a long time to market and thus a loss of the first mover advantage. A second option is to acquire companies with the required competencies. This would imply an increased coordination and integration effort. Furthermore the CSP would have to bear the acquisition costs. The third option is to form alliances with key players in the market in order to combine technical and contextual competencies. While CSPs could contribute standard services (e.g. billing, LBS, customer data) alliance partners could provide developer platforms, software tools and contextual data. This appears to be a favorable solution as it combines core competencies from all fields. A last option is to simply provide APIs to share the customer data with third parties.

Whether to pursue a holistic approach to context-aware services along the entire value chain or to only act as an enabler for other parties depends on the overall strategy of the CSP. In any case CSPs could strengthen their role within the value chain by providing another core asset besides network provisioning and operation. Through their direct customer contact the CSPs hold a strategic position within the value chain. Leveraging this position could ultimately lead to increased market power by making other players within the value chain dependent on them. Furthermore they can differentiate themselves against incumbent competitors in terms of service offerings.

4.3.6 Integration of Media Content Providers into Value Network

Media content providers face different situations in their respective markets today and will encounter several challenges in the next five years. Publishers have experienced an ongoing decline in advertisement revenues from traditional print media [330]. The music and film industries have to cope with illegal downloads from peer-to-peer file sharing networks and broadcasting channels have to deal with competition from user-generated content on websites like YouTube or Podcasts. Nevertheless media content providers have a common concern about finding the most profitable way to offer their digital content. Application stores and developer platforms will open up attractive possibilities for media content providers to address this issue in the near future.

Media content providers will use applications more extensively to distribute their content for two reasons. First of all the market for mobile advertisement will continue to grow [294, p. 1] driven by a higher penetration of mobile Internet. The framework of an application makes advertisement space more valuable for media content providers because it enables advertisers to target their customers more efficiently. On a standard website it is only possible to target customers according to their current location by analyzing their IP address. In contrast a mobile application makes it possible to identify each user and expose advertisements based on the available user data. In addition users will perceive more sophisticated applications as a value-add and might be willing to pay for additional benefits. This makes media content providers less dependent on the advertisement market. There are numerous examples indicating the trend of media content providers playing a larger role in the market for applications. Several newspapers have already launched their own applications (e.g. Stern, Bild, New York Times, USA Today) and some of them have implemented additional services for their customers such as location awareness for weather forecasts and customization of user interfaces (e.g. New York Times, USA Today).

Developer platforms could serve as an innovation driver for media content providers by enabling developers to embed media content into their applications. Media content providers will still claim complete control over their content but developers may add complementary features. One example that is already in a prototype phase is Alcatel-Lucent's social television application AmigoTV that offers "the possibility of having a real time communication over your favorite TV broadcast content with your friends" [128, p. 1]. The reason why AmigoTV is not available for large scale deployment is its “need for various network and application services to be deployed in service enabling platforms of operators” [128, p. 1].

For the reasons outlined above, media content providers might become an essential part of the value network for applications and developer platforms instead of mere outside providers of content. CSPs and media content providers could both benefit from establishing stronger strategic partnerships. Media content providers might use developer communities of CSPs, their customer data and services such as billing and LBS. For CSPs “content production offers little potential [as] most operators will do better by partnering with content providers than by attempting to produce content themselves” [240, p. 2]. Therefore CSPs might focus on media content delivery (e.g. IPTV) to enhance their service offerings.

4.4 Conclusion

Communication service providers have opened up their formerly closed networks and standard services to enable outside innovation by developer communities. They find themselves in a dynamic two-sided market with web service providers and device vendors also competing to position their developer platforms and application stores. Changing roles and a subsequent decomposition of the traditional value chain into a value network will shift focus towards complex relationships among market players. This overall development and the consequences are reflected in several concrete trends.

Sophisticated next-generation mobile services will emerge and find widespread use. This might attract new over-the-top service providers challenging CSPs’ predominance in the market. Media content providers have the potential to become an essential part of the value network around developer platforms and application stores and might establish strong strategic partnerships with CSPs. Leveraging their user data CSPs could provide context-aware services and thereby strengthen their role within the value network. Communication service providers and device vendors intend to cooperate and merge their developer platforms in order to challenge the predominance of established market players by becoming more attractive for developers. To address the growing business-to-business segment more complex interactions between developers, business customers and CSPs will be necessary. In search for new business opportunities and to remain competitive developer platforms will be key drivers for continuous innovation leading to further empowerment of third-party developers.

Will CSPs play a major role within the future value network around developer platforms and communities?

This mainly depends on their commitment to co-creation in complex relationships with diverse market players.

5

Chapter 5

Emerging Business Models

Fabian Alt, Christian Deger, Max Lamers, Stefan Rothlehner, Assif Daniel Sobhani

The evolvement of developer platforms and communities represents an important change within the telecommunication industry. Telcos are compelled to open up their former proprietary services and provide third party developers with tools to use these services in their applications. This paper identifies three main business models of developer platforms - network operator-centric, device-centric, web portal-centric - and analyzes the revenue and service streams involved. Based on that, industry trends which impact current business models are discussed. It is found that within the time frame until 2015 no disruptive business models will emerge, but it will be of crucial importance for business models to be flexible enough in order to account for the respective industry changes. Due to the fusion of the telecommunication and Internet market Telcos are forced to redefine their position in the value chain, with developer platforms being an opportunity to accelerate innovation through third-party enabling. Within the developer platform market, players are striving to reach a critical mass in order to attract developers as well as end-users. Furthermore, there are multiple technological trends, most of them based on higher bandwidth, which lead to a larger variety of possible applications and challenge existing business models.

5.1 Introduction

With the growing importance of the Internet as a communication platform and the emergence of Web 2.0, the Internet market becomes increasingly relevant for telecommunication companies. The evolvement of developer platforms reduces entry barriers for external applications and services. Third-party developers are integrated into the value chain in order to accelerate innovation, customer value and to create new revenue streams. A range of business models has emerged from this process so far, with Apple's App Store currently being the best known example for successful monetization of third-party content. But changes within the environment of developer platforms are challenging prevailing business models. This increases uncertainty for platform providers, but also offers opportunities for innovative new concepts. The dominant business model for developer platforms of the future still has to be determined. This report gives an overview of the current situation and a future outlook. In chapter 5.2 the main business models for developer platforms are described. Major external influences and their implications on the business models are discussed in chapter 2.3.

5.2 Status Quo

As developer platforms are multi-sided networks, the interests of various groups have to be coordinated in order to create a sustainable business model. To give a holistic view it is therefore necessary to describe the general structure of the relationship between the developer platform and the telecommunication industry first. Afterwards a more detailed view on service and revenue streams is given.

5.2.1 General Business Models for Developer Platforms in the Telecommunication Industry

Categorized by the dominating entity, there are currently three main business models for developer platforms in the telecommunication industry. The most important questions regarding the organizational structure are:

- Who provides the platform and infrastructure?
- What are the main revenue streams?
- Who is in control of the content and user data?
- What is the role of the network operator?

5.2.1.1 Network Operator-Centric Business Model

In this business model[1] the network operator provides the platform as well as the technical tools and support for developers to create mobile and web-based content and applications. Figure 5.1 shows the general structure of this business model:

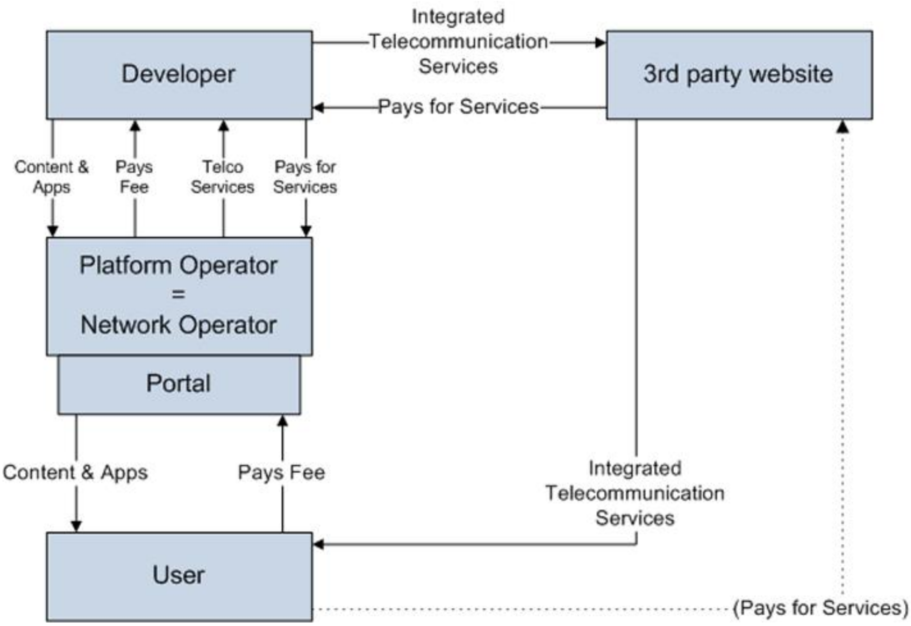

Figure 5.1: Network Operator-Centric Business Model
Source: adapted from Ballon [73]

The revenue is generated by selling applications to the end customers through a portal run by the network operator. The user is in a direct billing relationship and pays for the content via his telephone bill. The developers get paid directly by the network operator for the delivered content on a per-usage basis. To generate additional revenue, telecommunication services that can be integrated into third-party applications or websites, for example SMS or voice call, are offered to developers. These services have to be paid by the developers in advance. Most platforms of that kind do not offer an end-user billing service.

The network operator controls the offered content and services as well as the user data and profiles and is the dominating entity in this model.

[1] Adapted from Orange Partner [343], Developer Garden [145] and betavine [458].

5.2.1.2 Device-Centric Business Model

In device-centric business model[2] the developer platform is operated by the device manufacturer. He offers the infrastructure and support for developers to create device-specific mobile and web-based content and applications. These are distributed through a proprietary channel that is generally accessible via all network operators, but only for customers using a device from this specific manufacturer. The figure below shows this business model in a simplified way:

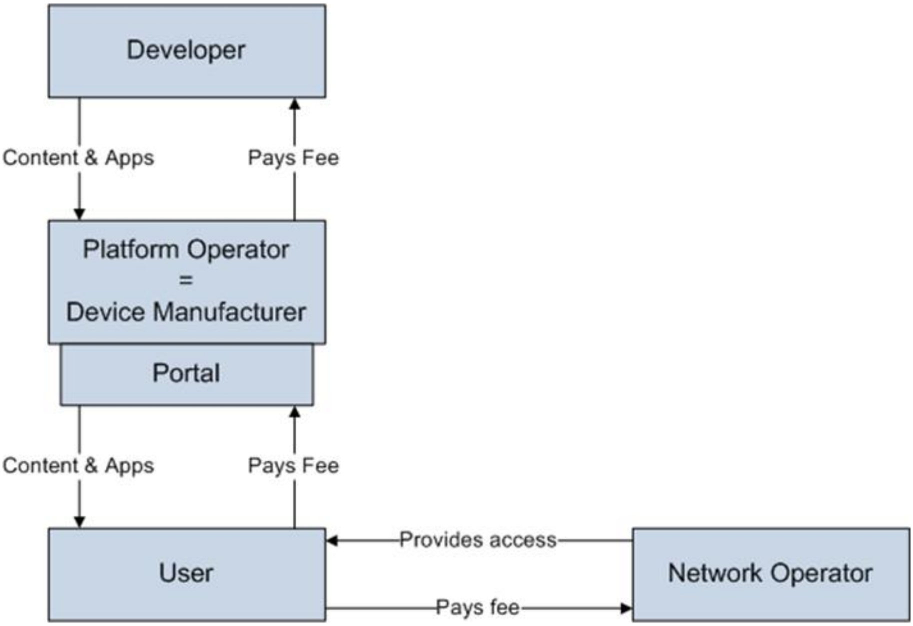

Figure 5.2: Device-Centric Business Model
Source: adapted from Ballon [73]

Selling applications to their customers generates most of the revenue for the platform operator, in this case the device manufacturer. The actual process of billing is outsourced to a third-party billing provider, developers get paid directly by the device manufacturer on a per-usage basis.

The device manufacturer takes most of the crucial roles, as he administrates most of the user data and profiles and can decide which content to publish. The network operator only provides access to the portal for the users via his network, but does not add any further value. Being able to offer the device exclusively is the only possibility for network operators to differentiate themselves in this model.

[2]Adapted from Apple Developers [62] and Nokia Developers [332].

Currently, the above described business model is predominant for developer platforms of telecommunication companies. Telcos provide the platform and combine that with services offered through their proprietary network.

5.2.1.3 Web Portal-Centric Business Model

In this case a web-portal operator runs the developer platform[3]. Third party developers use the provided infrastructure to create content and applications, which are directly embedded within the portal. Applications cannot be downloaded on personal devices but can be accessed online by the user. The general principle is illustrated in the following figure:

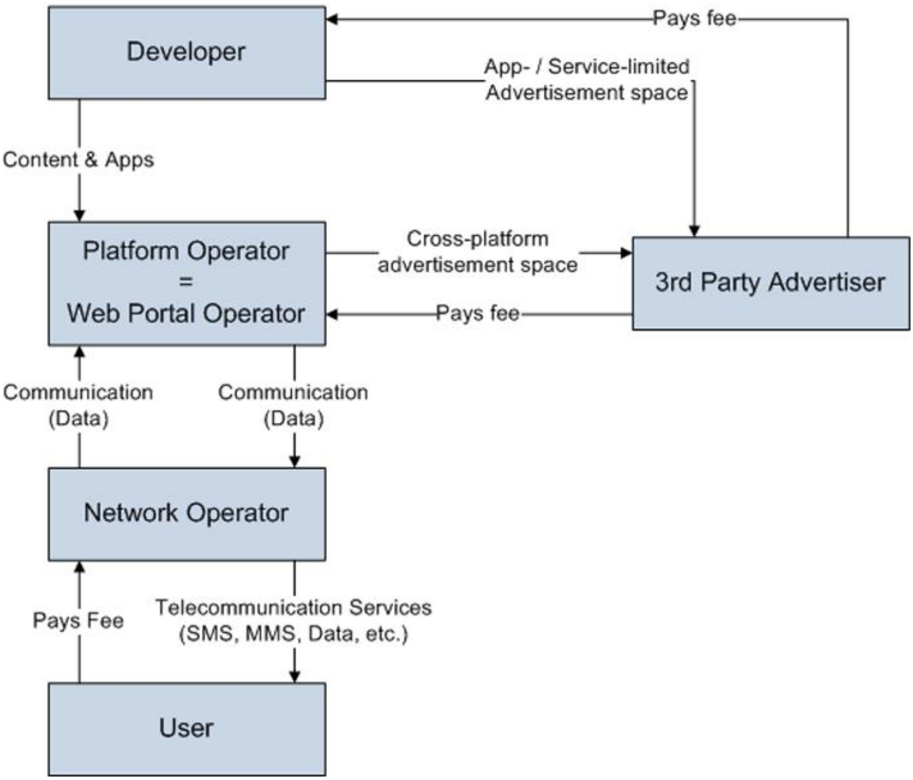

Figure 5.3: Web Portal-Centric Business Model
Source: adapted from Ballon [73]

The user has no billing relationship with the operator as most of the services and applications are free of charge. The portal generates revenue by offering

[3]Model adapted from Facebook for Developers [182] and Facebook Mobile [183]

cross-platform advertisement space, the developers have the possibility to sell application based advertising space.

The portal operator controls the user data and decides what content is allowed to be published. For the network operator the difference to the device-centric business model is that users not only communicate online with the portal but also via other channels like SMS or MMS. While this increases revenue, the network operator still only provides communication services. This means he does not add any further value and is hardly visible to the end-user.

5.2.2 Revenue Streams and Incentives for Developers

After introducing the three core business models of developer communities, this paragraph focuses on how the different parties are involved in the monetizing process and which incentives for developers and revenue streams are associated with these models.

5.2.2.1 Source of Revenue

There is a distinction between direct and indirect revenue. While direct revenue is generated through a direct buyer-seller relationship between end-user and vendor, indirect revenues are realized via a third party involved.

Direct Revenue
Direct revenue mainly includes licensing fees, service usage fees or subscription fees for the application. Additionally an application developer can charge his customers for the usage of network services, such as voice communication, SMS or similar services. As the developer himself has to pay the service provider, it is usual that he hands over the costs to the end-user at a certain premium. This, of course, only applies to Service Delivery Platforms (SDP) with network access such as Developer Garden[4] or Ribbit[5].

Indirect Revenue
Primarily common in web-based applications, advertising is the major source of indirect revenue. Developers have the possibility to include adverts into their applications, supported by companies which are specialized in mobile advertising. Another way to use advertising in mobile software is offering free applications to promote another product. One fifth of the applications in Apple's App Store are for free, and many of these are distributed by larger companies, which use them for marketing their products, both digital and physical [181]. A popular example of this strategy is the Virtual Zippo App[6] to advertise Zippo Lighters. Rarely platform providers or third parties buy applications from developers to market the software themselves.

[4] https://www.developergarden.com
[5] http://developer.ribbit.com
[6] http://itunes.apple.com/us/app/id291622252

5.2.2.2 Platforms Offer Incentive Schemes for Developers

Revenue Sharing Model

After having identified the source of revenue in these business models, the second question is how revenue is distributed among developers and platform providers. In this context it is important to differentiate between the service usage offered by network providers, which is mainly conducted on a pay-per-usage basis, and the application distribution, where usually revenue sharing plans are applied. These revenue sharing plans can include a sign-up fee for developers to get their application on the distribution platform as well as a revenue sharing agreement between platform provider and developer. The comparison of the two big rivals in this market, Apple's App Store and Google's Android Market, might be interesting, as both offer a sharing ratio of 70 percent for the developer and 30 percent for the platform provider. Thus it is not only direct monetary arguments which make a developer decide for or against a certain platform. Decisive factors are also market size, growth perspectives and restrictions providers impose on their platforms. A good example for this kind of incentives is the current discussion about Apple censoring content in applications sold via the App Store and reserving the right to review and reject any application [263], while Google follows a less restrictive policy on its Android Market platform [216].

Additional Service Offering

To increase revenues in SDPs, most providers offer additional service plans which mainly aim for professional developers. These plans include technical support and additional services such as advanced analysis tools and exclusive access to new features. The leader in the mobile applications market, Apple, gives a good example with its iPhone Developer Program [181]. Besides support for developers, this also includes an enterprise option which only allows the distribution of applications within a certain company [7]. Additionally developer platforms which are run by network operators can also offer their well-built billing infrastructure as additional service while software and device manufacturers in this market offer their distribution networks in order to attract developers.

5.3 Trends

This section depicts major trends with regards to their effects on the business models for SDPs within the telecommunication industry. The trends are discussed on three different levels:

1. General changes in the telecommunication industry,
2. trends within the third-party developer ecosystem and

[7] http://developer.apple.com/programs/iphone/enterprise

3. technological trends that impact the business models of the future.

The scope of the trend analysis reaches into the near future until 2015. Each trend will be described generally in a first step and in a second step the focus will be drawn to implications for emerging business models in the telecommunication industry.

5.3.1 Mergence of Web 2.0 Principles into Telecommunication Industry

Google, Apple and Facebook dominate today's web-business. Only a decade ago the telecommunication firms were thought to be the white hope of digital economy [226]. This section will explain how the Internet asserts pressure on Telcos and illustrates the major trends that drive change in the telecommunication industry in the subsections .

Nowadays Telcos are struggling to increase revenues as customers favor inexpensive flat rates or increasingly use Voice over IP (VoIP) services like Skype. At the same time Telcos have failed to use the Internet for their own benefit. Instead, Internet-based technologies and services challenge today's business models of German network providers like Deutsche Telekom AG and carriers all around the world. Average Revenue per User (ARPU) for voice services, which used to be the main revenue driver in the traditional telecommunications value chain, is expected to decline further in the upcoming years. This is due to increasing network capabilities and IP-based competition that turn voice transfer into a commodity. In mature markets like Germany there is less money to be earned with basic services like telephony, SMS and plain Internet access [226, 134]. To avoid being only the bit pipe while others participate in growing web-based revenues, Telcos have to find new ways to enter a rapidly expanding market for advanced products and services and make use of their existing assets in new profitable ways.

The CEOs of various telecommunication providers are aware of this situation as a study by IBM[8], conducted in 2007, shows. In this study CEOs of the worldwide leading telecommunication firms were asked what sources of value in global telecommunications they see. Business model transformation was perceived as one of the key drivers for future value (Figure 5.4).

[8] The Global CEO Study is conducted by the IBM Institute for Business Value and the Economist Intelligence Unit on a yearly basis and gives insight into the future development of the telecommunication industry. 47 international CEOs from fixed-line telecom providers, mobile telecom providers and integrated operators are asked within this industry research.

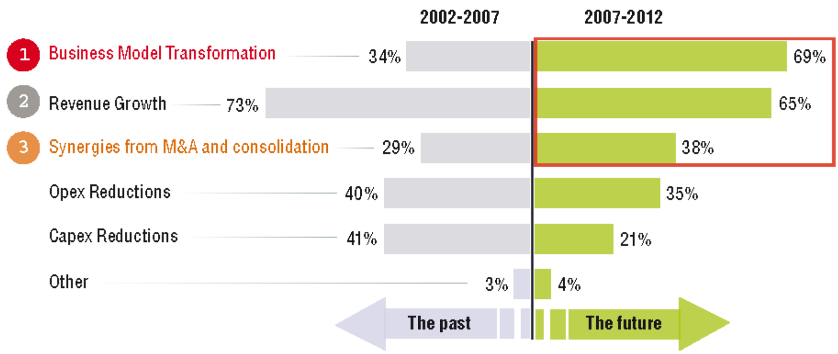

Figure 5.4: Business Model Transformation is Emerging as Key Driver for Future Value

Source: Slatnick [403]

The subsequent study in 2009 underlines this trend. 77 percent of the CEOs reported that they plan to change their business models extensively within the next three years [241].

5.3.1.1 Fragmentation of Business Models and Emergence of Value Networks

Mobile Internet connectivity, smartphones and the enhancement of the Internet Protocol (IP) technology are the driving forces for major market movements. Web 2.0 applications, growing wireless bandwidth and a new generation of devices have created a market with possibilities for complete new businesses. Players such as Google, Facebook and Apple enter new markets, disrupting the Telcos' traditional value chain and increasing competition. As a reaction the Telcos themselves move into new markets, build strategic alliances and open up for third parties as shown in the IBM Global CEO Study (see Figure 5.5).

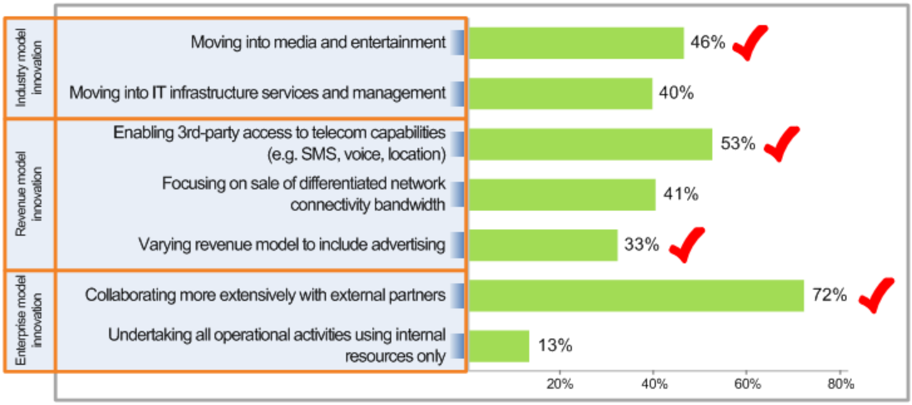

Figure 5.5: Anticipated Business Model Changes in Global Telecommuniations 2007-2012

Source: Slatnick [403]

In this study 47 CEOs of international telecommunication firms were asked, which initiatives they anticipate for their companies until 2012. The answers given, indicate that telecommunication firms will open up to third parties and become active in the field of media. This development will lead to a variety of new business models as Telcos try to generate further revenue in addition to the established sources such as broadband, fixed and mobile telephony and SMS. The Telco2.0 initiative depicts the following business opportunities for the telecommunication industry until 2017 [419] (see Figure 5.6).

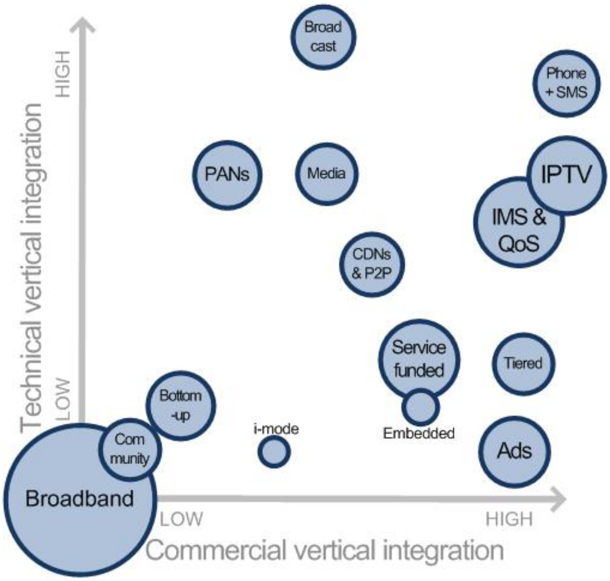

Figure 5.6: Telecommunication Services 2017
Source: adapted from Telco2.0 [419]

The graph shows different emerging trends grouped according to their technical and financial integration. Most promising future services are proposed to be IPTV, broadband, advertising, service funded and Personal Area Networks.

These business models will not be based on a one-sided value chain, fully controlled by the telecommunication firms, but achieved through collaboration and strategic partnerships. Evolving customer demands for content from an increasing variety of sources will require telecommunication providers to engage in a complex web of collaboration with media and entertainment, IT and consumer electronics industries. In the future there will be a new converged ecosystem where Telcos have to cooperate to create value. Success will depend on each player's ability to combine its unique strengths (network assets, customer management, service creation) with those of partners to create seamless communication services that meet the needs of targeted customer segments in value networks rather than in value chains [403]. Telcos are likely to engage in these value networks as innovation of products and services will be the source of future revenues. In the past Telcos have not been successful in creating value-adding services that could be monetized and tap advertisement revenues[134].
In summary Telcos will need to:

- develop business models that incorporate external knowledge and capabilities together with the companies' core capabilities,

- increase agility through service portability and faster time to market,
- reduce the risk of business disruption and
- support two-sided business models by enabling third-party applications

5.3.1.2 Leveraging Telcos Core Assets

In the value networks of the future, Telcos will take the role of facilitating interactions and transactions between people and organizations and thus build a two-sided market structure [419]. Leveraging the following unique assets of network operators will increase their attractiveness as partners for third parties in two-sided markets [134]:

1. Direct billing relationship:
   Advertisement based Internet players, content providers and manufacturers may easily charge customers via Telcos.
2. A large customer base:
   Telcos' customer base is in potential reach for services, application and advertisement providers.
3. Strong brand:
   Brand perception of Telcos is often linked to reliability and trust.
4. Detailed Information about customers:
   Telcos know relevant information about customer behavior, location and environment.

Third parties (developers, content providers, Internet players) will find these assets very valuable as Telcos are increasingly opening up. Thereby they give developers and other content providers the possibility to come up with new applications and services. Moreover many fixed and mobile network providers are trying to implement and enhance their own SDPs and distribution platforms. Third party enabling will help Telcos in reverse to gain additional revenues from:

- IPTV, Pay-TV (revenue value available to telecommunication providers by 2015 estimated at around EUR 2.6 billion in the Euro-zone) [134]
- Online mobile and fixed line advertising (possible for free content, revenue value estimated by 2015 EUR 451 million) [134]
- Value-added services (potential revenue USD 125 billion by 2017) [419]

It is likely that many Telcos establish two-sided markets that are characterized by win-win deals on subscription or pay-per-usage basis with application developers and other content providers. Developers will use Telcos' assets to harvest own revenues from end-users.

5.3.2 Maturation and Consolidation of SDP Markets

Current SDPs are facing the challenge of an emerging enterprise user market as well as the growing importance of incentivizing developers in order to reach a critical size. Besides those internal developments there is also evidence for a consolidation of this rather fragmented market. This paragraph analyzes those trends within the SDP market and reveals their implications on future business models.

5.3.2.1 Importance of Enterprise Users

There is an increasing importance of enterprise users, being the second customer group alongside private users. With applications demanding for higher reliability, data privacy and integrity as well as preferring the Service-Oriented Architecture (SOA) standard over Representational State Transfer (RESTful) approaches [316], the enterprise market differs significantly from the conventional private user market. This leads to the fact that there will be a need for a whole new kind of applications and developers creating these.

That enterprises are willing to take advantage of third-party business applications is shown by the example of Fresenius Kabi. The German provider for infusion therapy and clinical nutrition launched a new Customer Relationship Management (CRM) platform[9], which is flexible to be expanded through the integration of third-party applications [378]. Another example is the recently launched Google Apps Marketplace, a store for online business software, putting the company in direct competition to major business software providers such as Microsoft, Oracle or SAP. The applications, created by third-party developers, are integrated into Google services such as Gmail, Google Calender, Google Docs, etc. At launching date, Google announced to already have contractual agreements with more than 50 developer firms [217].

Future business models for SDPs need to account for the growing importance of enterprise users. As a result of this development, it will be crucial to offer distinct services, which serve the needs of enterprise applications in order to lower the entry barriers for corporate clients. IT-systems in large corporations are complex and a major cost driver [169]. Taking this into consideration, there will be the need for comprehensive application delivery platforms, which can be easily accessed and used by enterprises and their employees. There is a decisive need for innovative payment plans and service level agreements in order to avoid additional complexity to the corporate IT cost structure and to ensure transparency.

[9] www.salesforce.com

5.3.2.2 Evolvement of Different Types of Developers

Taking over marketing, sales and distribution of software products, developer platforms enable even private developers to focus solely on programming their applications without an extensive corporate infrastructure. With the market growing (see 5.3.2.1) it is becoming even more attractive for a larger number of developers to participate in it. As a multi-sided platform, a SDP must not only attract customers to buy its products, but also the best developers providing the platform with superior applications (Figure 5.7).

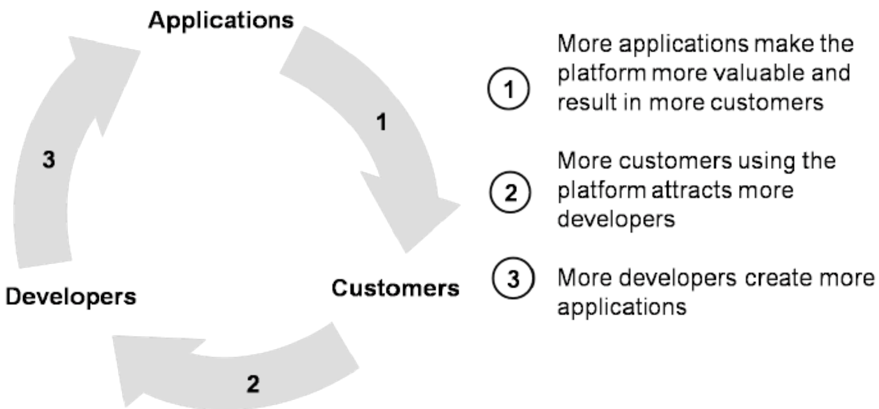

Figure 5.7: Feedback Loop Between Applications, Customers and Developers
Source: Pratt and Zangari [368]

However the dynamics within the developer community have to be taken into consideration. Currently the dynamics of an initially fragmented developer structure is best observable at web-centric platforms such as Facebook. As the developer community is getting more mature and certain applications are becoming very successful, developers partner up and organize themselves in various federations. Having one very successful application, these professionalized development firms make use of their visibility amid application users and promote new products through cross-promotion, creating a certain entry barrier for new developers entering the field[10] [452]. Eventually this dynamic leads to two different groups of developers. Professional developers, who develop large scale products and amateur developers[11], developing niche products (Figure 5.8).

[10] Zynga, a professional developer for Facebook applications, is a good example for that (www.zynga.com).

[11] There are also small professionalized amateur developers, serving the niche market. They are counted to the second group of developers.

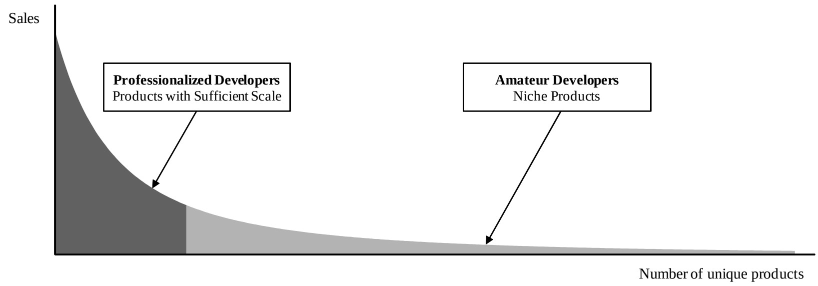

Figure 5.8: Two different types of developers
Source: adapted from Anderson [57]

This development in web portal-centric platforms suggests that a similar process is going to happen within network operator-centric platforms. SDP providers will need to offer incentives for both of the two parties. Thus future business models will face the challenge to be flexible enough to attract large professional developer firms while ensuring low entry barriers for amateur developers. Incentives for developers can be given by little restrictions, attractive pricing conditions and high quality documentation, creating an environment where developers can support and interact with each other. Additionally it will be decisive which services the SDP will offer its developers to include in their products (see also 5.3.3) [316].

5.3.2.3 Consolidation of SDPs to Reach Critical Size

As mentioned in the previous paragraph, the number of developers is an important aspect for a successful and profitable SDP. Recent activity shows that Communications Service Providers (CSP) are trying to achieve a critical mass of users by either building an own SDP (e.g. Developer Garden by Deutsche Telekom) or acquiring an existing SDP (e.g. BT's USD 105 million acquisition of Ribbit). Either way, both strategies require heavy upfront investments. At the Mobile World Congress 2010 at Barcelona an alliance consisting of 24 major CSPs and 3 device manufacturers announced their intention to launch a joint Wholesale Applications Community (WAC)[12]. The project is supported by the GSM Association and is intended to provide developers with access to over 3

[12] www.wholesaleappcommunity.com, Members as of 03/2010: América Móvil, AT&T, Bharti Airtel, China Mobile, China Unicom, Deutsche Telekom, KT, Mobilkom Austria Group, MTN Group, NTT DoCoMo, Orange, Orascom Telecom, Softbank Mobile, Telecom Italia, Telefónica, Telenor Group, Telia Sonera, SingTel, SK Telecom, Sprint, Verizon Wireless, VimpelCom, Vodafone, Wind, as well as Samsung, LG and Sony Ericsson device manufacturers.

billion customers. Developers will have the possibility to create applications for various devices, regardless of the respective CSP and operating system. Figure 5.9 shows a simplified structure of the WAC.

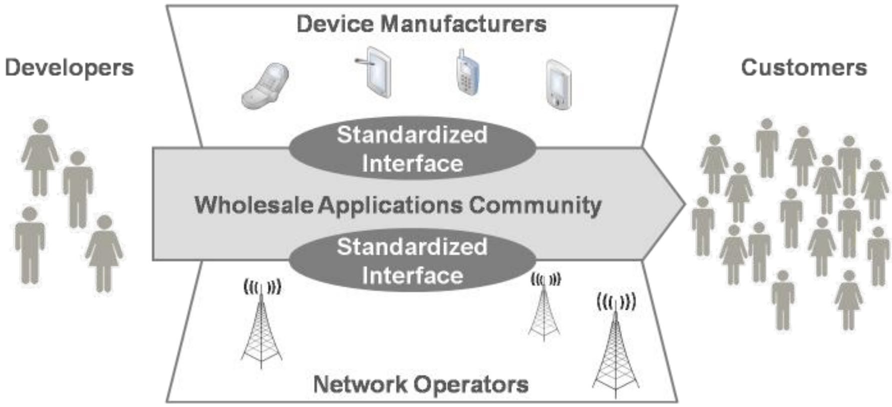

Figure 5.9: Wholesale Applications Community
Source: own illustration

Analysts regard the WAC as a logical step by CSPs in order to compete with Apple's App Store. However there are some doubts especially concerning the technical feasibility and the commitment of the companies involved [309].

There is a lot of activity in the market in order to achieve a critical number of developers. CSPs as well as device manufacturers have come to the conclusion that it is crucial to achieve a certain size in order to attract developers as well as customers to the platform. However size will not be achieved at any cost. Future platforms will need a solid business case in order to operate successfully and to provide additional revenue for CSPs [404]. This directly implies that CSPs will not only need to focus on external relationships to developers and customers but also on their internal cost structure, meaning that they need to weigh the investments needed to maintain the platform and additional revenue generated by it.

5.3.3 Technological Progress Offers New Opportunities

In the following section three main trends which have become important in recent years is discussed. First, the advance of mobile Internet as well as the ever increasing bandwidth is analyzed. Second, the shift in the mobile industry that puts more emphasis on software compared to hardware is elaborated on and finally, the last section addresses new possibilities of digitization and their implication on business models.

5.3.3.1 Rise of Mobile Internet and Higher Bandwidth

One significant trend is the heavy increase in usage of mobile Internet as well as the expansion of bandwidth. With network coverage growing and prices for end-users falling year by year, mobile Internet is on the rise. As a result people use mobile phones more often and the amount of data delivered through mobile networks increases. With the introduction of faster network standards, many new features like Media over IP will become available and accelerate this development even more.

In 2009, 70 percent of Germany's area was covered by the Universal Mobile Telecommunications System (UMTS) network, a third-generation standard (3G)[13]. With the network existing, customers using UMTS services are growing rapidly. The key factor to this increase in users is the constantly falling price for the service. In the beginning of 2010 mobile Internet flat rates in Germany are available for less than EUR 20 per month.[14] Compared to 2007, when one Megabyte of data transferred cost around EUR 0.40, this price has dropped by more than 75 percent to below EUR 0.10 in the first quarter of 2009. While in 2007 only 9.2 million people in Germany made use of UMTS services, more than 17 million people were using these services regularly by the end of 2009. Since there were only 20m customers who owned a mobile phone compatible with UMTS at the turn of the half-year 2009 and the number is growing steadily, there is a large market potential and this trend is most likely continuing for the next years [108].

Besides the growing number of customers the individual data received and sent by each user is increasing as well. Behaviors such as watching videos online or downloading music especially fostered the increase of data that needs to be transferred. This data rose from around 5 million Gigabyte in 2007 to around 40 million Gigabyte in 2009 for the German market (Figure 5.10). For the whole European market data volume is estimated to grow by around 30 percent in 2011 [108].

[13] http://www.hsdpa-umts-verfuegbarkeit.de
[14] www.handyflatrate-preisvergleich.de/mobiles-Internet/umts-flatrates-1457.html

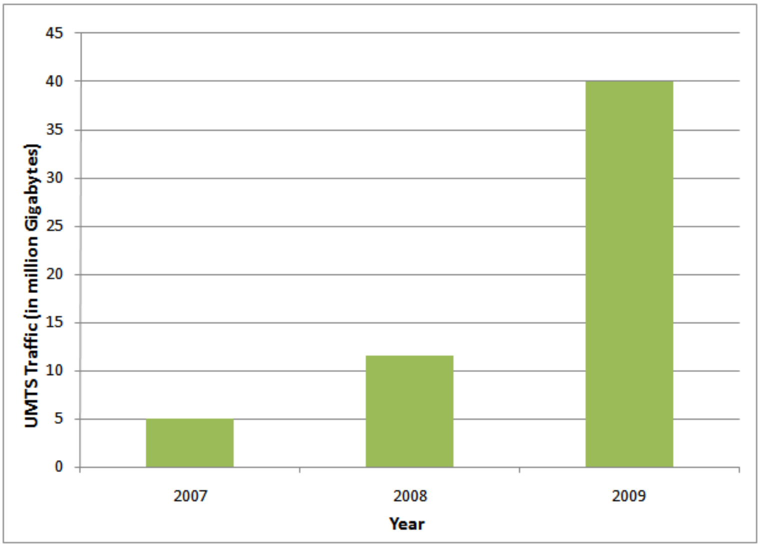

Figure 5.10: UMTS Data Traffic in Germany
Source: Bundesnetzagentur [108]

Industry experts claim that bandwidth will expand much further as soon as the so-called all-IP age will begin [463]. The all-IP world comprises services like VoIP or Television over IP (IPTV).

With the new upcoming technology norms such as Long Term Evolution (LTE), a fourth generation (4G) standard, data transfer rates will reach more than 340 Megabit per second and enable users to enter a new Media over IP world [95]. The switch to this so-called Next Generation Networking (NGN) - an all-IP environment - will make many new services available. Moreover with the 4G standard being used, an incremental gain in data transfer will not be as expensive for Telcos as it is with the current 3G standard [108].

Concerning the business model of SDPs, telecommunication companies have to prepare for larger data traffic on the one hand. On the other hand they need to provide APIs for third-party developers and develop new applications themselves that are linked to the upcoming technologies with a higher data transfer rate, like Voice over IP or Media over IP.

5.3.3.2 Importance of Software over Hardware

At the Mobile World Congress 2010, the exhibiting companies' dominant focus on software development was as strong as never before. Since the Mobile World Congress „is one of the mobile industry's flagship events" [309], its main focus on software shows the new path which mobile service companies are following.

Within the recent years, SDPs have become much simpler to handle, enabling users without profound IT knowledge to develop applications for the telecommunication industry. If this trend continues, even more people will start building telecommunication applications, pleasing the companies selling the applications and intensifying software's prevalence over hardware.

This fast-paced software development is evident, noticing that Apple's App Store delivers more than 5,400 applications per month. However the vast majority of network operators' platforms generate less than five applications per month. Moreover the average time Telcos need to release applications to their online store is around 9 to 12 months [454].

Given the shorter half-life of knowledge within software development, Telcos need to catch up in their efficiency of releasing software. Hence the network providers' business model needs to include efficient and adjustable processes, e.g. automated testing, to promote a quick and cost-effective application enablement [454].

5.3.3.3 Digitization of Classic Services Demands Flexibility

As new technologies are on the rise telecommunication companies need to be fast to make popular technologies available to use via APIs on their developer platforms.

The recent progress has shown that many classic services, such as paper-based mail, are substituted by their electronic equivalent. This is mainly due to the so-called electronic signature, in Germany regulated by the Signaturgesetz (SigG). The electronic signature enables to send legally binding documents in a digital format which opens many new possibilities for software developers as well as for customers [108]. In July 2009 the German Federal Post Office announced to introduce a new electronic certified mail, being the first to make use of the electronic signature on a large scale [15]. Moreover as of November 1st, 2010, every newly issued German identification card will contain a Radio Frequency Identification (RFID) chip to allow more services like easy and safe online shopping [324]. With 42 percent of all Germans having used online shopping in 2009, online identification will have a huge simplifying impact on it and furthermore enable many new Internet services [108, p. 350].

In a few years identification via SIM-cards in mobile phones might be available in Germany as it is already in Turkey. This is another major factor concerning SDP business models since many applications may be built around mobile identification. This technology can be used for example to vote via cell phone, to transfer money through mobile banking or to fill out financial reports [420].

Concerning the business model, network providers need to integrate an API giving developers the opportunity to request online identification from the users of their application. Additionally customers will expect applications making

[15] http://www.deutschepost.de

use the advantages of a new identification card or the electronic signature. Furthermore Telcos need to design flexible business models in order to be capable to react quickly to new developments.

5.4 Conclusion

Due to the convergence of telecommunication and Internet market, orientation of Telcos will fundamentally change and it will be crucial to properly define their position in the value network. Particular attention has to be paid to the question which services to enable for SDPs in order to ensure a sustainable and profitable business model. Currently there is a lot of activity observable concerning a consolidation of SDPs in order to achieve a critical mass. It will be very important that future platforms are based on a solid business case which respects both external as well as internal cost structures. While there is no advantage in trying to compete with free communication services which use IP technology, there will be services in the future, such as IPTV, which require heavy upfront investments and are worth to be owned by the telecommunication companies. On their respective SDPs, Telcos can provide third-party developers with added value by enabling access to their network and provide them with add-on services such as billing or subscriber data. In that context it will be important to find appropriate revenue models to charge customers for that service.

As described, there are multiple developments influencing the SDPs business model. However current trends do not indicate a fundamental change in how its participants interact. Future business models have to be flexible enough to adapt to changes in the industry structure as well as to newly evolving technological requirements. This, though, will be a process which takes place step by step as SDPs are gaining more importance.

Part II

Scenarios and Business Ideas

Chapter 6

ICT Devices

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In modern days, Telcos try to create a competitive advantage by offering service delivery platforms and thereby enabling third party development on top of their network services. This results in an abundance of applications running on ICT devices. Yet, there are several possibilities how future ICT devices might develop until the year 2025. The report at hand addresses exactly this topic and describes, how individuals will interact with the device and for what purposes. Uncertain factors that shape the future of ICT devices, such as acceptance of ICT, development of ICT hardware environment and collaboration of market players, are identified and analyzed. The possible developments of these uncertainties are reflected in three different scenarios. One possible vision of the future is the Seamless Communication Manifesto, which is characterized by high ICT acceptance, smart ICT hardware environment and a high degree of industry collaboration leading to standard interfaces. People live in a smart environment and rely on ICT. However, complexity prevails due to a multitude of professionalized devices and information overflow surrounding individuals anywhere and anytime. Embedded in this world, we developed a concept for an ICT device as a future proof business idea - the Shackle. The product is a small intelligent inter-device control unit acting as a nexus in a world that abounds in smart ICT hardware. It uses existing standard interfaces to connect to other devices and to coordinate multiple interconnections. A third function is smart and seamless identity management. The value for the customer is reflected in

simple user experience, reduction of complexity and high mobility.

6.1 Introduction

Throughout history, ICT devices brought about significant changes in the way people interact with their environment. Furthermore, it is through devices, that disruptive and innovative technologies are channeled to the end user. The term ICT device refers to tools that are used for communication, information and entertainment such as mobile phones, personal computers, netbooks or TVs. This report assesses the question how ICT devices will have developed in 2025 and for what purposes they will be used. In a holistic approach, the topic is assessed from different perspectives in order to include the whole ecosystem of the device. Therefore, technological, user and market aspects that have an impact on devices are considered. In a first step, ten drivers that notably shape future ICT devices are identified. Based on the development of the drivers, three scenarios are derived that describe different visions of how the world and the role of the ICT devices might have evolved by 2025. The goal of both the driver and scenario analysis is to provide a frame for the development of a future proof product idea - an ICT device. For further characterization of the device, technologies, user needs, the unique selling point and the business model are discussed.

6.2 Driver Analysis

Drivers can be ranked according to their uncertainty - depending on whether there are different predictions possible or whether one outcome is certain. They can be further differentiated by whether they have a high or a low impact. In the following section, ten drivers are analyzed which will influence the ecosystem of ICT devices. Figure 6.1 shows the ten identified drivers mapped according to their impact and uncertainty.

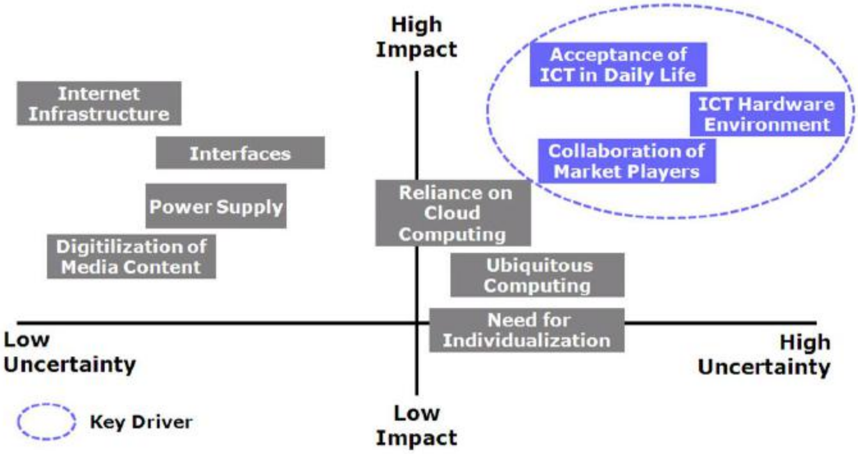

Figure 6.1: Matrix of the ten drivers
Source: own illustration

Within the drivers, technologies directly related to the tool such as the user interface, energy supply, processing and storing or security measures in the device are assessed. Technological facets indirectly linked to the device such as Cloud Computing, broadband Internet and Ubiquitous Computing might pave the way for entirely new device concepts and are therefore also considered. Moreover, the users' concerns, preferences and wishes are incorporated. Whereas technology and users' attitude towards the device are important aspects of the ecosystem of the ICT device, third party enabling, available applications and the industry structure also have an impact on the development of the device. The term industry structure refers to manufacturers of ICT tools and peripherals, content providers, network providers, companies that might integrate the device into their product such as auto companies or private home technology firms and also the interaction among them.

The most relevant drivers are the ones which are highly uncertain and have a high impact on the future of ICT devices. Therefore, they are named key drivers. In the upcoming analysis, drivers are sequenced by increasing importance beginning with the most certain drivers with the lowest impact.

6.2.1 Certain Drivers

Drivers are certain if their future development is predictable. Their implications on the development and introduction of new ICT devices are foreseeable and have to be considered equally in all three scenarios.

6.2.1.1 Digitization of Media Content

Nowadays, an unambiguous trend towards digitization of media content can be observed. The content offerings range from books to parlor games. Therefore, ICT devices need to be able to display various types of media like text, video and audio material in different formats. Furthermore, ICT devices are increasingly used for retrieving information and providing user driven content.

Digitization of media content comprises three different categories: newspapers & magazines, books and television.

Today, every big publishing company provides its articles also on the Internet. It is assumed that traditional forms of media will coexist with new Internet-based offerings [436]. Therefore, the initial value of newspapers and magazines will not be changed by the additional technology-based access paths. Traditional media serves as a gatekeeper in sorting, filtering and prioritizing information. In this function, this type of media plays an indispensable role - especially in a world of information overload.

Another aspect is the digitization of books. As opposed to the reluctance of consumers to pay for the provision of news on the Internet, the market for eBooks is perceived to be promising as new eReaders support a satisfactory reading experience. With new devices at hand, like the iPad or the Kindle, digital content becomes an attractive market opportunity for publishing houses [326]. The extrapolated development for eBooks is that people will increasingly read and buy books in a digitalized format.

The third category, television, shows a clear trend towards the digitization and distribution over the Internet. News, series and movies can already be watched on the Internet. With higher bandwidth available, television streams can be easily offered via the Internet. Homepages that offer on-demand video services such as YouTube have a huge amount of traffic and are increasingly visited by users for entertainment.

The digitization of media content brings along several benefits. The consumer is able to pick the exact content he or she wants from a variety of sources. With digitalized content provided over the Internet, consumers have permanent access to entire libraries and to virtual video shops through small devices. These benefits are pushing the digitization of media content as well as the technological innovations for ICT devices. With the further evolution of screen technologies, reading longer passages will also become a pleasant experience. Online video and television will increasingly grow in the coming years. The sharing and distribution of user generated content will be very important as well. This has a direct impact on the ICT devices, since there will be a high demand for interoperability between various device types, such as the TV, the mobile phone and the personal computer.

6.2.1.2 Power Supply

The driver power supply refers to both energy storage and charging. It is a major aspect of ICT devices since it determines mobility, size and weight measures. Thus, the improvement of battery and charging technologies will have an essential impact on the performance of ICT devices. Since efficient energy supply is, generally speaking, a topic of high concern, increased investments and future research will bring about improved technologies within this field.

Further improvement of storing and charging technologies will increase both energy and power density. Enhancing current lithium-based batteries will be possible through combinations with other materials that yield higher capacities, like sulfur or silicon [102]. To decrease the size of the cells, the battery can be manufactured by printing the material on a foil, which also makes it flexible [252]. Other possibilities to provide the necessary energy for devices include fuel cells that are powered by methanol or solid oxide fuel [14, 236].

Furthermore, there exist weak signals that hint at the emergence of digital quantum batteries. The concept relies on a huge number of nanoscale capacitors that store energy in the electric field between two electrodes. Once realized, the digital quantum battery features low manufacturing costs, quick charging without dissipation and the option to use the battery as data storage [417].

The mentioned storing technologies can only be used in combination with charging. This limits the mobility of the device, even if wireless charging is employed. However, current analysis suggests approaches that make recharging dispensable and thereby provide the user with maximum mobility and ease of use. The U.S. Defense Advanced Research Projects Agency is conducting research on nuclear power plants on chips. In this case, the device would not require any interface for charging, meaning neither a plug for a cable, nor an inductive receiver. This would further decrease the weight and size of the tool. However, it is not yet foreseeable at which cost the non rechargeable technology might come [227].

New power storage concepts that feature a much higher energy and power density will further reduce the weight, costs and size of the energy supply in future ICT devices. Charging could be achieved by using wireless approaches such as solar cells integrated into the device or magnetic induction [461]. Even nuclear power supply could be a feasible solution in the future.

Although, it is not clear which technology will be predominant in the future devices, the improvement of power supply technologies will certainly enhance the performance of ICT devices. The development of wireless charging technologies will make it possible to have the device charged more comfortably, without the necessity for device-specific cables. Further advancements towards stronger batteries with longer lifetimes are an enabler especially for mobile devices. Users will be able to run increasingly complex software and power consuming processes on ever smaller devices. This will eventually enlarge the scope of functions for a large set of devices.

6.2.1.3 User Interfaces

The way people interact with their devices is another driving force in the evolution of ICT devices. At the outset, one has to distinguish between two interfaces. On the one hand, the outside-in interface describes how users operate their devices, explaining how the user transmits information to the device. On the other hand, the inside-out interface defines how information from the device is conveyed to the user. Since it majorly impacts design, size and weight, the user interface has a strong influence on how ICT devices will have emerged by 2025.

In general, all human senses may be used to transfer information between the user and the device, ranging from vision, audition and touch to thermoception, gustation and olfaction. However the senses mentioned first – vision, audition and touch – are probably more suitable than the latter ones, since more sophisticated information may be transferred by eyesight and hearing than by taste, smell or perceived temperature.

By 2025, a multitude of different user interfaces will prevail that can be clustered in two distinguishable approaches. In the physical approach, customers will put emphasis on a haptic connection to their ICT device, meaning that they prefer touch screens to handle it. Therefore, touch will be the major human sense associated with the outside-in interface, giving users direct control over their device. The first advantage of this approach is intuitivity in operating, because customers use their fingers. The second benefit is the high degree of complexity that can be handled by physically interacting with the device, because manual control is more precise than other forms of control. It can be easily derived, that a screen or video projector is the preferred inside-out interface in this physical approach, using the user's vision as primary sense.

In the intangible approach, users will mainly use their visual and auditory sense. Concerning the outside-in interface, the device might receive instructions by a camera recognizing the user's hand movements. By pointing and waving with their hands, users may for example be able to open files or scroll through documents. Additionally, voice control might also play a more dominant role in this intangible way. This means that users can operate their device merely by uttering keywords to access functions such as voice calls, the Internet or to navigate throughout the entire menu. Thinking one step further, users may want to communicate via even more intuitive interfaces, as for example a brain-computer interface. Said technology relies on brain waves, i.e. turning the user's thoughts into real commands. The outside-in interface will have to adapt to the inside-out interface discussed before.

Device interfaces will influence the design, size and weight of ICT devices. In the future, multiple forms of interfaces both for outside-in and for inside-out will exist and can be clustered in the physical and the intangible approach. This, in the next step, will have an impact on where the device will be used. For privacy reasons, people might not want to use a voice-controlled device during public transportation. Furthermore, a huge and heavy screen is likely to be used stationary while a small built-in video projector might allow carrying the device along.

Moreover, usability, besides other factors like costs and functionality, is a driver for customers' buying decisions. Device interfaces therefore play a decisive role for the development of future ICT devices. Even though it is difficult to predict users' preferences for interfaces, it is certain that customers will use distinct suitable interfaces for communicating with different devices. Thus device interfaces will have an impact on how future ICT devices will look like.

6.2.1.4 Internet Infrastructure

In terms of future Internet infrastructure available at a large-scale for all users, one refers to several key areas. These include topics as Internet access, increased bandwidth, secure network connectivity and the amount of processing power on the device. The advancement of the mentioned key areas will certainly equip future ICT devices with an entirely new dimension, involving both many new ideas for applications and also increased productivity in the ever-connected mobile world we live in.

Devices with increased computing power and extended network connectivity will pave the way for an increasingly connected world, with the Internet being largely consumed across ICT devices ranging from laptops to PDAs and gaming devices. In fact, a recent study [124] predicts that the traffic of mobile data in the US will reach 327 PB per month in 2015, thus making up for an annual growth rate of 117 percent. Therefore, one of the biggest future changes for the Internet will be an increase in bandwidth due to the rising demand. In July 2009, the Global Mobile Suppliers Association (GSA) announced 7.2 Mbit/s has become the new baseline for mobile broadband globally. Further, according to GSA, the next baseline for mobile broadband peak downlink data speed will be at 21 Mbit/s through HSPA+[1] [429].

Along with future broadband experiences demanding a "capacity similar to that of a fixed network [...] per mobile subscriber" [322], ubiquitous Internet access is equally significant. Wireless network coverage areas with 4G technology are likely to be geographically broader than ever before in the wireless industry. In the near future, 4G promises download speeds of 10-12 Mbit/s, unheard of outside the fiber optic universe, making 4G look like a feasible option for true on-the-go and unfettered Internet.

The advancement of the Internet infrastructure will stimulate the industries around ICT devices in multiple ways. Increased fixed and mobile bandwidth will enable new services and applications. Furthermore, the next-generation Internet infrastructure will enable both private and business consumers to utilize "new

[1] Evolved High-Speed Packet Access is a wireless broadband standard

forms of information wherever and whenever they want” [313]. Consequently, this will open up the marketplace for mobile apps to unimaginable possibilities.

Evolving wireless and mobile broadband technologies will enable the next major wave - the Mobile Internet. The increasing number of people being continuously logged on to the Internet while they are on the move will undoubtedly require a great deal of operations being simultaneously performed, all with just one ICT device and an appropriate mobile service.

6.2.2 Uncertain Drivers

Uncertainty and risk are the key characteristics of the drivers in this section. The implications of these factors can be defined through different possible outlooks, which are decisive for outlining their possible future developments within the different scenarios. Similar to the previous section, the drivers are sequenced by growing importance. ICT hardware environment, collaboration of market players and acceptance of ICT in daily life are the key drivers that were identified for building the scenarios.

6.2.2.1 Need for Personalization

When describing the users’ need for personalization, it is reasonable to break the driver down to hardware and software customization. Within both fields it is still uncertain how the demand for personalization will evolve, meaning whether and how users prefer customized services and devices. These preferences have a great impact on the variety of devices offered on the market and on how companies have to offer individual solutions.

There are different reasons why users want to have personalized products. First, they simply want to be seen and considered as individuals. Secondly, they want to distinguish themselves and show their belonging to a certain group of people. This ranges from national, cultural and religious groups to groups of people who share the same sport or hobby. At last, user needs generally differ among different individuals. Considering this, it is uncertain in what way users’ needs for personalized products will evolve. There are three possible ways how users might want to customize their devices.

If something is regarded as chic and stylish, more people tend to buy the same product, making it even more popular. One example for this is the prevailing smartphone market share of RIM’s BlackBerry and Apple’s iPhone. However, since the number of different products on the market is limited, people might want to personalize via software. Therefore, Service Delivery Platforms (SDP), that enable third-party developers to create applications serving the long-tail, might be of great importance.

A second possibility is that people might have a need for personalized products even at hardware level, leading to lots of device manufacturers on the market. Users want to distinguish themselves by the device they are using. They might also demand custom-made devices in different sizes and colors. As soon as people have the chance to select between many devices, they would pick the one which has the most suitable software for them. Thus individualization would take place via hardware distinction instead of software customization.

The third possibility integrates both software and hardware personalization. In this case, users would request an individual device, differing from other hardware devices, as well as customized software that fits their needs. In this prediction, users thoroughly want to be regarded as individuals, starting with the color of their device and ending with applications designed especially for persons with their specific cultural background and certain hobbies.

If users want to personalize in terms of hardware, many device manufacturers would have a chance to sell ICT devices if they focus on one distinct customer group. Therefore, various individual requests for hardware features, like built-in cameras or MP3 players as well as for software applications arise. If hardware customization will not be of great interest to users, a few big players might dominate and cover almost the entire market with their very popular devices. As far as software personalization is concerned, SDPs will become very important since they provide individual software solutions for different customers. In addition, companies will need to examine their customer group and offer specific software to please their users. However, if individualization will not be a necessity for future users, ICT devices would offer standardized software that is compatible with other devices, granting lesser importance to SDPs in the future.

6.2.2.2 Ubiquitous Computing

Ubiquitous Computing describes the various ways in which smart devices and environments "relate to and support a computing vision for a greater range of computer devices, used in a greater range of environments and activities" [363]. Although the term Ubiquitous Computing is anything but new and has been present for already two decades, it concerns a future that is to a large extent yet to be defined and remains unassured. However, one cannot deny the close relationship between the future development of ICT devices and the direction in which ubiquitous computing is heading towards.

From the technological point of view, Ubiquitous Computing greatly relies on the existence of a well-structured and robust network of smart sensors that "coordinate their sensing, communication, and computation in order to acquire relevant information about their environment and to collaborate on high-level tasks" [101].

Nevertheless, there are still many issues to be resolved before Ubiquitous Computing reaches the point of a widely-adopted computing model. Some of the problems that need to be addressed in this area include building a low-cost sensor infrastructure. This incorporates a large number of sensors distributed over large geographical regions for location-dependent applications. By establishing this infrastructure, data security and privacy can be ensured when moving between various devices and locations. For the smart environments to become a reality, further progress is required in the design and manufacturing of smart cameras with system-on-chip embedded processors and in the development of software models that allow users to specify how the sensor data should be processed.

At this point, one could picture at least two future possibilities: either the Ubiquitous Computing approach would take place, or not. The first idea depicts a future in which computing might be ever-present in our daily life, seamlessly intertwined into our everyday routine. The second idea describes another possible setting, in which Ubiquitous Computing has little, if any penetration, at all.

The reasons behind the explained developments may greatly vary, from social issues, personal issues, to privacy issues and environmental issues. On the one hand, people may fear that the smart environments are not transparent enough in the way they operate and collect their private data, therefore fearing loss of control over their personal data and digital content. On the other hand, the question of downtime will arise. Users might wonder what would happen in the case of a malfunction in the system - what possibilities would exist to backup the system and to which extent could users rely on them. Furthermore, users might also distrust the unified, location-based functionalities - context-aware services in smart places - anywhere and anytime, as promised by the Ubiquitous Computing model. Further issues such as the security policy of the host, the security policy of the system, location-restricted access or methodology for connection, might be constantly brought up in connection with Ubiquitous Computing and might prevent it from becoming widely-accepted and widely-adopted.

The future ICT experience can undoubtedly be significantly improved by leveraging the Ubiquitous Computing capabilities. The user would therewith be able to have access to a broad range of personal media such as multimedia content, applications or documents in a wireless manner, anywhere and at any time.

By taking advantage of the advances in processing, storage and communications technologies, one could envision a mobile device of the future, which may be smaller and lighter, as it has to integrate a much smaller number of sensors and peripherals. Instead, it may rely on connectivity standards and interfaces to allow the user to access the content through whatever displays are available in the smart environment. Devices may therefore become seamlessly integrated in our clothing, turn into accessories, or be hidden in our ears.

Ubiquitous Computing technologies carry great potential in facilitating life in today's hurried society. An ever-present and reliable smart infrastructure may have great impact on the mobile devices, by engaging people “as part of self-monitoring and behavioral change programs” [385]. By making mobile devices and smart sensors easily and effortlessly interoperable, people will be able to "take control and change their habits or lifestyles to be healthier by taking account of and acting upon dynamically updated information provided by them" [385].

6.2.2.3 Reliance on Cloud Computing

Cloud Computing might bring about disruptive changes to the way we do mobile computing. If this new approach were to become the preferred means for computing, it would undoubtedly have a tremendous impact on ICT devices. More specifically, it would involve dramatic changes such as much thinner devices, increased mobility, and a persistent connection to one's personal data and applications, wherever the user goes and irrespective of the device being used. However, it is not certain if Cloud Computing will be utilized by the majority of private and business users due to security and transparency concerns.

In general, using Cloud Computing is a very efficient approach to processing and storing data. On the one hand, the user is only charged for the amount of data that is actually stored and processed in the Cloud, whereas in most cases the storage in the device itself is not used to full capacity. On the other hand, the device can revert to virtually unlimited storing and processing capabilities by using the Cloud. This enables the user to exert much more sophisticated applications and store huge amounts of data [113]. The above-mentioned advantages are not restricted to private users. Also businesses profit from using Cloud Computing. They circumvent costs for both hardware and software infrastructure in their company and avoid expenses for maintenance or updates. Thus, Cloud Computing is especially appealing to small businesses that need to keep their cost structure lean and efficient. As a consequence, large firms will face fierce competition from the mentioned small fast-followers that are able to provide a new generation of services and products [252].

Nevertheless, in order for Cloud Computing to become a widely-embraced computing paradigm, the providers at all layers will have to become much more transparent in their operations. Furthermore, legal insurance must be established for handling particularly sensitive data, such as health-related data and financial data. Moreover, Clouds will have to support interoperability between standards and free movement and deployment between the Clouds.

When it comes to the future of the Cloud, at least two evolutions are possible. One possible direction incorporates full user reliance on Cloud Computing. Current services as, for example, GoogleMaps, Facebook or GMail are already a first step into this direction [400].

The second possible evolution of the Cloud assumes that the users would reject mobile Cloud Computing. Customers might not want their data to be stored or processed in the Cloud. Moreover, the user wouldn't depend upon broadband coverage and remain unaffected by possible failures of the Cloud host.

The reliance on Cloud Computing shapes future ICT devices in two ways. First, it determines the extent of data storage that would have to be provided by the device itself. Secondly, it has a huge impact on the degree of processing power the device needs to be capable of.

As a consequence, future tools might outsource all processing and data storage to Clouds and focus on user interfaces, given that an adequate wireless broadband coverage is available. This development would further enable rich applications that require higher processing power and more storage space on devices such as smartphones, televisions, netbooks or even stationary computers. Therefore, the advancement of the Cloud is not only shaping the mobile devices, but also the stationary ones, both in private and business environments.

However, data security remains an issue to be solved, especially with regard to sensitive data, such as, for example, bank account data, addresses, research data, or passwords. The rejection of Cloud Computing might result in devices that would have to provide the required data storage and processing capabilities themselves. This would also limit the extent to which the device could be scaled down and may result in higher costs for the customer. Therefore, it is vital for Cloud Computing to achieve acceptance and trust among users, before it can be adopted at a large scale.

6.2.2.4 Collaboration of Market Players

The development of industries related to ICT devices remains uncertain as the communication and media markets are evolving very dynamically and depend on many variables. However, the impact of the market structure on future ICT devices and the services around them is extremely high. Which standards will evolve? Which technologies will be predominant? The markets and the technologies have already reached a level of immense complexity. Collaboration between manufacturers, network and service providers seems indispensable in order to produce a perfectly performing device. Therefore, future innovation of ICT devices increasingly depends on the cooperation of many parties.

In a complex and cross-linked world, the number of competitors is rising. Likewise, the number of participants in the process of value creation is increasing, as well. The value chain for digital services is built of four consecutive blocks: content provision, content processing, content distribution and content presentation [84]. The parties involved are music, film, publishing and software companies, Internet firms, mobile and fixed network providers, as well as manufacturers of for example personal computers, MP3-players or mobile phones.

Technological progress - with the Internet at the forefront - and globalization have led to the convergence of industries that were once set apart within the ICT device and services ecosystem. Companies that have previously concentrated on their core competencies are increasingly looking for involvement in other sectors, as traditional product markets leave no scope for growth [468]. Many actors try to become active in new sectors through acquisitions and diversification. Thus, the boarders between technologies and industries involved in the process of value creation for digital services are increasingly blurring.

This raises the question of how convergence will affect the market structure. Devices like the mobile phone or the personal computer need to be able to handle all kinds of services and have the ability to seamlessly interact with many other devices. However, the participating market players are still acting very independently and in an uncoordinated way. Nowadays, it is the user that is integrating different offerings either physically, by connecting devices with each other, or logically, by collecting services from different sources. The market accomplishes the integration of components only to a very low degree. Collaboration as a business strategy and business model innovation is still not very widespread. Customers, however, are demanding integrated solutions and a low level of complexity. They want information and services from a variety of sources anywhere, anytime and on any device.

How will the market players react to the changes mentioned above and what are the implications for ICT devices? One possible development is that the different players from the ICT and media industries might collaborate in an international value network. This would help to standardize technologies and interfaces in order to reduce complexity and ease interconnectivity between devices and services, even from different brands. Evolving customer demands for services from an increasing variety of sources would require single companies to engage in a complex web of collaboration with the telecommunication, media and entertainment, IT and consumer electronics industries. The challenge for vendors, Telcos and media companies then is to establish network relationships in order to transform the growing complexity into a simple user experience.

A second possibility is the emergence of partner networks. In a converging and highly competitive market, companies could become engaged contractually with other players in order to separate from competitors. This would lead to the emergence of other partner networks, which would try to separate from each other and keep technical and functional integration with competing partner networks on a low level. Partner networks are a possible way of collaboration among different players from different industries - companies from different branches would exclusively work together. Within these „walled gardens“, customers could benefit from full interconnectivity between devices and from the integration of functions.

Furthermore, it is possible that we will see greater fragmentation within the ICT and media ecosystem, as the competitive attitude of market players might prevail. In an ever-changing environment, companies will try to keep their market position. Single parties like device vendors, service providers and content providers could be afraid of becoming dependent on each other since they would not want to lose visibility in a value or partner network to the consumers. Instead of collaborating to set standards and build an integrated infrastructure, the players would try to enforce their own technologies and platforms. Acquisitions and vertical integration would be means for companies to grow in scope and be able to offer products along the whole value chain. This development would likely increase complexity regarding the coordination and compatibility of services and devices.

6.2.2.5 ICT Hardware Environment

The term hardware environment describes the availability and accessibility of computing equipment, in private, in business and in public. This includes stationary ICT workstations people may use, such as publicly or privately available computers, screens to display the individual user's content or communication stations. Hence this hardware infrastructure will have an impact on the range of functions provided and will influence the customers' behavior. We assume, that businesses will extensively employ innovative ICT hardware in their facilities. However, the degree of ICT hardware penetration in public as well as in private surroundings is uncertain as it relies on many interconnected factors.

There are two fields that have to be considered separately, private and public ICT infrastructure. Future private infrastructure comprises all devices at home that are used as means for information and communication. This includes for examples phones, entertainment systems and computer screens. Thus in 2025, there may be two distinct effects. Either a smart environment prevails, where users will be surrounded by computing and communication devices. Or alternatively, ICT hardware will not be able to enter private homes to a large extent and users would not be encompassed by ICT hardware throughout their house.

Concerning public infrastructure, there are different developments as well. A possibility could be huge private investments in public infrastructure, carried out by telecommunication companies for instance. They might create workstations in cities, enabling their customers to use them and work mobile at any of these stations. Another option could involve public investments, conducted by the government to strengthen the presence and benefits of ICT for its citizens. This would allow for a much wider expansion of information and communication technologies, making it possible to have screens and computers at public buildings, airports, bus stops or even during transit in underground trains. However, there might also be a completely different development with nobody willing to invest in public hardware infrastructure, just leaving customers with their own devices they carry around.

In the future, one can imagine various evolvements within the field of hardware environment. One option is the rise of a smart home environment. People would be encompassed by computing devices and screens inside their homes, but wouldn't have access to public hardware equipment because no investments will have been conducted. Therefore, ICT devices would be used and interlinked at home, but would not need to be connected to outside public devices. Instead they would rather be stand-alone mobile companions.

Another feasible future is a complete sphere of ICT hardware, which might be in place at home as well as in public, where ICT hardware would be accessible everywhere. Thus, personal devices need to be capable of connecting to any hardware available, making use of the large ICT hardware infrastructure.

Nevertheless, a third plausibility would be a world with neither any large private infrastructure nor public usable hardware. Hence the users' devices would need screens and functions integrated because there would not be any hardware infrastructure the customers' equipment could link to.

6.2.2.6 Acceptance of ICT in Daily Life

The continuously increasing proliferation of ICT is a major trend in many parts of daily life. Hence, the acceptance of ICT is of decisive importance as it mainly determines to what extend and where ICT devices are used. Characteristically, the usage of ICT is no longer limited to professional areas. As opposed to the past, when mostly technology-prone professionals were typical end-users of technical products and devices, nowadays broader user groups have access to information technology. Effective usage of ICT has become an essential requirement in today's working and private life. However, it is highly uncertain whether the acceptance of ICT in people's everyday routine will continue to grow through 2025 or change the bearing.

Not all users perceive ICT as advantageous and helpful. Therefore, users weigh the individually-expected benefits and costs before accepting and adopting new technologies. Within this paragraph the costs and concerns are opposed to the benefits accruing to the user.

Complexity of new technologies is a vital aspect regarding the concerns. Youths and young adults will not have any problems dealing with complex technologies, since they grew up in a digitalized world. However, the profound demographic change leads to an aging population in Germany. According to the Federal Statistical Office, 26 percent of the German population will be older than 65 years in 2025 [412]. Usually elderly people have greater difficulties in handling ICT devices or acquisition of new technology skills since they are not digital natives. Therefore the acceptance of ICT by elder people largely depends on their willingness to adapt to complex technology and the ease of use. Besides complexity users might also be concerned about the impacts of ICT on human health. The usage of ICT generates electromagnetic fields. Several studies dealing with the health effects of these electromagnetic fields have been published and sparked public interest. Although no harmful effects could be verified at present, the impact from long term exposure is still uncertain and might be critical in the future for users' acceptance of ICT services [104]. Furthermore, users' privacy needs have to be considered since through high usage of ICT a lot of sensitive information is submitted. In mobile communication for instance, conversations can easily be wiretapped. Consequently, profiles might be built out of phone calls and provided to third parties. The same applies to Internet search engines like Google. They already collect user data to target advertisements more precisely. As a conclusion, users might be afraid of using ICT services in the future if they are concerned about privacy.

Having discussed the costs and concerns, the benefits of ICT for users have to be highlighted. Making use of ICT, information can be gathered and provided everywhere and every time in an instant. Thus, mobilization is one of the main benefits for the user since it saves time and provides flexibility. At present, mobile communication is already part of our daily life. Further trend is leading towards mobilization of Internet enforced by sophisticated smartphones. In addition to this, more entertainment and information services, such as TV, might be mobilized. However, mobilized services can hardly fulfill user needs on a high level of quality. Although one could watch the Saturday's soccer match live on his 3.5 inch iPhone screen, it would not be competitive to a 40 inch Full-HD TV. Consequently, the acceptance of ICT highly depends on the individual needs of the user - whether mobility is considered to be highly beneficial and more important than the quality of standalone services. Developments in ICT infrastructure and rapidly emerging new technologies will lead to an increased number of new services and functions. Users might highly benefit from these services as they potentially facilitate daily life. Various tasks, such as shopping or the visit of public authorities could be done in a cost and time saving fashion.

Weighing the benefits and costs of ICT, users may accept ICT in daily life. Mobility and facilitation of life may outweigh the concerns about health, privacy and complexity. Users' acceptance of ICT in work and private life would grow. As a result the usage of ICT devices might continue to increase through 2025 and the devices have to fit to emerging mobility needs. Moreover this might result in heightened investments in further technologies and infrastructure funded by governments and companies.

However, it is also possible that acceptance of ICT is hindered due to strong concerns. Users might not see the worth of a mobilized and facilitated life but rather the problems and costs. This results in partially or low usage of ICT devices. Consequently, devices have to meet the high quality needs of users. Since there is no user need for advanced technologies, investments and research efforts concerning ICT would be at a low level.

6.3 Scenarios

The following paragraph outlines three scenarios that depend upon the key drivers. In total three key drivers were identified - the acceptance of ICT, the ICT hardware environment and the collaboration of market players. The mentioned driving forces can be characterized by a high impact and great uncertainty and have been derived from the ten drivers which were explained in the previous chapter. The development of each key driver varies among the scenarios and thus a unique set of landmarks, which defines the borders of the scenario, is determined. Therefore, each scenario features a different picture of how the world around ICT devices might have evolved by the year 2025.

6.3.1 Scenario 1: Convergence Dictate

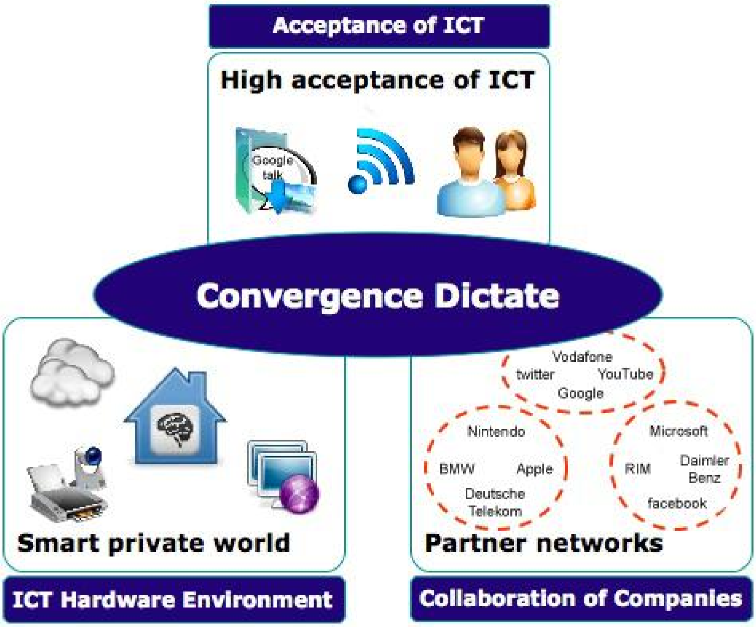

Figure 6.2: Development of the key drivers in the scenario Convergence Dictate
Source: own illustration

The first scenario Convergence Dictate depicts a vision for 2025 where ICT devices feature many integrated functions. The key drivers have developed as follows (see figure 6.2): The market players related to ICT and media have built strategic alliances among themselves and with players from various industries. This development enables different company conglomerates to provide end-to-end, efficient and easy to use services to customers via devices. People live in a world in which ICT is highly accepted and plays an indispensable role in daily routines. Intelligent systems and ICT devices surround people in their homes to a high degree and have become essential tools in their working environment, as well. This scenario focuses on the convergence of various device types and on the interoperability of services and functions.

For the consumer, convergence means combined multiple features in a single device. For media providers and conglomerates it implies remaining competitive in the struggle for market dominance. Customers are demanding new functionalities, to which manufacturers are responding by developing a range of converged devices. In 2025, Ubiquitous Computing and Cloud Computing are widely used in the business environment, as well as for private purposes. In this scenario, people use ICT devices and the Internet to organize and control their lives. For the majority of the population in Germany, mobile devices are an essential companion. Internet access with high bandwidth is available everywhere as major investments in the ICT infrastructure have taken place. The technology progress around ICT devices has given rise to many innovations concerning the functions and the usability of devices. Wireless charging and new battery technologies are in place, enabling the continuous and extensive use of mobile devices. A new generation of multi-purpose mobile devices has emerged. In this converged world, a single ICT device allows consumers to make, for instance, voice calls, watch movies, work on documents and store huge amounts of data. It also enables them to access their home or office remotely, manage their bank accounts, access e-mails and manage time, thus bringing together personal and business life. Foldable screens have been developed and allow consumers to display large format media on these single devices. As all information can be easily stored in the Cloud, people can access their data anytime and at any place. As the desire for ICT has been strong over the past two decades, the digitization of life has reached a high level. For instance, government services are offered online, many people live in smart homes and even a high percentage of the elderly are online.

Service providers and consumer electronics companies create value by means of personalized offerings that meet the needs of every user individually. Companies from various industries, such as automobile, Internet, media, consumer electronics and telecommunications have built partner networks. Within these exclusive company conglomerates, standardized services and full interoperability of functions are given. People who buy products of a special brand or associated companies benefit from wireless interconnectivity of devices and fully integrated services. Different partner networks offer the same services and integrated functions, but within each partner network different technologies are used and unique standards exist. The converged mobile device can, for example, be seamlessly used as an entertainment system in cars of partner brands - the cars themselves only provide the speaker system. Projectors are integrated in the converged mobile device, making large scale desktop projections possible. Virtual keyboards can be projected likewise, which enables the user to work like at his personal computer. For the consumer, this signifies a reduction of devices that he needs to be able to use and less complexity in terms of connecting devices with each other. However, the performance of the converged device functions cannot compete with professionalized single devices.

Convergence is a major trend that can already be observed today. For example, game consoles function as web browsers and social networking tools. Mobile phones are another good example, for they increasingly incorporate digital cameras, mp3 players, camcorders, voice recorders, and other devices. The vision of one device being able to come up to all needs and do everything perfectly is utopian. Nevertheless, technology convergence can lead to one device having many functions integrated and is one possibility for the future. In the depiction of the first scenario, the converged device not only integrates many functions, but complements other systems. This will strongly depend on the collaboration of partner firms. Companies that built consortia around their technologies and services with partner companies can be considered as a weak signal for the development into the direction of Convergence Dictate. The formation of the Wholesale Applications Community (WAC)[2] by many telecommunications operators and device manufacturers is already an indicator for the emergence of large partner networks.

[2]http://www.wholesaleappcommunity.com/

6.3.2 Scenario 2: Decelerated Diversity

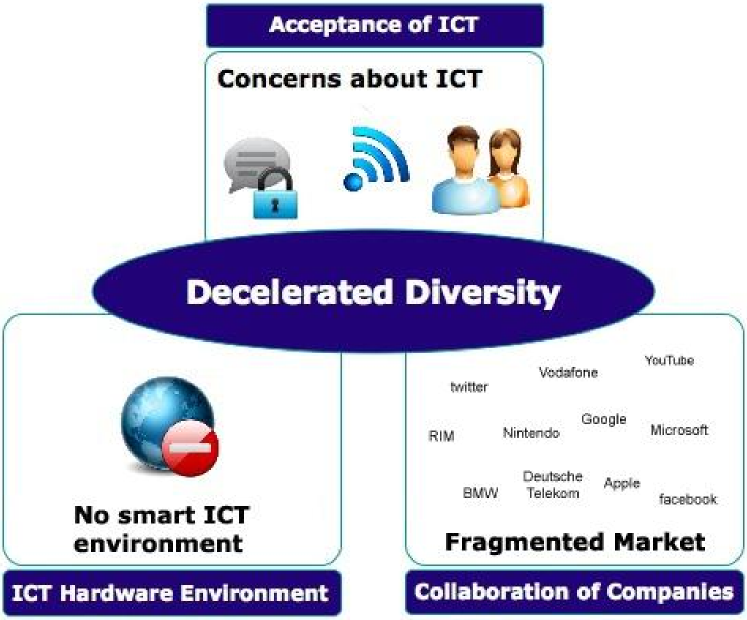

Figure 6.3: Development of the key drivers in the scenario Decelerated Diversity
Source: own illustration

Within the second scenario the world is largely characterized by non-virtual experiences since an overall ICT environment could not be established. The emergence of new technologies increased complexity and evoked user concerns. This impeded the acceptance and usage of ICT devices for broader groups. Consequently, investments in ICT hardware in both public and private are at low level. Neither governments nor companies are driven to set standards and common interfaces for ICT devices. Furthermore, the markets around ICT devices are highly fragmented, as market players do not intend to collaborate within or across industries. Instead, competition prevails. The development of key drivers can be seen in Figure 6.3.

The increased proliferation of ICT caused considerable problems. Web companies were faced with a lot of competition as telecommunication service providers entered their playing field. Additionally, the willingness of users to spend money for services relying on ICT networks decreased. In order to gain additional revenue streams, service providers, most notably Google and Facebook, leveraged personal data of users by selling it to third parties. From that point on, Internet was merely used to gather information. As a result, people became more conscious about the threats in the ICT networks. Due to low trust in Internet, hardly any new network services are used. People are skeptical. Neither do they want to be surrounded by ICT in their everyday routine nor do they want to share their data - for example videos, photos, music or other personal content. Consequently, Cloud Computing is solely used for business purposes. Instead of accepting the Cloud, users keep their private data on their storage devices.

Industry players within the ICT market responded to this development in two ways. Firstly, huge investments were made to increase the quality of single devices. TV vendors, for instance, focused their business on offering huge screens for home usage with an ever increasing resolution. Secondly, small players and start-ups specialized their devices in order to serve the long tail. Third party enabling became stunted in its development. Consequently, customization of products is not achieved through personalized software but specialized devices. As a result, the overall market structure is highly fragmented. Characteristically, companies have no intent to cooperate, as the basis for complementary services and devices - ICT networks - has hardly been penetrated. Thus the convergence of services declines since devices with multiple features are too complex to handle and cannot provide simple user experiences.

At the end of the day, the users' anxiety concerning ICT networks and the fragmented market structure lead to a downturn of the Internet hype. Furthermore, there are highly professionalized and customized devices as well as multiple brands and companies, characterizing the diversification in this scenario. Within the world of Decelerated Diversity people's attitude is driven by the trend to go back to the roots. People prefer personal interactions instead of virtual relationships. ICT devices are not regarded as an essential factor in everyday routine. The user seeks full control of his daily life. This matches to the users' needs of slowing down their lives in order to encounter a rapidly accelerating and globalizing world.

There are several factors indicating the occurrence of the scenario Decelerated Diversity. First signs for users' concerns regarding ICT networks and usage of ICT in daily life is given by recent problems with social networks and search engines. Facebook, one of the largest social networks, announced to offer its 400 million [184] user database as a market research tool to corporations [325]. Moreover, Google is often criticized for compiling data and thereby violating people's privacy. These criticisms were strengthened by an interview of Google CEO Eric Schmidt in 2009. He admitted that "search engines - including Google - do retain [...] information for some time [...] and it is possible that all that information could be made available to authorities" [305].

Furthermore, people are recognizing that their daily life is accelerated by quickly advancing technologies and the overall presence of ICT. Users are online and communicating permanently. Emails, for example, are frequently checked by the user. Already nowadays, activists agitate for Internet off days to countervail this development.

6.3.3 Scenario 3: Seamless Communication Manifesto

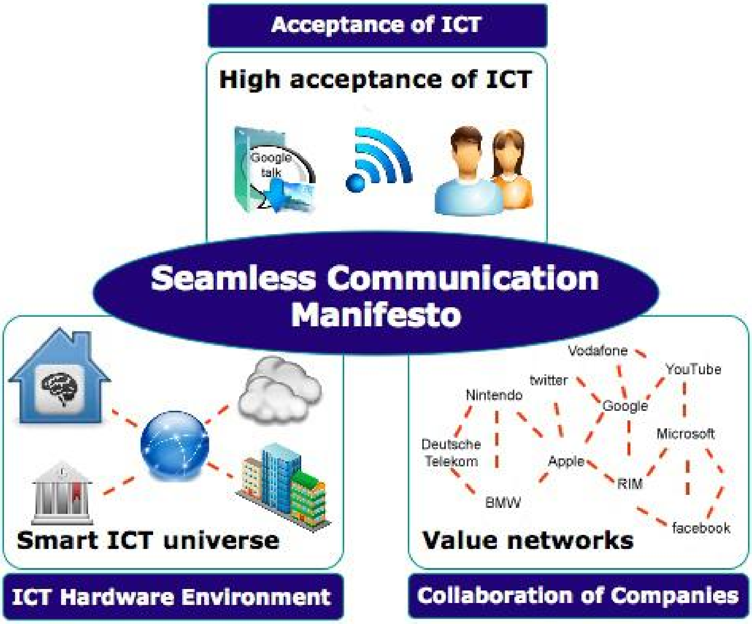

Figure 6.4: Development of the key drivers in the scenario Seamless Communication Manifesto
Source: own illustration.

These are the times that science fiction movies of the early 2000's have anticipated. People enthusiastically embrace ICT in their everyday lives, industries agree on common standards and interfaces, smart devices are seamlessly embedded everywhere, making this scenario turn into an exciting reality. The development of said key drivers can be seen in Figure 6.4.

What does the future have in store for people, when it comes to ICT gadgets and their interaction with the surrounding? By 2025, Ubiquitous Computing is more than just a buzz word - it has turned into a common reality. Developments have been made in networking technology, inexpensive sensors have been built and reliable software systems have been made possible. Also, following the patterns foreseen with respect to the acceptance of ICT devices and with respect to pervasive computing and the concerns related to it, people have learned to accept that privacy as formerly known has become a thing of the past. In fact, they to some extent trade access to their personal content for a convenient life in this fast moving society.

As far as the smart public infrastructure is concerned, governments and agencies have collaborated with industry to the point that smart grids and broadband connections are available everywhere. After many years of considerable planning, designing and lots of money spent on the hardware infrastructure, this vision of the future sees a new digital infrastructure coming to life, which connects homes and public terminals in a gigantic network of information exchange.

These commitments to the expansion of the broadband network coverage and to the creation of a prevailing smart setting have also stimulated the industries to reach a consent regarding standards and interfaces with various devices. The markets related to ICT devices and services have developed and changed at high speed. Innovative technologies from an increasing number of enterprises have created a vibrant market environment, with many players emerging as new technologies developed. This has led companies to constantly rethink the status quo and to quickly react to new developments. As a result, customers are offered a rich ICT experience, as they are able to choose various devices from different brands that are all interoperable and can easily communicate and exchange information with the smart sensors present in the environment.

A similar physical and information infrastructure exists in private homes as well. These smart homes integrate sensor nets - an upshot that has greatly relied on the technological developments, involving issues such as improved face-recognition and user-localization techniques, as well as on the retrieval of personal data and individualized preferences from a database.

In this picture of the future, technology has advanced to the point that computers are monitoring their environment, for instance to find new products based on past user preferences or to securely buy wanted items without any need for constant input from the user. Therefore, thinking machines are surrounding people everywhere. For example, the smart house mentioned above automatically checks the identity of the people inside and automatically switches lights on or off when entering or leaving a room. By retrieving information from the smart public infrastructure and adjusting the route accordingly, cars effortlessly navigate drivers on the least busy artery to their destination. Moreover, the mobile device automatically informs the smart house about the user being on his way home. Consequently, the smart devices at home adjust the room temperature to the preferred degree, the cushion in one's favorite armchair warms up according to one's liking, and the coffee machine starts brewing at the right time.

According to the distinction previously made regarding outside-in and inside-out interfaces, people in this scenario are making use of the full range of usability options. Verbal commands are being extensively used to communicate with devices, alongside traditional means of input such as touch-screens. In response, ICT gadgets use high-level voice recognition algorithms to analyze and react to the user input. The replies and answers from the device - the inside - out interfaces can be both verbal and visual, displayed on screens or projected on a wall by a smart projector. At the same time, voice calls can integrate holograms, creating the illusion of a face-to-face conversation. In 2025, the computer as well as the mobile devices of the early 2000's are a mere memory of former times. As a matter of fact, many of the ICT devices disappeared to the size of a watch, a pair of sunglasses, or a pen. Still, wall-sized screens are the norm, both in private as well as in public places, such as in the waiting room of a hospital or in universities. Moreover, customers may use public screens in underground trains, bus stations or airports, funded either by the government or private companies, such as Telcos.

The future brings ICT a lot closer to the people, to the very core of their humanly existence - and the Cloud plays a central role in this process. By 2025, personal computing has been completely substituted by Cloud Computing, both when it comes to private users and businesses. Computer applications are running on off-site servers, rather than on the company's hardware in expensive IT buildings or on one's own computing devices at home. This, in turn, has made it possible for the ICT devices to be far smaller, thinner and lighter than in the earlier days. For the application industry, the Cloud has opened up the market to a wide range of new software and services, all having one thing in common - namely large amounts of data and the need for extensive computing power.

Giants such as Microsoft, Google and Amazon have led the way in changing the way people view and use data storage and computing power. Paying for computing services, as one does for electrical or telecom services, is becoming more and more common these days. The cost savings enabled by Cloud Computing will most likely drive its acceptance, as well as important aspects such as the offline access for online applications. This implies that Internet connectivity is not always required for users to be able to work with an application that is hosted on a Cloud platform.

Companies from all sectors have put extensive and ongoing research efforts in building smart public grids, smart household appliances and smart homes. In fact, there have been many signs of collaboration between companies from various industries lately and determined attempts from the governments to support smart infrastructures. The New Energy and Industrial Technology Development Organization, an alliance of over 33 international companies has recently started a series of smart grid tests with national laboratories and utilities in New Mexico, possibly bringing the smart infrastructures to the U.S. in the near future [258, 386]. Panasonic has been working on building modular homes that "will combine green construction along with sophisticated electronics to curb energy consumption" [258]. Alongside Panasonic, major companies such as Sharp and Sony have also invested time and effort in building TVs that run on solar power, hoping to reduce the power consumption in plasma TVs by two-thirds by 2011 [257]. There also exist many private smart systems that have already been installed, with Asia taking the lead in this area. For instance, in 2006 SGI Japan has won an award for the RoomRender system [251], an intelligent room setup that manages and controls all prevailing hardware and electronics based on the user's voice commands or emotions.

6.4 Product Idea: The Shackle

The word shackle generally refers to a connection element, which is exactly the role that this new product assumes. It stands for a small intelligent device, that acts as a nexus in a world that abounds in smart ICT hardware that is ubiquitously present - the Seamless Communication Manifesto. The Shackle ultimately provides the user with a plethora of possibilities to exchange and display information, while perfectly catering the individual preferences and information needs of the customer. Therefore, the device acts as a sixth sense that facilitates users' lives and enables them to focus on the activities that they want to spend their time on. At the same time, Shackle incorporates smart identity management. In order to minimize its scope, the device does merely feature a voice interface and outsources most of the processing and storage capabilities to the Cloud. Thus, the device itself may assume different shapes as can be seen in Figure 6.5. The subsequent paragraphs further describe the Shackle and analyze its fit to the related scenario, the technologies, the user's needs and the unique selling proposition, the market structure and the financials.

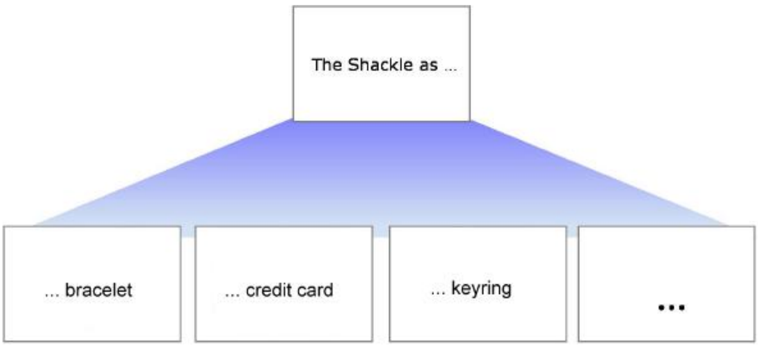

Figure 6.5: Different realizations of the Shackle
Source: own illustration

6.4.1 Embedment of Product Idea in Scenario 3

In the world depicted in the Seamless Communication Manifesto, people will be surrounded by ICT devices and use them to a high degree in public, at work and at home. Cloud as well as Ubiquitous Computing have given rise to new service offerings around communication and computing devices. In this vision of the future, universal standards for interfaces and protocols are established, that ease the interaction of distinct devices. Companies collaborate extensively in value networks as the ICT and media industries have converged.

Since the number of devices, functions and services around ICT has increased dramatically, the need for smooth and universal interoperability between devices is very high. The Shackle helps users to administrate several devices in their environment. From the user perspective, the Shackle represents a means to facilitate the usage of many devices. Moreover the device aggregates and filters information that it retrieves from the smart environment and thus helps the user to master his or her everyday tasks.

Prerequisite for the Shackle-technology is the wide use of standard interfaces and protocols as explained in scenario three. The Shackle relies on the ability to communicate with various device types from different brands. In a vibrant, competitive and digitalized world, people seek simple solutions. The Shackle shall be everyone's ally enabling users to cope with the complex world and facilitating their lives.

6.4.2 Description of Device

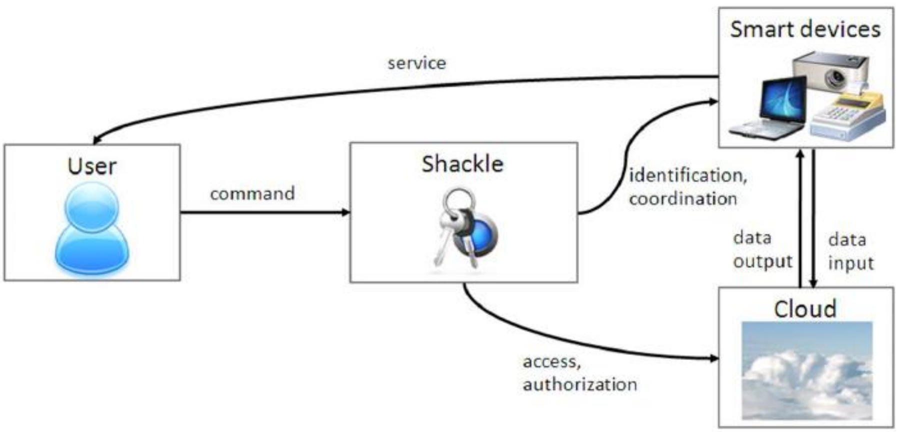

Figure 6.6: Flowchart of the Shackle
Source: own illustration

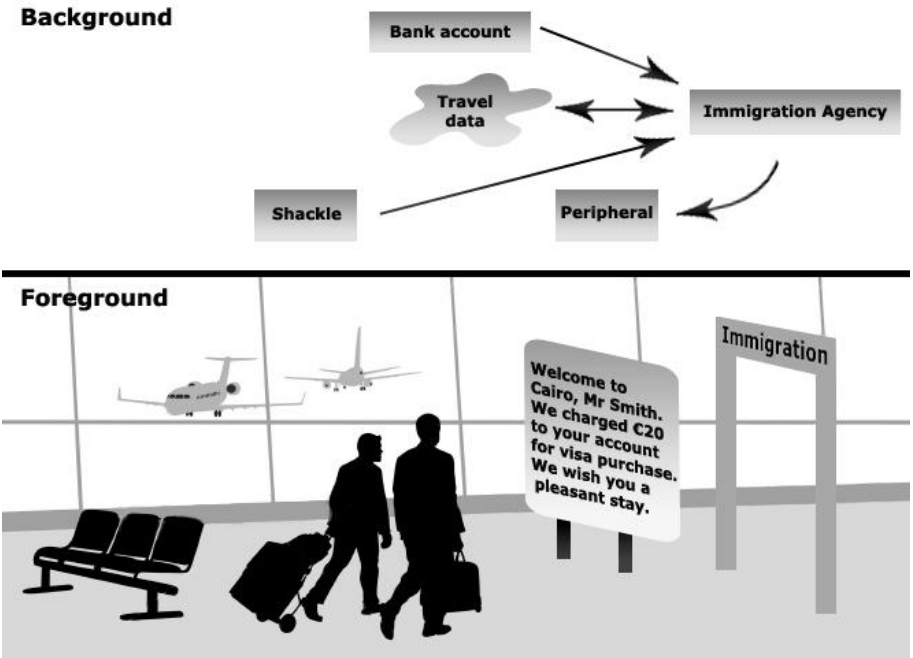

Figure 6.7: Example - Shackle used for immigration at the airport
Source: own illustration

The Shackle can be described as an inter-device control unit. Its functionalities can be outlined with the help of three dimensions: communication, coordination and identification. The term communication refers to the Shackle's ability to communicate with the Cloud and with multiple peripheral devices wirelessly. Therefore, the Shackle coordinates several peripherals both for inside-out and for outside-in information transfer. Its capability to identify other devices and in turn be uniquely identified is necessary for accessing the Cloud, for seamless communication with other devices and for using services as transactions or log-in's.

Figure 6.6 illustrates the main functioning of the Shackle concept. The device can be operated in two ways. Indirectly, via peripherals such as touch screens or laptops. The second possibility is direct control through the integrated voice or possibly brain outside-in interface. To start any operation, the user inputs a command by using one of the available interfaces according to the current situation. Once the command has been received by the Shackle, it is processed and transmitted to the Cloud. Simultaneously, the Shackle identifies smart inside-out peripherals. Subsequently, the requested data is processed in the Cloud and proceeded to peripheral devices that were previously recognized by the Shackle. However, peripherals such as laptops may also be utilized to store data in the Cloud.

For instance, the user wants to watch a video. He can utter the instruction to the Shackle. The Shackle then establishes a connection to the Cloud where the requested video is stored, identifies the user and determines the preferred output device. The Cloud immediately streams the video directly to the chosen peripheral, for example to a hologram projector, an OLED screen or a TV. Thus, the Shackle enables a simple and effective procedure.

Another example would be the entry into other countries at airports. When passengers immigrate, they need to identify themselves and sometimes purchase an entry visa. The Shackle would facilitate this process considerably. Before commencing the trip, the user stores his travel data such as length and purpose of the stay and the exact accommodation in the Cloud. When approaching the passport examination at the airport, the Shackle connects to a smart device supervising the entry process which identifies the user. Afterwards, the smart supervising device retrieves the previously stored travel data from the Cloud and initiates the purchase of the required visa, charging the passenger's bank account. The electronic visa is issued and the related data stored in the Cloud. Finally, the user merely receives a welcome message confirming his entry and the transaction, which is displayed on a peripheral such as a screen. Figure 6.7 shows the explained setting.

Infrastructure Requirements

The success of the Shackle foremost relies on three technological factors: the availability of broadband connectivity everywhere, prevailing common interfaces and cloud computing. Since the Shackle is embedded in the Seamless Communication Manifesto, all three factors are well established and allow the device to reach its full potential. As a consequence, the Shackle is able to communicate with its whole environment and to connect to multiple peripherals.

Technical Triangle

Given the necessary infrastructure, the Shackle itself is embedded in a technology triangle that comprises the user interface, processing and storing capabilities as well as energy supply. The technology concept of the product focuses on minimizing both size and weight of the Shackle in order to feature maximum mobility for the user. The emphasis on connectivity to other, on their specific task specialized devices furthermore ensures, that the product itself relies mostly on providing the mentioned connections.

The user interface of the Shackle includes two dimensions. Firstly, the interfaces that the tool itself provides to the user are assessed. In this dimension, the Shackle outputs information through audio signals and does not feature a visual interface. This implies that the customer either uses earphones or that the output of the Shackle is transmitted over integrated speakers. However, the Shackle is equipped with an intelligent audio system that can copy the pronunciation of an individual and alters the loudness, speed and the pitch of the voice according to the given situation. Likewise, the user can interact with the Shackle by voice commands. However, this does not necessarily mean that he has to speak up loudly. Button-sized sensors, that are placed around the Adam's apple and might be integrated in a necklace, computerize nerve signals that are further forwarded to the Shackle.

The second dimension of the Shackle's user interfaces incorporates indirect interfaces that are wirelessly connected to the tool - i.e. peripherals. There are virtually infinite possibilities of how the device can make information available to the user.

The excellent connection of the Shackle ensures that Cloud Computing can be used extensively. As a consequence, both the processing and the storage capabilities of the devices itself can be kept to a necessary minimum. Furthermore, the hardware can be optimized to fulfill the one major function of the device: connectivity.

Also the energy infrastructure of the product aims at maximum mobility. Naturally, wirelessly sending information is very energy-consuming, especially when transferred over long distances or in case of bad reception. However, since broadband Internet is advancing and since neither extensive data storage nor processing is required to be installed on the device, the energy consumption of the tool is reduced. Recharging is either achieved wirelessly by magnetic induction or by a microgenerator that transforms physical movement to power. This means that already casual walking provides sufficient agitation to induct small currents. This makes a plug for wire connection dispensable and saves space. The battery itself is a digital nanocell that features efficient recharging, high reliability and a small size.

Shape of the Shackle

As the main functionality and scope of the device has been stated, the shape of the Shackle will now be discussed. This aspect is particularly determined by user preferences. The Shackle technology can be offered in different forms. Logically, these may vary among different user groups. Whereas male users might favor small box- or card-shaped devices, females may rather go for necklaces, arm rings or rings. Since the device features a very small size, all of the mentioned realizations seem feasible and depend on users' demand.

Artificial Intelligence

A major advantage of the Shackle is its informal way to filter information and respond to the user's individual behavior and characteristics. In a world determined by complexity and ubiquitous information penetration encompassing news, advertisement, emails or voice calls, an intelligent device handling is required. Therefore, an Artificial Intelligence (AI) software that is able to track the user's bearing, concludes certain patterns and derives the way the user might want the device to interact.

First, such an artificial intelligence autonomously makes relevant suggestions to the user: it presents customized news, forwards only relevant emails if it detects that the schedule of the user is blocked and time is short. It also analyzes the current position and suggests relevant product information as for example the location of the next ice-cream seller if the weather is hot.

Secondly, the AI develops new suggestions according to already analyzed preferences. For example, if soccer is high on the user's agenda, the Shackle posts the newest soccer game results. Furthermore, it reacts to the user's interaction preferences. If the Shackle for instance observed that the user likes to watch movies mainly on the projector and is fond of turning on the sound system on a high level, the Shackle might automatically use the mentioned peripherals with the observed settings.

Thirdly, the Shackle not only relies on perceived behavioral patterns and concludes new suggestions, but also reacts swiftly to the user's current situation. This refers to the mentioned time schedule, the current time and the user's physical condition. For example, it could detect the user's tiredness by comparing the current pitch and tone of the voice with the usual conditions, incorporates also the hour and concludes that business calls and emails are not forwarded in certain moments to enable the user to relax and wind down.

The fourth aspect of such an AI must be its learning structure and behavior on a more abstract level - the Shackle also features meta-learning. This means that the AI inquires, if the observed preferences hold and if the user agrees, that these settings are going to be applied also the next time. In general, this is a highly complex and sensitive process that also has to be tailored to the user.

Security and Identity Management

Since the the Shackle relies on communication with other parties, data security is a major aspect which has to be considered. Furthermore, the device can also be used for transactions and serves as a digital identification card. For example, the device makes payments both in the real world and also in the Internet much simpler, since the user can easily conduct the transaction by employing the Shackle. But the tool also identifies the user when logging on to social platforms or to E-banking platforms. The mentioned possibilities imply that the Shackle needs to feature an elaborated and well developed authentication system.

Said security measures include voice recognition, passwords and a finger print scan. Like this it can be assured that the individual using the Shackle is de facto the one user of the Shackle.

6.4.3 Customers and Unique Selling Proposition (USP)

The product idea can be regarded as a sixth sense enabling users to experience the ICT environment as it has never been before. Therefore, the Shackle serves as the key to the whole ICT world. In the following paragraph, we elaborate on the user needs and how the Shackle will create value for customers.

Target Customers

In order to identify the target customers of the Shackle, segments with respect to age and socio-economical background have to be analyzed.

The Shackle is addressed to almost every age group as its intuitive interface does not require any previous knowledge. Naturally, youth and young adults are seen as the main user group since they grew up with new technologies. Due to demographic change, elderly people as a large customer group have to be considered as well. As the Shackle facilitates the everyday routine, reduces complexity and provides an intuitive interface, anyone is expected to use this device.

Within the third scenario, the infrastructure in both public and private is at a high level. Therefore, the target group of the Shackle covers a wide range of social and economical groups, from school kids, to business people and even retired persons.

User Needs and Unique Selling Proposition

Within the world of seamless communication, users are beset with abundant information and devices at any time. Therefore it is crucial for users that needless information can be filtered. Otherwise people get lost in the complex ICT world. The Shackle exactly fulfills this need as it is a personalized key to every service and offers individual settings. Consequently, the Shackle only connects with other devices and provides information if these fit to personal preferences or settings. Moreover, users are confronted with many devices both in the private and public environment. These smart devices, like a smart refrigerator signalizing when milk is off, solve many problems in daily life. The major problem, however, is the coordination and interplay of these various devices. Customers expect an ease of use for every single device as well as low complexity when it comes to combining several features from other devices or services. These expectations are perfectly met with the product idea, since the Shackle orchestrates several services by intuitive usability. For instance, while the user dials a number, the Shackle automatically connects the mobile device with the adjacent projector and the Internet in order to set up a video conference. The necessary input of the user narrows down to a minimum which leads to facilitated and simple user experiences for complex practices.

Besides reducing complexity, the Shackle enforces the mobility of users. All personal data and media on the Cloud, such as photos, music, videos, emails and documents can be recalled everywhere at any time since the Shackle is continuously connected to the Cloud. Displayed via public ICT hardware, this data can even be used on the way to work or while jogging in the park, for instance. The role of the Shackle can be seen as an unit seamlessly linking your personal data on the Cloud with every device in your environment. This enhanced mobility also accelerates the convergence of leisure and work since employees apply the Shackle to access the Cloud of the company and use smart devices at home or in public as working stations. At the end of the day, mobilizing people with the Shackle leads to an effective usage of time and environment.

In its function as a universal digital Identification card for every purpose, one major benefit for users is that no other IDs, like credit cards or passports are needed anymore for paying or traveling. Another benefit is given by seamless identification of users within the ICT environment. Sensors and devices recognize the user through the Shackle and thus allows or denies access to services. A smart home, for example, automatically identifies the resident and only grants access to him in order to regulate the energy supply of the house.

6.4.4 Financials

We see two major aspects of financials with regard to the Shackle: both the revenue streams that the device generates and the cost structure that prevails for the manufacturing company.

Revenue Streams

There exist multiple revenue streams related to the product idea that cover different stakeholders. First, the greatest revenue occurs to the manufacturer itself. He assembles the necessary hardware and software to an innovative product and further adds services as software updates, call centers for user support or merely a guarantee. Thus, a value package is generated and sold to resellers. The resellers generate income by actually selling the value package to the end user. However, the larger part of the revenue to resellers accrues not when the sale takes place but during the duration of the concluded contract with the user. This contract particularly includes a flat rate for Internet usage and an annuity payment for the purchase of the device itself. Possible resellers are mostly national or local operating Telcos commanding the necessary distribution channels. Another revenue occurs to the government. When the end user buys the product, a special tax for public ICT infrastructure is further added on the price. This fee enables governmental investments for example in airports, train stations, libraries or museums in order to provide ICT infrastructure such as OLED screens integrated in tables or walls or projectors.

The mentioned revenues arise when the device is being purchased by the user and independent of how the device is used. Content providers, banks or factoring companies and Cloud providers also generate income that is, however, dependent on the degree how intensive the respective service is used. If the customer utilizes a lot of online content, extensively practices mobile payment or processes huge amounts of data in the Cloud, the respective stake holders generate usage related revenues.

Major Cost Drivers

For the manufacturing company, the cost structure can be drilled down to a few major cost drivers. First, costs for purchased hardware and software have to be taken into account. The manufacturer relies on external components as for example on hardware as the energy supply, the interface, the processor and memory or on software as the AI, the required operating system or voice recognition software. Thus, the primary costs are high and are the most important cost driver. Furthermore, transaction costs occur during the interaction with manufacturers of multiple peripherals. Due to the company struggling to remain at the vanguard of technological progress, R&D expenses that also include spending for personnel are the third major cost driver.

Since the device mostly relies on connecting to peripherals, frequent software updates in order to incorporate newly emerged peripheral devices require the company to spend large amounts on the development of software patches. Finally, the company faces costs for marketing and maintaining a service system to ensure full user support.

6.4.5 Market Structure and Competitors

The ICT device market is growing fast and evolving dynamically. Big corporations and new ventures are very active in developing new technologies and try to place their products in the market. The development of new technologies promises great business potential, but the markets for ICT devices are highly competitive. Many national and international companies exist that manufacture various device types such as projectors, cameras, portable screens, computers, gaming consoles, TVs or mobile phones. This makes the market for controlling devices, that enable the seamless communication between different devices, very attractive, while promising great potential for high revenues and future growth. Potential providers for inter-device control units are technology companies. As common protocols and standards for the communication between devices exist, many players can enter this market. Manufacturers need to collaborate closely with many other companies from different branches within the ICT ecosystem to ensure a satisfactory user experience. The ability to quickly integrate new devices into the scope of micro control units and supply customers continuously with software and service updates is necessary to maintain a competitive advantage.

Competitors

The market entry barriers into the business of inter-device control unit production are rather low for big technology companies. The devices can be assembled at relatively low cost. Upfront R&D investments, however, will be on a relatively high level. The perfect fit and the integration of various functions into one small gadget, nevertheless, demands for professional design and development. Thus, big corporations, such as mobile device manufacturers or other technology vendors, with big R&D departments are major competitors. Additionally, new ventures financed with Private Equity and Venture Capital might enter the market as well. These small enterprises put sole focus on developing similar devices to address the growing market for inter-device control units. In addition to national competitors, it can be assumed that strong competition will come from companies based in USA and Asia - at the forefront Japan. Their markets are strongly developed and the standards for inter-device connectivity are very far established.

Ways to differentiate from rival companies are product design and dimension of functionality integration. Inter-device control units can have many shapes. The exact size and product design is likely to vary from different competitors. Possible solutions for different designs range from key fobs to glasses. The controlling gadgets can be integrated within other devices like mobile phones, laptops etc. Conversely micro control units, as distinct devices, can integrate additional functions. Integrated RFID-chips for identification purposes and embedded digital payment systems can leverage the primary function for this device. Inventing services around this technology and the integration of other functionalities will increase the value of micro control units and be the major source for competitive advantages.

Partners

Providers of inter-device control units need to get engaged with other partners depending on the degree of functionality the device should incorporate. The basic functionality of the micro control unit, to enable the connection and transmission of data between different kinds of devices, can be done by using the standard interfaces and protocols that exist. Manufacturing companies can do this without being involved with many partners despite their suppliers. In order to further enhance the range of capabilities of the controlling device unit, partnerships with different companies become essential. Micro control units with implemented identification functions and digital payment systems rely on the collaboration with identification service providers as well as with banks and telecommunication companies.

Besides the hardware configuration, the software that enables the inter-device communication is a key element of the Shackle. The software can be either provided by external companies or also developed by the manufacturing company. The continuous upgrades, necessary to keep the controlling device unit updated to new technologies, demand a high level of communication with other device manufacturers and service providers. The close collaboration with these parties is also very important in order to ensure the security of this technology. Key partner for manufacturing companies, who provide the technology of Shackle, are most likely telecommunication firms. Telcos take the part of reselling the device to customers. Their broad customer base makes them indispensable partners for the successful placement in the market and the safe provision of the services around the device.

6.5 Conclusion

The quest for future ICT devices in the year 2025 is mainly defined by the three key drivers: the acceptance of ICT in user's daily life, the ICT hardware environment and the collaboration of market players. Throughout the elaboration of possible developments of each driver, we created three scenarios that describe both the different visions and the role of the ICT device in 2025. Each of the scenarios features a different tool for information, communication and entertainment.

Convergence Dictate illustrates a world in which the public has developed a pronounced affinity for information and communication but a ICT hardware environment is only available in private homes since no investment for public places has been initiated. The industry around the devices has developed into multiple conglomerates that compete with each other. Decelerated Diversity pictures a vision that is determined by user's deterrence of ICT. Therefore, no such infrastructure prevails neither in public nor private places. Finally, Seamless Communication Manifesto refers to a world in which ICT is strongly embraced and the hardware environment is established both in public and private sites. Industry players have organized themselves in a value network. Common interfaces and standards prevail throughout industries and enable a plethora of possible innovations and applications for ICT devices.

A statement about the probability of each scenario cannot be made. However, the Seamless Communication Manifesto provides the most fertile ground for innovative and disruptive new ICT devices such as the Shackle.

The pressing question is, what role telecommunications companies will assume in a world of value networks, ICT acceptance and prevailing ICT hardware. Finally, Telcos should base their operations on a three pillar model that incorporates distinct fields of operations. First, Telcos are foremost network providers by the year 2025. In a value network, each industry player concentrates on its core business, but provides common interfaces for others to easily cooperate and connect to the own product or service. Since data transfer will increase both via wires and wireless networks, this may yield stable and easily predictable cash flows to Telcos. However, the role of Telcos is not circumscribed to being mere network providers. Secure identification and data storage is vital in the Seamless Communication Manifesto and can best be offered by Telco companies. Therefore, the second pillar of Telcos is to establish themselves as data fortresses - a trusted company that administrates users' sensitive data. Telcos are predestined for this task, since they already today govern a huge pool of customer data and foster a relation to the user that is based on trust and confidence. Thirdly, Telcos act as resellers, spreading new ICT devices such as the Shackle through their extensive network of sales channels. By integrating and combining the mentioned three pillars, Telcos can majorly contribute to value creation and help to enable a thrilling, interconnected and smart environment in which groundbreaking ICT devices are integrated.

7

Chapter 7

Telcos as Development Platform Providers

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Facing disruptive changes within the telecommunications industry, Telcos see the need to find new business opportunities involving third parties on development platforms. To determine the future of development platforms, technological and social developments have been analyzed in order to identify three main drivers. The evolution of the Internet to the Semantic Web may allow for fast and highly flexible service compositions resembling service-oriented architectures. Needs and characteristics of developers on such platforms may drive their growth and acceptance as key players within the application development market. Furthermore, the handling of user data as well as the customers' willingness to share their data remains another crucial factor for application development in 2025.

Based on these and other drivers, three scenarios have been created reflecting the drivers' different predictions. The **Scattered Islands** scenario describes a world where several development platforms have emerged over time but are mutually incompatible. In contrast to that, in the **Post 1984** world people have lost trust in technology and are not willing to share user-specific data any more and thus anticipating further innovations. In the **Data Playground** scenario users are greatly willing to share their personal data enabling a broad variety of applications around the world. Here, the idea of the Semantic Web

has been realized finally enabling service compositions within a service-oriented architecture. This scenario has been chosen as the most likely one and builds the foundation for **Brokeris**, the described service idea.

Brokeris is an information and service brokerage platform leveraging semantic search technology to discover modular service components located throughout clouds within the Semantic Web service ecosystem. In addition to that, developers can register their developed services at the platform deciding on Brokeris as their billing provider. On user request Brokeris links and orchestrates necessary standardized service components to deliver an individual service composition. Brokeris uses its understanding of service interfaces to create flexible service compositions that may consist of a multitude of different service components. Featuring a recursive billing model, each service component within a service composition is subject to transaction-based billing. Each developer registered with Brokeris receives micro payments according to the usage of his services. For external services Brokeris forwards payments either directly to the service provider or to their specific billing platforms. Revenue is generated by withholding a premium on each transaction executed by one of Brokeris' registered service components. Brokeris' main USPs lie in handling complex billing and payment relationships as well as in the discovery and linking of modular service components. Given the chosen scenario along with a telco's expertise in complex network architectures and reliable billing infrastructures, telcos in general feature a great starting position to adopt the Brokeris service idea in the near future.

7.1 Introduction

Due to an ongoing convergence of Internet and telecommunication services, Telcos are facing an increasing competition within their traditional markets. Third party enabling through development platforms may be a measure to find new business opportunities and avoid becoming a mere bitpipe.

In general, a development platform offers an environment where services are exposed and interfaces are offered. By offering their own platform Telcos can distribute their own service offerings through the platform (inside-out) while at the same time integrating external services into the platform (outside-in). This set of offerings can then be used by external developers to create new services and applications that reflect fast-changing user needs. Nevertheless it remains unclear what role developer platforms along with third party enabling might play in the future. This report tries to evaluate this question by highlighting future aspects of development platforms. The influencing factors for development platforms will be thoroughly discussed in the following section. In the third chapter the ten most important drivers will be named and possible developments will be explained in detail. Derived from the three key drivers, three feasible but distinct scenarios will be presented in chapter four. Outlining a world in the year 2025 each scenario describes a possible future environment for development platform providers. Based on the most likely scenario, a service idea will be given in chapter five. This includes a general description of the idea itself, an analysis of the future market, a revenue model and a short example.

7.2 Driver Analysis

The following chapter will outline the ten most important drivers in order to determine the situation of Telcos as development platform providers in 2025. As shown in Figure 7.1, the drivers are mapped according to their certainty and impact. Drivers are classified as certain if their development is rather evident, whereas the future of uncertain drivers is unsure. Each driver is shortly introduced, then described in terms of its aspects, and finally possible developments and their influences on development platform providers are given.

7.2.1 Certain Drivers

The first two drivers are categorized as certain. Their general development until 2025 can clearly be pointed out. Both drivers are first analyzed with respect to their essential characteristics. Then, the last paragraph of each driver focuses on different possible developments and their implications for Telcos.

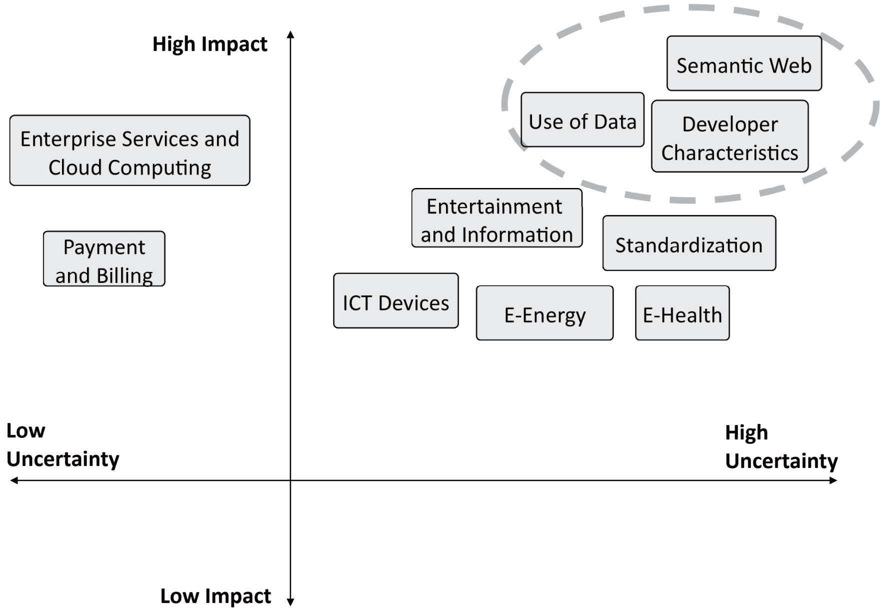

Figure 7.1: Map of drivers
Source: own illustration

7.2.1.1 Payment and Billing

New payment models and schemes create new opportunities, especially within the Internet. Easy-to-use and reliable payment and billing systems increase the acceptance and through common systems and interoperability they can be offered on many systems. With payment systems, users can pay arbitrary amounts of money to different parties including developers, whereas with billing systems users can be charged systematically.

When it comes to financial services there are three factors that will be important in the future. There is the mobile payment sector, allowing consumers to use their mobile phones or handsets for paying bills on many occasions. Current methods (such as premium text messages or PIN/TAN forwarding) are time consuming and not widely supported. The second factor are billing systems. Telcos have a highly sophisticated billing infrastructure that can be made available to a greater group of potential users. The final factor is the micro payment. The goal is to create a payment back-end, which specializes on transactions of small amounts, often only a few cents. To use the current payment systems to exchange those small funds is mostly not an option because the transaction costs are generally higher than the amount you want to transfer. First systems are offered for example by Google Checkout [213] and PayPal [349], but transaction fees are still at a minimum of USD 0.30 and EUR 0.35 respectively.

In the future, micro payment will evolve, mobile payment will be widely in use and the billing infrastructure will be used by thousands of customers. This is highly relevant for non-commercial developers, as users can show their appreciation for their work by transferring small amounts of money to them. Mobile payment will have reached a critical mass, allowing the use of mobile phones for payments in everyday life. Combined with an installed micro payment infrastructure this allows for new business opportunities and payment models [377]. Advertisement as the main monetization model for websites, for example, could partly be replaced by (micro)payment schemes [122]. The use of centralized and sophisticated billing systems lets businesses concentrate more on their core functions without having to worry about the difficulties of payment and billing.

7.2.1.2 Enterprise Solutions

Enterprises in 2025 will have to deal with a lot of challenges. Earlier it as been explained that mobile working is growing. One can assume that this trend will continue. Furthermore, highly flexible solutions are needed to stay competitive in a changing environment. Cloud computing, which affects most business sectors, has been a hype for some time and it will grow even more. Therefore, solutions for enterprises and cloud computing should be taken into account as an important driver for development platforms in 2025.

Enterprises in 2025 will have to adapt to a highly volatile environment. For example, development cycles will shorten and brand loyalty will be increasingly substituted by word-of-mouth. There will be a need for modular software which can be adapted easily to changing conditions. Furthermore, it is likely that innovations in the market for enterprise applications will be driven not only by the big players in enterprise software, but equally by small companies or individuals. One company that tries to enable third party developers to offer their solutions to enterprises is Google who recognized this trend by launching the Google Apps Marketplace [214] for corporate applications. Technologies that recently evolved, such as cloud computing, will enable companies to use these tools very efficiently in 2025.

There are several consequences for Telcos which result from the high importance of enterprise solutions and cloud computing:

1. Telcos have to decide whether they offer separate platforms for private and enterprise users. Since enterprises as consumers might still differ from private consumers there might be two platforms designed to meet the

specific needs of each customer group or one platform that targets both groups.

2. Telcos have to provide access to their development platform to big players in the market for enterprise software, to smaller companies and to individual developers.

3. Telcos have to look at ways how to provide flexible and highly combinable modules for enterprise solutions. This could be achieved either through general standardization or through providing standardized access to third party applications as a platform service.

4. The ability to set standards in the enterprise market would give Telcos both an increase in credibility among enterprise users and a competitive advantage over other platforms.

5. Telcos should consider providing a cloud computing infrastructure for enterprises since it is likely that all applications might run in the cloud in the future.

7.2.2 Uncertain Drivers

Eight uncertain drivers for development platform providers can be identified. Neither their general development, nor their specific situation in the context of platforms can be foreseen with certainty. Each driver is again divided into three paragraphs: a general explanation, a description of its main aspects, and possible developments and their implications. They are ranked according to their impact on development platform providers in ascending order.

7.2.2.1 ICT Devices

Mobile phone users, Internet users, enterprises, even people who do not own a communication device until now will be affected by a possible change in future ICT devices. Especially for developers, it is crucial to know what functions will be included in the device, the rate data will be transferred with and many other characteristics of devices.

When looking at ICT devices, three major influences can be extracted for the next 15 years. The first one is the question what kind of device will eventually be dominant, either multiple devices or an all-in-one device. The more technology advances, the more tension there will be between simplicity of a device and combining functions in a single device. Combined components of today might be available separately until 2025, so they can be utilized as needed by the customer [277].

The next influence is the degree of innovation. A radical, respectively fast, change of ICT devices might not be accepted by the customer. An incremental innovation might never be dominant enough, resulting in a possible substitution by something else. The degree of innovation also affects development platforms. They need to be flexible enough but stay consistent at the same time. Developers are unlikely to start experimenting with a new technology if its acceptance is not yet ensured.

The third major component influencing ICT devices is ubiquitous computing. It is still uncertain whether for example automated home systems will be completely connected [312, p. 13]. Technological improvements will greatly affect the possibilities for developers and enable additional services unseen before. However, the need for an increased IT security and a framework to avoid the abuse of the 24/7 connectivity might not be met within the next 15 years.

Since future ICT devices cannot be forecasted with certainty, the following three developments seem plausible:

1. Multiple devices in combination with a broad acceptance of ubiquitous computing would increase the need for more and more applications. Since ubiquitous computing is literally ubiquitous, telecommunication companies as providers could step further into everybody's life. They could handle the data needed to do so, act as a distributor.

2. Considering that a general implementation of ubiquitous computing into our private home is questionable, another possibility would be its acceptance on an enterprise level only. Ubiquitous computing in an enterprise environment might be adopted rather slowly, but steadily. Development platform providers could specialize on enterprise services, since ubiquitous computing in that context could save a lot of time and money, it could make work more efficient by improving processes.

3. The last possibility would be a one-device-fits-all approach. That would distinctly change the devices from today and enable an exceptional amount of new applications. Together with an acceptance of ubiquitous computing but a lock-in on the providing platform that possibility could be very interesting for development platform providers, especially in terms of platform dependency.

7.2.2.2 E-Health

A clear and sharp definition of the term E-Health is hard to provide as it is used as a synonym for various developments in the context of healthcare. However, this term is usually understood as a way to support health-related issues and topics by using electronic devices and services. These may be used as an enabler for creative applications and services on development platforms, where needs accompanied by E-Health could be satisfied.

Popular examples are electronic health records and various applications in the area of telemedicine where for instance results of medical checks enabled by wireless-connected devices can be easily transmitted from a patient's home to a doctor. Additionally, projects on a healthcare infrastructure level such as the introduction of an electronic health card in Germany are also a major part of the E-Health market.

Given traditional healthcare markets within the European Union accounting for roughly 10 percent of a country's GDP [136, p. 3], the growing markets for E-Health offer a multi-billion Euro potential to be unlocked. With estimated annual growth rates of 11 percent [136, p. 6], it can be expected that E-Health will play a leading role in future healthcare environments. Several major driving forces within the E-Health market can be identified at the moment. First, demographic change and a resulting reorganization of healthcare systems in the developed world can be seen as the main forces to push the development of E-Health. In this context E-Health is largely seen as a way to improve efficiency and reduce costs within healthcare systems. These forces correspond with ongoing efforts on a political level, such as of the European Commission that actively promotes both regulatory and innovative efforts within the European E-Health market. Second, manufacturers of telemedicine devices as well as E-Health service providers are starting to develop E-Health products and services. Third, Telcos have already entered the E-Health market and are currently searching for their position within the market.

The Telcos' future role in the E-Health market for the next 15 years is hard to predict, but a shift towards offering value-added services can already be observed. In order to do so, Telcos may use their established competencies to provide Quality of Service (QoS) infrastructure for handling sensitive data to build their own E-Health services targeted directly to end customers. As it has to be expected that the E-Health market in future will be subject to a strong regulation (QoS, data security etc.), a tight cooperation between Telcos and developers seems imaginable. External developers might bring new and innovative ideas for applications and services in the context of E-Health to the platform, while the Telco has expertise and credibility in providing such services to end customers following extensive regulatory requirements.

As an alternative, E-Health's impact on development platforms might be lower than expected or even not existent at all. In this case, tight regulation might discourage developers from providing applications and services for E-Health.

7.2.2.3 E-Energy

E-Energy strives towards a so called "Internet of Energy" [192]. Consumers will get feedback of their energy usage over the Internet, giving them the chance to change it. Moreover it should be made possible to easily integrate various energy sources, even from private persons, into the power network and balance the power fluctuation. This topic is currently heavily researched [191].

For Telcos it is a great opportunity to get involved in this development, mainly because many new business ideas will result from its adoption which can be leveraged by the Telcos' development platforms.

The important question for a Telco is how strong the impact of E-Energy will be. One possible future considered here is that E-Energy will not be very successful and only adopted be a small minority. In the other one E-Energy is a big success and every household is connected to the previously mentioned "Internet of Energy".

If the impact of E-Energy will be small, it will not play an important role for development platforms and therefore not influence their development. Whereas if its impact will be big there will be a big business opportunity for Telcos. This is due to the opening of a whole new market with many new customer needs. To leverage this potential Telcos could arrange co-operations with energy providers and with their help offer new services for E-Energy incorporated in their development platforms. To enable this business development it will be important for a telco to get involved into this area already at an early stage of development.

7.2.2.4 Standardization

Standardization describes the harmonization of programming techniques, interface descriptions and offered services. This allows for a widespread reusability of applications and code. The standardization level will influence the developer and customer base and also the platform per se. Especially with respect to Internet related topics, there are often so-called de facto standards that have not been standardized by the responsible authority. But even without proper standardization they are widely used throughout the Internet.

When it comes to standardization there are two distinct topics to cover. The first one is the standardization of handsets with respect to their hardware and software. This basically covers the user side and allows for a differentiated view on the variety of handsets and operating systems. The other describes the platform side. This affects the interfaces provided by the platform and the technologies uses to access them. It also describes the services offered by the platform, especially basic functions offered by default.

One possibility could be that there is no standardization, concerning both the handset and platform side. Developers would have to write applications for a multitude of different operating systems and possibly also in different programming languages. The distribution range of an application would be very limited and it would be time costly to port them to other devices. The platforms available to the programmer would be incompatible to each other, meaning that similar services might be offered, but the inclusion of another platform would require a lot of customization effort.

The lock-on-platform future would imply that the platforms agree on a common set of functions and interfaces thus providing exchangeability for the developer and end user. But concerning devices, there would still be no standard agreed on to allow developers to write their applications to be able to run on different kinds of devices.

The complete opposite to the previous one would be the lock on platform. In this case, the handsets would provide a standardized way of running applications. For the developer, this would create a broader distribution market for their programs. The drawback would be the restriction to one platform, because the platforms would be incompatible to and different from each other.

The last direction is full standardization. The developers would have no ties, neither to a specific platform nor to a handset type. The applications could be run on all kinds of handsets and at the same time access a great variety of platforms.

7.2.2.5 Entertainment and Information Content

Entertainment and Information Content is one important driver for development platforms in the telecom industry in 2025. This is mainly due to the fact that media and information are big markets and that they require high bandwidth, a service that Telcos can provide.

To get a clear picture of the driver, one has to look at the question of what kind of media will be distributed. It is uncertain whether text-based news will still have the same importance as today or whether they will be substituted by another type of media, for example video or audio. One also has to look at the possibilities of Telcos offering value added services on already existing products such as aggregation of blogs, or providing single access to various portals. User generated content will be even more important and it is possible that it will ultimately substitute traditional media and information.

It is crucial to consider whether media will be distributed via Telcos or telecommunications platforms. Media and information companies could choose Telcos as their partners to distribute media, they could partner with other platforms or they could distribute their media or information on their own. Users could distribute their content on their own or they could partner with a platform to obtain higher visibility.

Second, the question whether there is a competitive advantage over other platforms has to be analyzed. Telcos could create a competitive advantage through different means. They could for example have the exclusive right to distribute certain media or information. They could dispose of the largest collection or they could have an interface that is especially easy to use. Leveraging the network infrastructure could also lead to a competitive advantage as Telcos could for example offer video streaming that adapts to the user's currently available speed of connection on the fly.

If Telcos provide media and information content with a competitive advantage, implications would be that telco development platforms should leverage this advantage as they can provide something, other platforms can not. In this case, building a platform that is centered on media and information content would be a logical consequence.

In the case that entertainment and information content is distributed via a telco platform but without a competitive advantage, Telcos should try to offer these services on their platform together with other services. Bundling media and information content with other services (for example information about the speed of connection) would give them an advance over potential competitors.

It is also possible, that Telcos will not provide media and information content at all. This can be due to the fact that publishers do not want to cooperate with Telcos or to strategic decisions inside the telco. In either case, Telcos have to look for other sources of revenue and competitive advantage.

7.2.2.6 Semantic Web

The term Semantic Web has been coined by Tim Berners-Lee and describes an Internet where all services and information entities are described by standardized meta data that allows for a precise meaning [82]. It will be possible for machines to understand the meaning of a service or a piece of information just by looking at its meta data. This would enable a quick and easy interconnection of various sources and different kinds of services as well as data throughout the Internet. Having a Semantic Web in place, the way the Internet is used today will significantly change, revolutionizing the whole process of connecting services and information.

In today's Internet one major challenge poses finding and aggregating the correct and relevant information a user may be looking for. Search engines like Google use complex algorithms enriched with a massive amount of collected usage patterns in order to retrieve relevant information from the Internet. Although continuously improving, these traditional approaches lack one basic feature. Machines are still unable to determine the real meaning of information found on the Internet. The idea of the Semantic Web may find a remedy for this by adding meta data to each piece of information or service provided on the Internet. In line with standardized descriptions of interfaces this may result in a web of services and information that can be seamlessly integrated into each other with only little effort. Complex business processes as well as every-day end user requests could be executed by leveraging a service-oriented architecture where services are composed of subservices.

Services and information may be located and stored decentralized throughout the Internet. Although simplifying the retrieval process by semantic-enriched meta data, the search for the right service or information might still pose a major challenge. Given standardized interfaces for services and information, the way business processes work and people interact may be revolutionized and service-oriented architectures may become a reality beyond company limits. Such an environment may be supported by a telco on a technical infrastructure level as well as on a service infrastructure level. In an era of the Semantic Web, this would allow for great opportunities for infrastructure and communications providers.

The emergence of the Semantic Web would push higher process and service efficiency. Striving for standardization of interfaces and meta data that allow for clear description of service or information entities, may result in a huge efficiency increase for the global economy.

Presented about 10 years ago, the overall development of the Semantic Web and its next phases in the future remain unclear. It has to be expected that the development of the Semantic Web will be an iterative process where a specification of one standard might be adopted slowly but eventually become a de facto standard by 2025.

7.2.2.7 Developer Characteristics

Looking at developer characteristics is an elementary step in order to determine the future evolution of development platforms and communities in the telecommunication industry. Developers are customers and contributors of Telcos at the same time. Telcos have already realized that they cannot exclude external developers from internal processes in order to be successful.

Characteristics of developers can be divided into four key influences. The first is the appraisal of a developer for the platform. Since consumers will be increasingly involved into the development process, the relationship between platform provider and developer might change.

The second major influence on developer characteristics is the ratio of non-commercial developers (NCD) to commercial developers (CD). More highly skilled NCDs are expected to enter the market, who could play an important role in fulfilling the need for a critical mass of developers. Therefore a platform might compete especially for them.

Another important component of developer characteristics is the loyalty towards a platform. Switching costs can decide whether a developer will stay at a platform or not. Also, a developer will be loyal to a platform if provided with support and additional attractive features [54]. Loyalty towards a platform is closely linked to the appraisal, but looked at from a different point of view. The higher the developers feel valued by the platform provider, the higher their tendency to stay at that platform.

Last but not least, the needs of the developers considerably influence development platforms. Simplicity and a comprehensive documentation are elementary needs of all developers. Whether the needs of developers are fully met or not also affects their loyalty towards a platform.

Since the development of these four influences can only be assumed, the following three possibilities seem plausible. Firstly, a high loyalty coming along with only partly met needs and a high appraisal of developers in general. That could be happening due to a high ratio of CDs, since for them, needs do not necessarily have to be met in order to contribute to the platform. Also, CDs could be offered proper partnerships and thereby their loyalty will increase. Depending on the focus of the platform, a dominance of CDs could even be of advantage, for example for enterprise solutions. This is because CDs tend to have a higher willingness to pay for tools needed for the development process and because partnerships fixed by contract would secure enterprise processes and the privacy of data.

The second possibility would be a high ratio of NCDs, due to the fact that data is widely available. Developers' needs would be fully met, which would enable many consumers to become NCDs. The sheer endless amount of NCDs would lead to a relatively low valuation of a single one, since there will always be others. Loyalty towards a platform would also be low, because no effort would be made to show respect to developers. In order to increase a platform's attractiveness, the provider could think about leveraging user data to the developer and therefore enabling more customized applications. Especially for NCDs, new ways of assistance could be implemented, for example professional coaching.

The third possible result could be a balance between NCDs and CDs, a low appraisal of developers in general and a low loyalty towards a platform. The needs could only be partly met, but due to only de facto standards, a developer would be bound to one platform. In that case, the needs of developers would play an important role, because they would determine which platform the developer chooses in the first place. The provider should think about modularization or a thorough documentation for the NCDs, or an interesting financial model for the CDs.

7.2.2.8 User-Specific Data

Another driver that has to be taken into consideration when looking at development platforms in the year 2025 is the handling of user-specific data. The way user data is handled will play an important role as different approaches to this topic will result in various types of services that development platforms can offer.

An important factor of user-specific data are regulatory aspects, meaning laws and regulations that specify the way that user-specific data may be stored, processed and published. On the one side it could be possible that there are massive restrictions from the government which result in very short storage spans and high privacy, whereas on the other side no limits might be set on the use of user data.

Another aspect is how the data is leveraged by developers. One possible development is that developers rarely use user-specific data. This means that there would only be a small amount of personalized applications and that the developers focus more on general applications like video streaming or news broadcasting. The other development is that user-specific data is extensively used resulting in highly customized and personalized applications that, for example, analyze the statistics of the user's voice calls in order to provide him with additional services.

The last aspect of user-specific data deals with user awareness. It might be possible that users are very aware of the implications of giving out personal data and that they are very concerned with privacy issues. Users would not be willing to share much of their personal data forcing developers to focus more on general, non-personalized applications. The opposite might become true as well. This means that users would handle their personal data very openly and therefore enable developers to design applications that leverage this data.

One possible future might be that there is no legislation concerning user-specific data and that users are not aware of privacy issues. Additionally user data would be leveraged on a high scale. Thus there would be a big market for very customized and personalized applications that make use of freely available user data. This could enable a high level of innovation on the developer side. Here, because of the many users and developers and therefore many applications, development platforms would grow to an enormous size and provide users with a great variety of services enriching their everyday lives.

Another development would be that there is still no legislation, but users are very aware of their privacy. User-specific data that would be available would still be leveraged by the developers. However, the awareness of users could force the developers to provide so-called 'Opt-Ins' and 'Opt-Outs', meaning that the users might be able to choose by themselves which data they want to release and which not. In this development there would still be a lot of innovation and development platforms would still provide a lot of services, but not as much as in the first discussed future.

The last development that is covered here is that there is a very strict and prohibitive legislation and a high user awareness. Also, the very small amount of user-specific data that would be available is not leveraged by the developers. This would result in only a small number of applications and very little innovation compared to the previous two outcomes. This means that development platforms would not play an important role, since there would only be few applications that would be used by the vast majority and not many new ones in development.

7.3 Scenarios

The following three scenarios describe different possible futures of Telcos as development platform providers in the year 2025. Based on the highly uncertain but highly important key drivers Semantic Web, developer characteristics and user data, all scenarios head into different directions. In each scenario, distinct projections and their impacts result in an environment, which creates interesting outcomes for the industry.

7.3.1 Scenario 1: Scattered Islands

This scenario describes a distributed world. In the past, enterprises were not able to agree on common standards which led to specialized platforms providing a unique set of services. In 2025, this still has the advantage of having mature services for the customers and thus attracting developers to the platform. However, due to the incompatibility between all platforms, there is a shortage of developers for every platform. Once developers decide for a platform they have a strong binding to the platform. Figure 7.2 shows the characteristics of the main drivers.

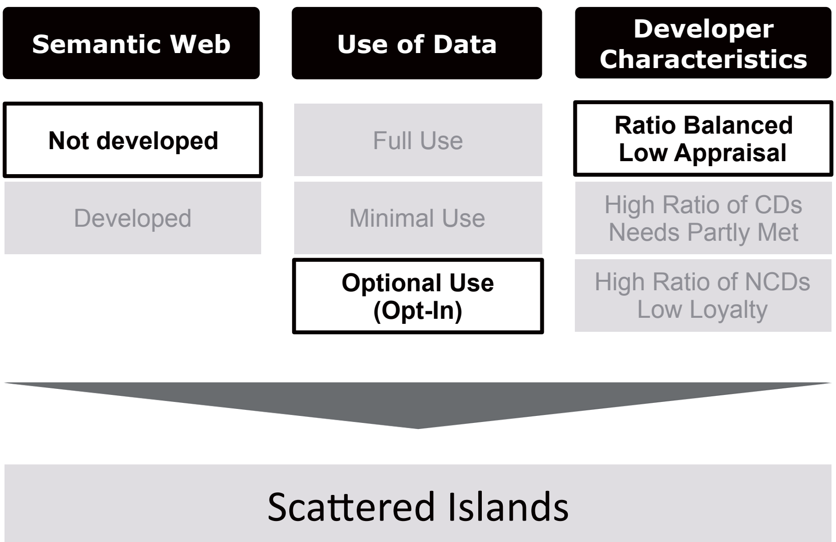

Figure 7.2: Driver characteristics of the 'Scattered Island' scenario
Source: own illustration

Even though the Semantic Web was praised as a game changer for the Internet and was about to introduce a new era, the expectations have not been met yet. The many individual platforms are not eager to agree on a standard (or de facto standard) to interconnect and describe content, information and services. Nevertheless there are some platforms that have implemented common standards, mainly because these platforms are run by the same company. The developer receives low appraisal after committing to a platform, mainly because there is no need for an extra treatment in the point of view of a platform. The ratio between Non-commercial developers (NCDs) and commercial developers (CDs) is balanced, but the platforms focus on either one of them in most cases. Due to the incompatibility of the platforms many developers are not satisfied with the services. Once they decided on one platform they are mostly locked-in and the main efforts of the platforms concerning new users are made when trying to attract new developers. The regulations concerning user data and the restrictions in using and distributing personal information are superficial. Nonetheless a basic level of security is offered, especially due to the fact that opt-in methods are mandatory for many applications. This is mainly owed to the user awareness on topics like data privacy and use of personal information.

As the standardization is only applying to the device side, developers struggle to find the right platform to develop on. The applications virtually run on every operating system and mobile device and can incorporate a wide range of information provided by those handsets. In contrast to the platform side, this presents the developer with a widespread market, without having to worry about device specific features and properties. In the past developers struggled when platforms were not able to meet their expectations. Leaving them stranded when platforms were shut down has been one major annoyance. In that case they had to reorientate themselves and adapt their applications to a new platform. This has been especially painful, if there has been no other platform with a matching set of functions.

E-Energy is reality, smart grids are integrated and control modern power infrastructure. Due to the incompatibilities of the different platforms innovations in this sector are blocked. Every energy corporation is still pushing its own technologies and developments on its respective platform. Several highly advanced applications exist, but are restricted to an exclusive platform. To prevent those incompatibilities in the E-Health segment, the government stepped in as the sole platform provider for health services. The platform has been in use for a few years now, but only a limited number of citizens opted for sharing their health records for research purposes and new applications. The biggest incentives for using the platform are still provided by monitoring systems of health insurances.

Most of the platforms are either hosted within a cloud-based architecture or offer one as a development environment. Commercial platforms distinguish themselves from their non-commercial counterparts by offering a higher quality of service. This leads to further separation of the developer community and restraints the information exchange on a platform.

A wide spectrum of entertainment and information content is offered on various platforms, meaning there is no common platform offering a single point of entry point for all media needs. The availability of sophisticated billing services, mainly offered by telcos and the widespread adoption of micro payment services opened new business opportunities and models for the individual platform. Information services no longer mainly rely on advertising revenues and have been able to introduce new payment models for their customers.

The current ICT device is an all-in-one device, offering a multitude of services and usage scenarios. Mobile payment technology is integrated and - opposed to the normal platform landscape - fully standardized due to strict financial regulations. Distributed devices, as part of the previously very popular ubiquitous computing movement, are widely utilized, but mainly rely on a special platform to interact with and provide their services.

A few weak signals can be identified that predict developments in the direction of the scenario presented above. As the scenario name already implies the biggest indicator is the decentralization of platforms and the lock on platforms due to standardization issues. This combined with the rise of user privacy awareness and a responsible use of personal information (for example by providing opt-in processes) is the most important weak signal for the scenario. Advancements concerning the Semantic Web may point towards the direction of the scenario, but these have to take place within one platform in order for the scenario to commence.

7.3.2 Scenario 3: Post 1984

In the scenario 'Post 1984', traumatized users caused strict regulation while innovation is only enterprise-driven. Back in 2010 social networks such as Facebook or Twitter connected people from all over the world. Everybody shared personal information, for example contact details or how they spent their last weekend, regardless of data privacy. After a few major data scandals a radical change of people's mindsets began. Figure 7.3 gives an overview of the driver characteristics of the scenario.

Users realized the importance of secure data and in a first step tried to delete their digital footprints and partly rejected modern technologies. Legislation was forced to follow the population's demand for a stricter regulation of user data. However, trust into new technologies has been lost, leading to a drastic change of the developer structure. NCDs mostly vanished, as nobody was willing to try out new technology and develop applications with it. The result is a high ratio of CDs, but their needs are only partly met. Even though they are highly valued by the platform, the restricted and only basic use of technology and data prevents them from having completely met needs. Those CDs have

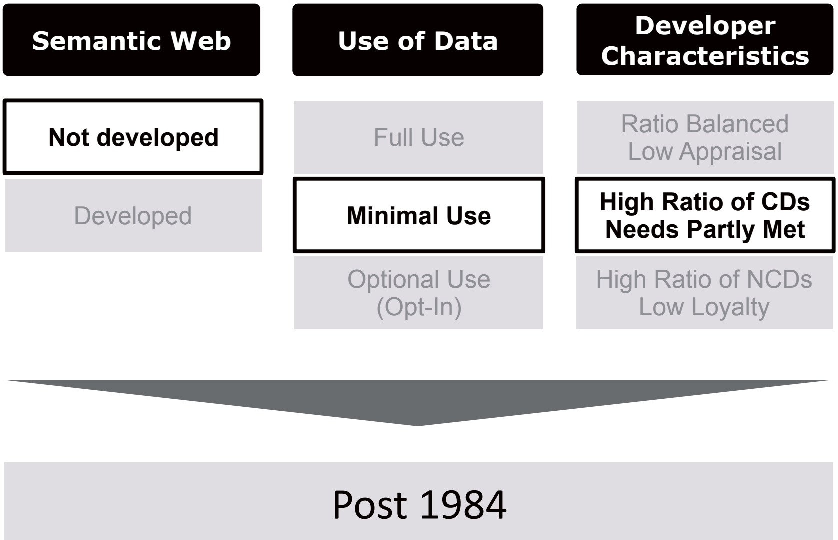

Figure 7.3: Driver characteristics of the 'Post 1984' scenario
Source: own illustration

to be attracted to a platform which is why they are offered full support as in professional coaching and a good personal network. On top of that, good partnerships, mostly sealed with contracts, strengthen loyalty so that those few available CDs stay on a platform. The Semantic Web never developed. In this 'Post 1984' world the technology of the Internet mainly stayed at the level it had been 15 years ago. The effort needed to implement a Semantic Web is still too high to be properly manageable. Maybe, technology will advance further and new ways to utilize the Internet will evolve. Then again, today's society is not too fond of the idea of a smart Internet so that development platform providers could irrevocably lose any kind of support from the society if they were to push technological development.

ICT devices in 2025 are highly specialized, but not combined in one. Until recently there had been no standardization which is why no attempt to merge devices has been made. The result for developers is a huge variety of applications which is always limited to only a part of the market. Most of the new technologies are accepted on an enterprise level only. E-Energy is largely adopted, but not in private households. Smart meters and other E-Energy devices were invented, but only used in businesses and therefore adapted to them. The same applies for cloud computing. The rejection of cloud computing on a private level does not affect its use in enterprises. A few new technologies such as E-Health were never established at all. After the population turned away from storing data comprehensively and centrally, the government and the industry tried to implement a nationwide E-Health system, but did not succeed. A similar development took place in the field of financial services. Even though the technological progress would enable billing and payment, it has never been widely accepted. Taking into account that in the last few years the situation for developers and development platform providers was rather tense, the industry organized a round table in 2020. They decided it was time for a revision of the status quo and came up with ideas to make technological advance more appealing to the population. In a first step, they just recently started standardizing both devices and interfaces. The development platform providers as one of the main players on an enterprise level succeeded in pushing their de facto standards to normed universal standards. This created a huge potential for developers. A spokesperson of one of the big players announced that there might be more NCDs if the acceptance of technology improves.

There are various indicators for a development towards the 'Post 1984' scenario. If data scandals on social media platforms or network spying occurs, a higher privacy awareness of users is likely. Another weak signal would be no improvement of the Internet towards a Semantic Web as the realization of the Semantic Web turned out to be overly optimistic. An increase of LOHAS, consumers who maintain a lifestyle of health and sustainability, would be another clear signal towards this scenario. They could consider health and environmental issues related to modern technologies as threatening and therefore reject their usage.

7.3.3 Scenario 3: Data Playground

In the scenario 'Data Playground' end users have developed trust in technology and providers and therefore enable great innovations by allowing to make use of their personal data. This is additionally fueled by a widespread adoption of Semantic Web technologies. This is presented in Figure 7.4.

During the first years of their existence there were some privacy issues on platforms such as Facebook, where user-specific data has been sold to third parties or has been subject to unauthorized use. This led to a higher awareness of privacy and data security on the user side. However, the providers of these platforms learned from their mistakes and made privacy and security of their users' data one of their top priorities. Thus, over the years the providers regained the trust of their users which started to share an increasing amount of data which then could be leveraged in new applications.

This positive attitude towards data sharing is not weakened by any restrictive regulations. The Telcos fully leverage the user-specific data on their development platforms in order to enable new kinds of applications.

The large amount of data available attracted a lot of non-commercial devel-

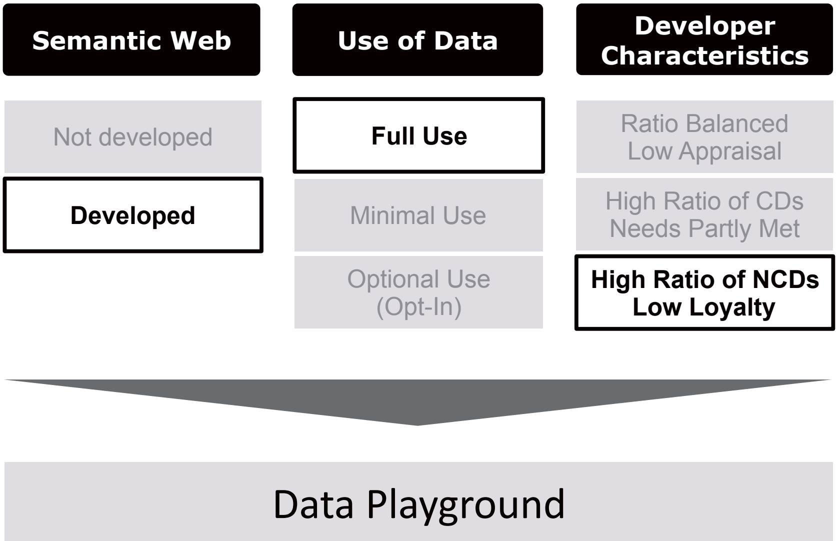

Figure 7.4: Driver characteristics of the 'Data Playground' scenario
Source: own illustration

opers (NCD) which were interested in playing around with the technology and applications that become possible when leveraging the users' data. Thus, there are much more NCDs than commercial developers (CD) on the platform. This trend has been strongly amplified by the adoption of programming paradigms such as visual programming that enabled programmers to design applications by using visual tools instead of just typing code.

There is low loyalty of NCDs towards the development platforms, because it is easy for them to switch to other platforms due to de facto standards that have been adopted over time. But still, the Telcos do not provide the NCDs with attractive offers like seminars to bind them to the platform, because there are already many active developers on the platform. This means that the NCDs have a low appraisal by the platform.

Since the idea of a Semantic Web became popular at the beginning of the century a lot of research effort has been put into that area. This finally led to a breakthrough and therefore a growing adoption of this disruptive technology. At first only enterprises started to add semantic information to the data they provided on the Internet in order to attract new customers. An increasing number of applications has been developed that used the semantic data provided by these enterprises. This raised the interest of private users which then started to adopt this technology as well.

Thus, in the year 2025 the Semantic Web technology is strongly present on the Internet and it is easy to search for semantic data using web search.

Traditional software development approaches were replaced by service-oriented architectures. In these architectures software is considered as a service which can easily be combined with other services in order to generate more sophisticated applications. The Semantic Web simplifies this process of combining services, because it can add computer-processable semantics to services provided on the Internet.

Media and information content is distributed via the development platform, but without a competitive advantage. That is because the content that is distributed is available on other development platforms as well.

In this scenario there are many different development platforms. This is due to the myriads of developers and niches for applications that allow for very specialized development platforms. Those specialized platforms compete in a large market with only a small number of general development platforms which offer a very broad variety of services and are also the biggest platforms. Media such as video and news are provided by all general development platforms. In order to make profit out of this media content they combine it with other services to generate additional value.

There is a positive attitude in the society towards existing technology as well as new technological developments. This, combined with the presence of the great amount of developers has led to a boom in new technologies. This made it hard to agree on standards, because those standards were outpaced by new technologies. Thus, there is a low degree of standardization in this world. However, some de facto standards have evolved over time, like for example in the field of the Semantic Web.

E-Energy turned out to be a big success in the world of 'Data Playground'. After intense research in the first years great effort has been undertaken to build up a smart network for power supply. Many renewable energy sources were connected to the power grid. These include wind turbines, solar collectors and tidal power plants. Power does not only come from big power plants, but also from private households that are able to use the smart network to feed their produced power into the power network in times of high request.

The adoption of E-Energy led to many new opportunities for application that were leveraged by many development platforms. Big development platforms even have contracts with power suppliers to offer exclusive additional services which give them a competitive advantage.

Similarly to E-Energy, E-Health has also been adopted. This development has been mainly enabled by the society by embracing a big technology hype. For health organizations E-Health also means financial savings because of easier patient data transfer and processing. E-Health applications are also provided on development platforms.

Another trend that emerged is ubiquitous computing which is now present to

a high degree. Typical household devices such as fridges, coffee machines and entertainment systems are wirelessly connected and communicate with each other. This is also the case for cars that communicate to prevent traffic jams. Users facilitate their mobile devices to access and control their home electronics over the Internet at any place.
Even though there were some efforts to develop an all-in-one device, this never happened. Instead many different devices were developed. An important reason for this is a multitude of different applications that are possible in this world and that could not be covered by just one device.

Over the years, cloud computing has gained increasing importance so that by 2025 it is common to do most computations within the cloud. This is the case for private users which use the cloud mainly in combination with their mobile devices that do not have enough computation power. Also enterprises use cloud computing extensively. This way they save a lot of money because resources can be used flexibly and they do not have to set up a server infrastructure.

Mobile payment is widely adopted and especially used in combination with micro payment. Users are able to give small money donations to developers of free software if they want to show their appreciation for a developer's effort. This serves as a big motivation for these developers and may empower many new innovations.

Of course not only free software is affected by micro payment, but also commercial software that can be payed on a usage-basis.

There are different indicators that point towards a 'Data Playground' development. One of them is the amount of data that is shared on platforms like Facebook. Young people grow up with Facebook and are used to sharing data such as pictures or videos through it. They have little awareness of their privacy. If this trend continues, it will be a strong indicator for the described scenario. As people are used to sharing their data developers are happy to use this data in their applications.

Possible advances in the field of visual programming also show a tendency towards the 'Data Playground' scenario. If visual programming technologies become more popular and sophisticated, more people will start to develop their own little applications and because of this might even dive deeper into software development and become professional developers. This might lead to a countless number of developers similar to the one described in this scenario.

Another very important weak signal is the evolution of the Semantic Web. If the Semantic Web achieved a breakthrough, then this would enable a lot of new applications leveraging semantic data available on the Internet, being a very strong hint towards the 'Data Playground' scenario.

Acceptance of E-Energy and E-Health also give a hint towards this scenario. If these two fields are adopted this may result in new business opportunities for development platforms. Furthermore, the platforms would be able to use the health and energy data of their customers.

7.4 Service Idea: Brokeris

With the emergence and widespread adoption of the Semantic Web, the data playground scenario allows for a fundamentally different way of how services and data are provided and composed. Thanks to standardized descriptions of both data and services, an easy and on-the-fly composition of different services and data components becomes possible. Businesses are able to run their processes leveraging a multitude of external service components that together with additional data components may interact with each other. Private end users can satisfy their personal information and service needs by linking various data sources and services. Data as well as services are decentrally provided in various clouds, offered by a large number of providers and developers worldwide. This includes large corporations as well as individual developers who develop service components and determine usage and price. Each service or data component features contractual details including price and availability as well as restrictions for usage. An interface description defines input and output data of interacting service components. Due to this meta data provided, services and data are becoming unambiguous allowing for seamless integration.

The decentralized character of services and data which are provided in a large number of clouds worldwide, poses four major challenges:

1. Service and data components that are deployed by a certain provider have to be findable for the end user. Although Semantic Web technology will improve the search process itself, semantic search algorithms are still needed to find a service or data component matching a specific user need.

2. A service supporting a business process or a certain end user need may be composed of several service components that have to be integrated into each other. Based on the interfaces provided, service components have to be bundled and possibly some logic has to be added in order to integrate these service components.

3. Although the description of service components is standardized and thereby allowing for an easy and on-the-fly integration in theory, in reality access may be restricted and subject to contractual agreements.

4. An end user service composed of several service components may incorporate highly complex billing relationships as several independent service component providers have to be paid for their individual value delivered.

7.4.1 Service Concept

The core concept of the idea of a service and information broker Brokeris presents itself as a platform where different kinds of service components available in clouds throughout the Semantic Web can be found and linked together in order to fulfill a user's request. By leveraging semantic search algorithms the platform provider is able to search all relevant service and data components and find a suitable component based on its semantic unambiguity. This request can be the need for a business process involving several service providers or gathering and visualizing of a piece of information. In both examples service and data components of different providers have to be connected and the result of the interaction has to be delivered to the user. Understanding the users' requests and providing them with relevant service or data components that can be linked together creates a significant value-add for the customer. Linking components can be done either automatically or manually with an actual developer involved. As mentioned before, the billing process may feature a high complexity if several different service components and providers are involved. This billing complexity is completely handled by the platform leveraging a self-developed micro payment system.

7.4.1.1 Unique Selling Propositions

Four major USPs build the foundation for Brokeris.

1. Discovery of Services and Data

   The quality and expertise incorporated in its search technology is a means to gain a competitive advantage. Although the Semantic Web facilitates the discovery and interpretation of services and data by its nature, the demand for a flexible service and data composition can only be satisfied by sophisticated search algorithms.

2. Connection of Services

   Connecting service components in a Semantic Web service ecosystem calls especially for knowledge in service orchestration. In complex service compositions with for example hundreds of services and components a correct orchestration of components becomes a major asset. Next to matching inputs and outputs between services, a deep understanding of process flows is necessary.

3. Certification of Services

   Service and data components in a decentralized service ecosystem face questions about their quality and reliability. Therefore platform providers offer certification for all services they accept on their platform. This aims at increasing the trust in the services offered by leveraging its strong and solid reputation.

4. Billing Services

   Service compositions within the Semantic Web service ecosystem enjoy a high complexity. Especially billing relationships and transactions within these compositions are highly complex, creating the need for a platform provider to handle this complexity. An efficient recursive micro payment solution enables Brokeris to offer transaction-based billing at reasonable cost.

7.4.1.2 Service Delivery Process

Discover
A screen that gives users the opportunity to describe their needs for a service or a piece of information is provided. Separate user interfaces for private and enterprise users meet their different needs. While enterprise users aiming at composing complex business processes get an advanced view, private end users see a simpler and personalized view. Using search technology relevant service and data components are returned to the user as seen in Figure 7.5. Service components that are registered at the platform are shown as preferred components, ranked at the top of the result view. Now the user may choose between alternative choices (if existent), or in case of a private end user simply select one of the suggested service orchestrations.

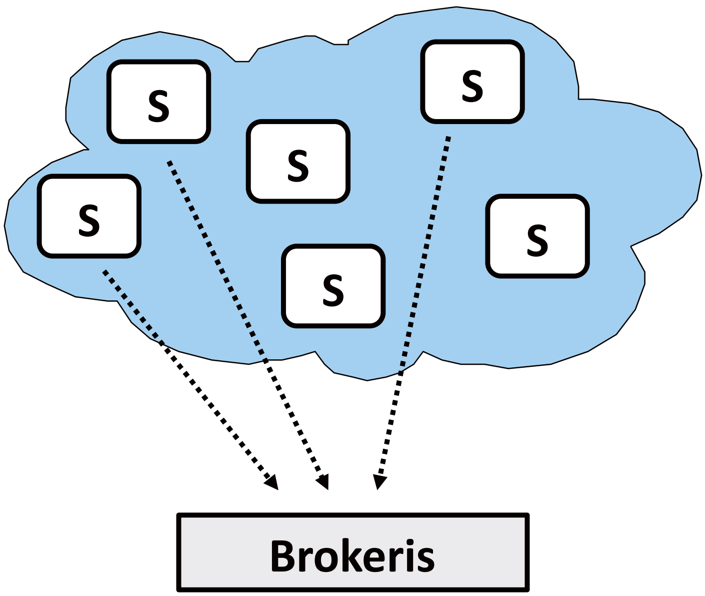

Figure 7.5: 'Discover': Automated search for service components
Source: own illustration

Connect

Figure 7.6 shows the next step, where Brokeris initiates the integration of the different service components. Although the underlying technology is the same, in this step it has to be distinguished between business and end user requests. In case of a business process, the service composition is instantly connected with existing services used within the company. For private end users an automatically and individually created front end is provided that connects the different service components and visualizes their content and interaction. Even within the Semantic Web service ecosystem some service components are not instantly connectable as a connecting component might be not yet available. In this case the user may choose whether a request to build such a service component is posted on the platform. Third party developers can see this request and offer a solution participating in a reverse auction.

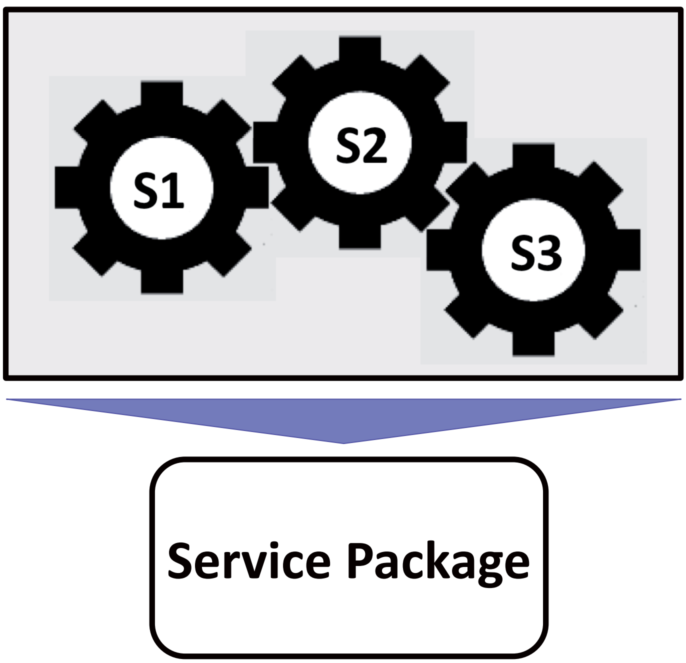

Figure 7.6: 'Connect': Logical linking of the different service components
Source: own illustration

Bill

Finally, the platform provides the billing logic needed to handle the payment of complex service compositions as modeled in Figure 7.7. The user is charged for using the service as a whole while the service providers are paid for the provision of their own service components.

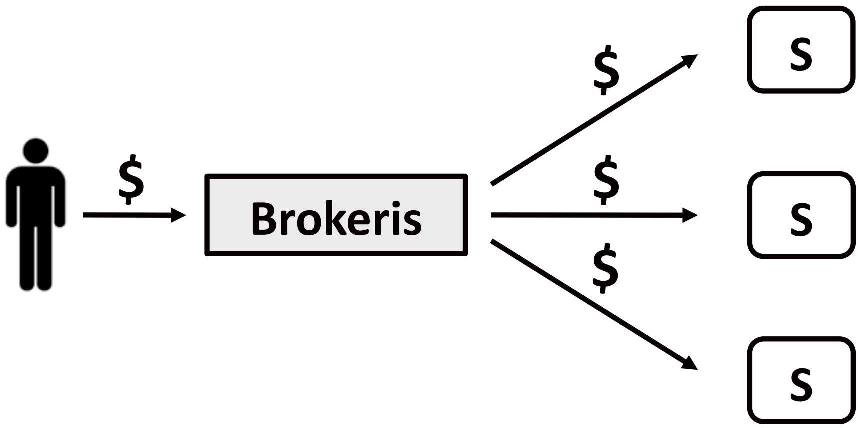

Figure 7.7: 'Bill': Handling of the complex payment processes between brokers and service component providers
Source: own illustration

7.4.1.3 Component Registering Process

Developers and providers of service and data components can register their services running anywhere in the cloud at a development platform in order to achieve two things. First, the provided service is linked with the Brokeris' payment module, making the platform the service's billing provider. This includes handling payments from others service components or users accessing this service as well as charges for other components leveraged. However, service providers are forced to register their services exclusively at the Brokeris platform. Second, a certification of a service can be requested, ensuring a high level of quality while serving as a quality signal to service users. Such services are then also advertised as preferred services on Brokeris.

7.4.1.4 Recursive Billing Model

The recursive billing model in the described service idea rests on transaction-based billing. Each service component in the service ecosystem features one billing provider who handles all payment details when invoking a service or being invoked by another service component. Whenever a service composition is established, the user is instantly billed for using the service. In order to do so Brokeris first identifies the top level components involved within the composition and adds up the individual fees for each component. The user is then charged with this amount, while a share of the total revenues corresponding to the top level services' value-add (less a handling charge) is directly credited to the service component providers if they are members of the same platform. If services of other platforms were invoked, a share of revenues is simply credited (without a handling charge) to the corresponding platform operators which in turn may credit their registered service component providers.

Recursive billing means that in a multilevel service composition for each component involved its invoked sub components are identified recursively. Picturing the service composition as a tree structure in Figure 7.8, this process continues until the very basic level of service components is reached. Each component involved and registered with the platform is only paid for its value-add to the whole service, and in case this component is registered at the platform itself as indicated by a 'B' in Figure 7.8, a small handling charge is subtracted from the amount theoretically credited to the service component provider. If, during the identification of involved service components along the tree structure, a component is found that is registered with a different platform provider, its sub components are neglected and the remaining share of revenue is simply credited to the component's platform provider. In case one of its sub components is registered at Brokeris, the corresponding service component provider is paid by their platform through Brokeris' payment module.

7.4.2 Customers

Offering a multi-sided platform two types of customers have to be distinguished, namely platform users and developers/providers. Platform users are both private end users as well as business users or enterprises requesting a service to be established or an information to be delivered by Brokeris. Users are charged either transaction-based or with a monthly fee for the services consumed. Their need for data security can be satisfied by providing secure service transactions where data flows are encrypted. Privacy controls give users the possibility to manage what data they want to share with service component providers.

The second customer group consists of both individual developers and enterprise service providers. Looking at customer needs from a developer point of view, it has to be differentiated between individual developers and professional service development companies. The latter own a strong customer base and feature a high brand recognition within the enterprise market. For them additional visibility on the platform is less relevant. However, the ability to bill their services is an area where a lot of expertise is necessary. Therefore it is attractive for all service providers to choose a platform as their billing provider for all their service components.

In contrast to that, individual developers without such a brand recognition are looking for ways to advertise and sell their services. Brokeris can help them satisfying this need by increasing visibility of their services and certifying their

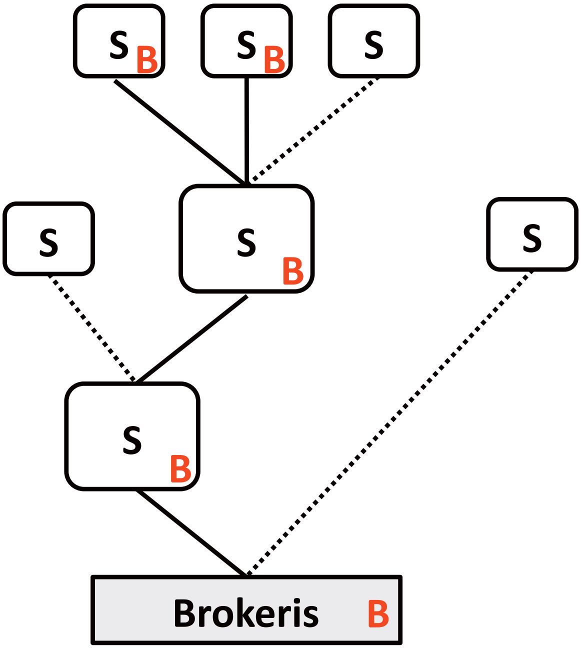

Figure 7.8: Recursive payment scheme for service components
Source: own illustration

level of quality.

7.4.3 Market and Competition

The information and service broker has to deal with a highly competitive environment in 2025.

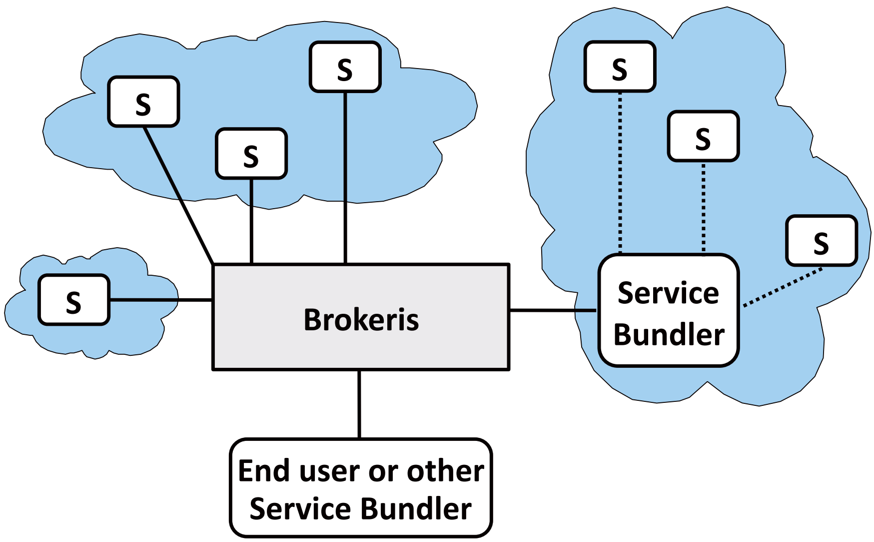

Figure 7.9: Market players
Source: own illustration

7.4.3.1 Market Players and Structure

The market for service and data components is not subject to regional boundaries as services are hosted in the cloud and accessed from anywhere in the world. This results in a truly global market where market players are distributed all over the world. It resembles a value network as the generation of value is spread over several levels and dimensions. All players interact in a highly complex network of relationships as shown in Figure 7.9 where Brokeris is part of the whole service ecosystem.

Looking only at the number of developers, a few large service development enterprises still exist, focusing mainly on highly complex enterprise service architectures. On the other hand, a large long-tail of individual developers is offering their services to other developers and users. In contrast to that, only a small number of platform providers exist that operate globally and compete for developers and users beyond regional barriers.

As services can be composed of other existing services, another market player presents itself as a service bundler who integrates different lower level services to represent a more comprehensive service. Therefore service bundlers target either developers or in combination with a fitting visualization directly to end users. Finally, demanding end users are expecting high quality service compositions that service component providers or bundlers have to deliver.

7.4.3.2 Competitors

Generally speaking, the described market presents itself as highly competitive, as entry barriers for offering new services are comparably low. Furthermore, the global reach of service and data components intensifies competition among all players in the value network. More specifically, Brokeris faces competition from direct platform competitors as well as from other market players expanding their businesses. Especially service bundlers offering comprehensive services with user interfaces can be seen as competitors when expanding their businesses to transaction-based billing. Due to the complexity of both service discovery and billing infrastructure, the entry barrier for new direct competitors is quite high, leaving direct competition between the existing platform providers.

7.4.4 Value Chain & Network

The Semantic Web service ecosystem can be seen as a large value network. From Brokeris' perspective it has to be distinguished between the internal value chain and its role within the external value network.

7.4.4.1 Internal Value Chain

The internal value generation presents itself along the described process of service composition. Discovering relevant and necessary service components located somewhere in the Semantic Web service ecosystem to satisfy a user's request marks the first step within the internal value chain. Showing the retrieved components to the users, giving them the possibility to build their service composition and providing them with a graphical interface in the end, constitutes another value-add. By outsourcing the complex billing process, service component providers can concentrate on their core service delivery. Another value-add in the internal value chain lies in the certification of registered service components. This serves as a quality signal to users, simplifying their service composition choice.

7.4.4.2 External Value Network

Seen from the external perspective, each component adds value to another component, assuming that their combined value is higher than their individual value-add. While internal component value creation follows a traditional value chain, the value creation takes place in a multidimensional value network externally. As Brokeris only leverages value within the network on a user's request, the biggest share of the actual value creation takes places within the external value network.

As Brokeris is also a member of the value network, the created value by the platform for instance can be further leveraged by enterprises which integrate composed services in their already existent service infrastructure.

7.4.4.3 Co-operations

By its nature the whole Semantic Web ecosystem as described highly relies on cooperation between its actors, as everyone of them fulfills specialized tasks within the value network. With multiple platform or billing providers in the market, cooperation between them is necessary to allow for processing billing transactions beyond platform barriers.

Next to binding developers and their service components exclusively to the platform, other service or content providers can be offered partnerships to gain direct access to the many users accessing Brokeris.

7.4.5 Revenue Model

Transaction-based billing presents itself as Brokeris' main revenue source. Whenever a service component is invoked that is registered with Brokeris, a small share of its value-add is charged to the user or service. This amount is either paid by one of Brokeris' users directly or by another platform if one of their users or services invoked a service component registered at Brokeris. It is easy to see that in complex service compositions a multitude of components has to be paid with small amounts of money. As Brokeris can only generate revenue when one of its registered services is invoked, there remains a strong incentive to attract specifically component providers to the platform which are popular and generate high revenue.

In addition to transaction-based billing further revenue streams may come from service or content providers who are offered preferred spots in the result view for component discovery as well as the certification of service component providers.

7.4.6 Visualization

Figure 7.10 shows an exemplary business tool for a vendor of ice cream, who needs an efficient solution for running his business. Key elements are the payment and procurement processes as well as advertisement. Brokeris combined different modules to fulfill this task. First there is a database provider, who stores all business related data like payment details and the quantity of ice cream sold. The mobile payment provider offers the tools that enable customers to pay with their mobile phones or without using any kind of physical money. A procurement provider is integrated to ensure supply with the ingredients needed to create ice cream. Attracting possible customers is the main task

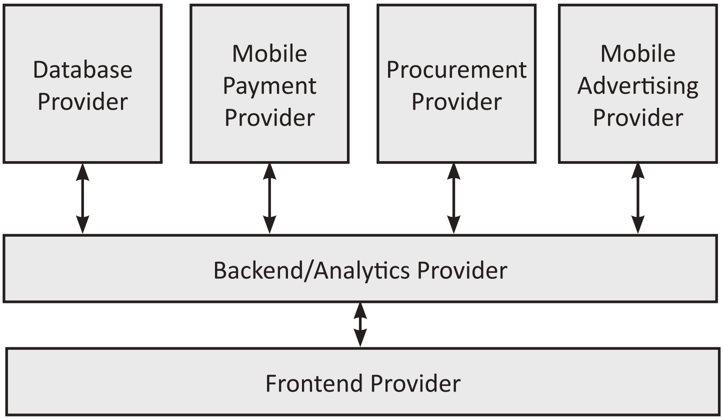

Figure 7.10: Possible service components and interconnections for an ice cream parlor
Source: own illustration

of the mobile advertisement provider who could for example target potential customers via advertisement in location based mobile applications. The back end provider orchestrates the involved interfaces and analyzes the exchanged data. This could be for example information about consumer behavior that can be derived from a combination of the mobile payment data and an input by the shop assistant. The front-end provider visualizes the data needed by the shop owner and provides an easy-to-use interface for inputs.

Figure 7.11 shows a possible Brokeris interface for linking the different service components for a specific business process. A possibility is offered to the user to choose out of different alternatives for one task. The user can define different actions that occur between the various providers.

7.5 Conclusion

Development platforms and their providers will undergo drastic changes in the next fifteen years. This report thoroughly looked at the driving forces behind this development. Its direction cannot be foreseen with certainty. In order to get a rough picture of the possible environment of Telcos in 2025, three

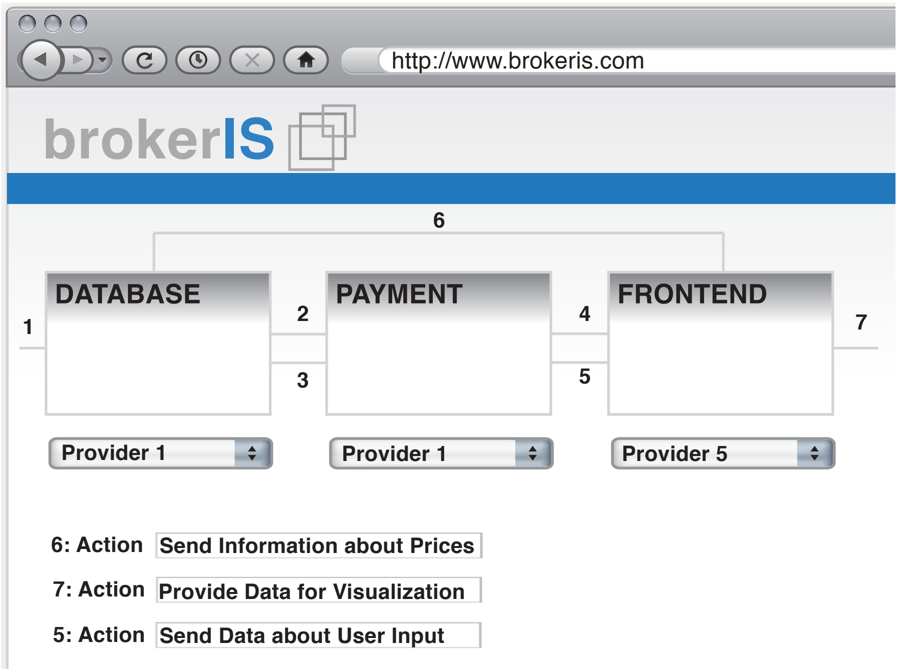

Figure 7.11: Mock-up of an exemplary composition
Source: own illustration

scenarios have been modeled. Each is based upon the same main influences, namely user data, Semantic Web and developer characteristics. Considering that every driver has at least two conflicting possibilities, the scenarios are coherent in themselves, but opposing each other. At the end of each scenario, so-called signposts are given to indicate a direction.

The scenario 'Scattered Islands' predicts an advance in technology, but no implementation of the Semantic Web. Nonetheless, service platforms have greatly improved and compete for developers, who are bound to a platform due to restricted compatibility.

The second scenario 'Post 1984' describes a world, in which data security is high, influenced by privacy awareness. As a result, developers are rare. The same applies for services and applications, since a general reluctance of technology anticipates great innovations, such as Semantic Web or Payment and Billing services.

In 'Data Playground', the last scenario, positive experiences throughout the years led to a wide leverage of data. Consequently, developers and enterprises make use of it by highly innovating services and products. The introduction of the Semantic Web amplifies this trend. This scenario seems the most likely, which is why the service idea Brokeris is created within it.

The information and service broker Brokeris fully takes advantage of the Semantic Web by combining three core functions: Discovering, Connecting and Billing Services for both private and enterprise users. The Semantic Web, where every piece of information has its own meta data, might simplify general search. However, finding adequate service components to create for example business process tools could be rather complicated. Various clouds could exclusively offer certain modules and input and output data could not be aligned when combining components. That will be done by Brokeris or, if more complex, by third party developers. The last function within Brokeris is handling highly complex billing structures. The customer who requested the service will pay on a usage-basis. That results in multiple billing interactions each time, which can only be accomplished by a specialized company such as a telco.

Nobody knows what the future will bring. The three scenarios given in this report and the underlying drivers help development platform providers to get a better understanding of the challenges that are yet to come.

Chapter 8

8 Enterprise Services

David Bellem, Indranil Bose, Paul Laechelin, Hanna Renz, Tim Tetzlaff

The advent of innovative technologies has the potential to revolutionize the enterprise services market. Opening up a multitude of distinct paths for developments, the acceptance and feasibility of ubiquitous computing, enterprise cloud computing as well as new forms of communication and collaboration within the workforce are key drivers shaping future enterprise services. While companies from different industry backgrounds are pushing into this segment by offering developer platforms, communication service providers are yet to find their role.

In this report, three scenarios for 2025 are outlined to give a framework for strategic planning in the market for enterprise services. The first scenario **It Was All Just a Hype** is mainly characterized by the infeasibility of industry wide implementation of ubiquitous computing and the reluctance to outsource critical business processes into public clouds. Conversely, in the scenario **Realm of Reluctance** both enterprise cloud computing and ubiquitous computing are feasible from a technological point of view. However, the future workforce's reluctance towards new ICTs hinders the technologies from unfolding their full potential within enterprises. The third scenario, named the **Flat World**, with its full acceptance and availability of ubiquitous and cloud computing in everyday life and business processes, is assumed to be the most likely.

The innovative service offering **pluS ME** aimed at small and medium sized enterprises is introduced to illustrate the opportunities for communication service providers in this scenario for 2025. From a customer perspective pluS ME is an application with flexible payment schemes that allows for the optimization of business processes and the usage of smart devices, interconnected by the communication service provider's network. From a developer perspective pluS ME is a cloud based platform building on telecommunication and ubiquitous computing services. As small and medium sized enterprises are faced with global competition and an interconnected business environment in the Flat World, pluS ME enables them to take advantage of numerous applications and smart devices to succeed in global e-commerce.

8.1 Introduction

The advent of innovative technologies such as ubiquitous and cloud computing has the potential to revolutionize the way business is conducted. Modern communication and collaboration tools enable enterprises to take part in a global market environment. With increasing complexity of interactions, the suitable integration of business software solutions becomes a vital factor to ensure a firm's sustainable competitiveness. As a consequence, the market for business service solutions is expected to grow. While companies from different industry backgrounds are pushing into this market, the role of Communication Service Providers (CSP) in these developments remains unclear. Traditionally they have provided basic communication services to enterprises and are currently exploring ways to expand their business offerings. Examples include the provisioning of cloud computing services and the deployment of Service Delivery Platforms (SDP). For CSPs, a solid understanding of future enterprise needs is essential to finding a successful long-term strategy.

This report identifies and analyzes major driving forces of future developments up to 2025. These drivers open up a multitude of distinct paths. The combination of extreme directions of the forces results in plausible scenarios. These provide a framework for the evaluation of strategic options in the enterprise services sector. Building on the most likely scenario, a product idea for enterprise services is introduced and thoroughly analyzed to illustrate the opportunities for CSPs in 2025.

8.2 Driver Analysis

The following section features ten drivers shaping the world that enterprises will face in 2025. While there are six certain drivers which are considered to take a reasonably predictable development, four drivers with uncertain outcomes are also identified. Out of these, the ones featuring the highest impact while also being highly uncertain are considered key drivers. Figure 8.1 displays these findings.

8.2.1 Certain Drivers

The six certain drivers described in the following section are expected to follow a well-predictable future development. Nevertheless, they will distinctively shape the world of 2025.

8.2.1.1 Landline Broadband Access

Broadband is often called high speed access to the Internet. The United States (U.S.) Federal Communications Commission (FCC) as of 2009, defines

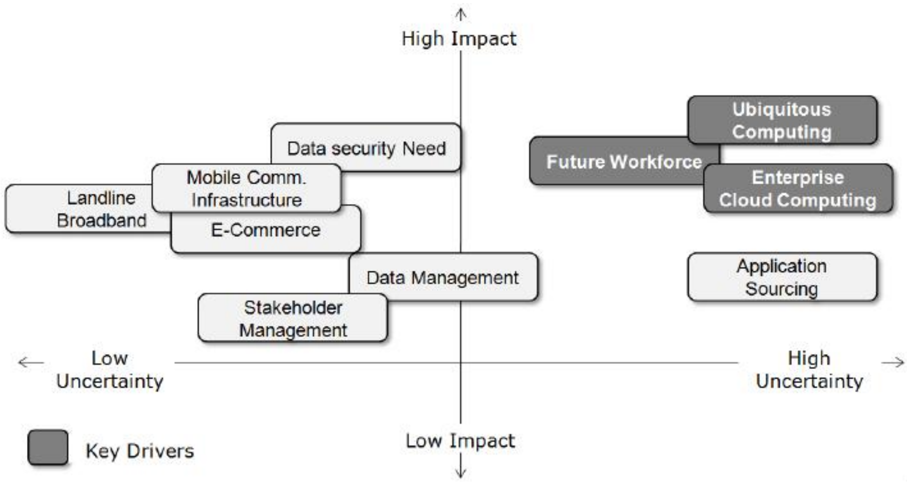

Figure 8.1: Visualization of the main drivers influencing the world of enterprise services and applications in 2025
Source: own illustration

basic broadband as data transmission speeds exceeding 200 kilobits per second (kbit/s), in at least one direction. The trend is to raise the threshold of the broadband definition as the marketplace rolls out faster services [189]. This is of particular importance to enterprises in the services sector as this enables them to transfer large files instantaneously over high bandwidth connections. Leaving aside the immediate benefits of quicker downloads and simultaneous web and phone use, broadband-enabled businesses have access to a wide range of other benefits and facilities. These include services such as webcast seminars as an innovative and cost-effective way to train staff, video-conferencing to cut down on travel cost as colleagues and clients communicate face-to-face despite being hundreds of miles apart. Recognizing the importance of broadband as an essential business tool, enterprises are proceeding to empower themselves with this technology.

Broadband enables access to high quality Internet services such as streaming media, VoIP, gaming and interactive services. Most of these current services and also those being developed for the future require the transfer of large amounts of data in a very short instance of time, something which is not technically feasible with dial-up services. Therefore, broadband services would be increasingly necessary to access the full range of services and opportunities that the Internet can offer. One key essential advantage of broadband besides greater bandwidth is that it is ’always on’; meaning it does not block phone lines and that there is no need to reconnect to the network after logging off.

There have been three major contributing factors to the growing importance of this topic globally. Firstly, there has been a concerted effort from governments around the world to push for a policy on broadband such that it plays the role of a great equalizer. In the U.S. the Broadband Technology Opportunities Program established under the American Recovery and Reinvestment Act of 2009 is one such prominent example [398]. The FCC in conjunction and coordination with the National Telecommunications and Information Administration has been tasked with creating a comprehensive National Broadband Plan. It further states that the National Broadband Plan shall seek to ensure that all people of the United States have access to broadband capability and shall establish benchmarks for meeting that goal.

Secondly, with the emergence of mobile applications such as video streaming, online media sharing, and other resource-hungry data services, there is a critical need for existing mobile networks to support larger capacity and greater bandwidth. This is enabled through the use of high-bandwidth optical fiber based back-end networks. Emerging applications including context aware services and mobile advertising have also added to the need for a complete broadband experience. The ability of backhaul technologies to satisfy high-bandwidth needs serves as a major force, driving their immediate adoption among the fraternity of service operators globally. Research into this field finds that offering a hybrid framework capable of supporting multiple services is expected to be the way ahead for the developers and vendors in the backhaul domain [199].

Thirdly, the push from enterprises towards cloud computing has created a need for a robust landline broadband access availability. Cloud computing is expected to be the top most technology area IT concentrates on in the year 2010 [205]. With companies like Microsoft through its Azure platform, IBM, EMC and Amazon all having established themselves, there continues to be a surge from other companies in the similar direction.

As governments worldwide are pushing for a higher level of broadband connectivity, the future will see a drastic increase in the availability of broadband access. A global broadband fiber based network with more than 1 Tb/s on optical fibers over long distances can be expected.

The implications of this might be that enterprises will migrate towards an almost-instantaneous computing paradigm. Cloud computing would in reality be a very feasible option. In general it will lead to a better connected world.

8.2.1.2 Mobile Communication Infrastructure

Mobile communication infrastructure describes the availability of high speed mobile Internet access technologies and the spread of smart handheld devices, which allow for an extensive usage of this network. The environment enterprises have to navigate in is growing ever more complex. Projected developments in Business-to-Business (B2B) relationships such as the increasing importance of the value network underline the significance of efficient enterprise collaboration.

A universally available and reliable high speed mobile network could serve as a foundation to address these issues.

Enterprises profit from a holistic incorporation of the mobile Internet infrastructure, since it enables them to optimize communication, collaboration and business-processes.

Regarding the deployment of high speed mobile Internet access, the 4th generation Long Term Evolution (LTE) network is supposed to be introduced in Germany in 2011 [416]. LTE will feature high speed data transmission rates. These are scheduled to rise to a multiple of current day DSL speeds. 50 Mbit/s will be reached for upload links while download will eventually be offered at 100 Mbit/s. Furthermore, LTE will feature a wide bandwidth range from 1.25 MHz to 20 MHz to support a broad set of device capabilities [288]. Intensive real world environment testing is already taking place around the globe. In Europe, the Deutsche Telekom subsidiary T-Mobile is operating the largest LTE testing network in Innsbruck, Austria [421].

Another factor having an impact on the mobile communication infrastructure is the spread of smart and highly capable handheld devices enabling an exhaustive use of the 4th generation network environment. Mobile Internet enabled smartphones will account for one third of phone sales in 2010 compared to 20 percent in 2009 and are projected to gain even more market share [90].

By 2025, the mobile communication infrastructure is expected to be a reliable backbone for enabling innovative enterprise services. Governmental infrastructure plans and the advancements in handheld devices drive this development. Living in a networked world, it can be deemed possible to have high speed Internet access independent of location. Additionally, the general availability of highly capable mobile devices could lead to an increasing importance of cloud based services. With mobile file transmission no longer facing a bottleneck problem, uploading larger amounts of data will be possible. Furthermore, combining LTE and high quality optical fiber networks allows for the opportunity of a seamless high speed Internet connection.

8.2.1.3 Data Management

Managing, organizing and using data in a meaningful way will be a necessity for a competitive enterprise in the future. The advent of sophisticated data management technologies is likely to shape the world enterprises will find themselves embedded in 2025. Highly capable data management technologies could allow for extracting enterprise relevant information from unstructured databases in an exceptionally resource efficient manner.

A prerequisite for a meaningful management of data is the ability to store large amounts of data at reasonable costs. Today, widely spread hard disk drives already feature capacities of up to 2 TB [464], while solid state drives, which are mainly built into mobile devices, incorporate a maximum of 1 Tb [303]. At the same time however, the advent of services such as Amazon's Elastic Block Store offers the opportunity for a distributed, cloud based approach to data storage [55].

Technologies like data mining and data warehousing enable enterprises to recognize patterns and anomalies in huge data sets. They are used in enterprise units such as controlling, monitoring, marketing and finance where they provide a competitive edge [129]. Furthermore, companies specializing in business analytics have become an interesting acquisition target for global information technology corporations. In 2009 for instance, IBM expanded its corporate portfolio by purchasing SPSS, a company specializing in predictive analytics [239].

In the networked world of 2025, storage of data is not expected to be a serious issue for enterprises anymore. With cloud based offerings such as data storage as a service accounting for a high market share, the possibility to store an abundance of data will no longer be reserved to large corporations with proprietary server farms.

More and more services will be distributed, managed and executed online. In such an All-IP environment, where every click, page visit and purchase could be logged, the creation of new data will reach dimensions unheard of today.

Facing an increasing global level of competition, enterprises will need to put the available data to use. Therefore, semantic web technologies will mature and allow for linking multiple databases using meta-data-description languages. Social mining and social intelligence technologies are expected to enable enterprises to analyze unstructured social content on an intra and possibly supra-enterprise level.

8.2.1.4 Stakeholder Management

Stakeholder Management describes the process of measuring, managing and monitoring stakeholder relationships. Stakeholders of a corporation are the individuals and constituencies that contribute, either voluntarily or involuntarily, to its wealth-creating capacity and activities and that are therefore its potential beneficiaries and risk bearers [364, p. 19][477, p. 15]. Based on the trend that stakeholder management becomes more important [364, pp. 12-14], it can be concluded that enterprise needs for software support in this field will increase.

The most important stakeholder groups of an enterprise can be clustered into social-political arena, industry structure and resource base as shown in figure 8.2. Some of these groups are already well managed by enterprise applications. For example, customers are usually dealt with in Customer Relation Management (CRM) systems and supply chain associates in Enterprise Resource Planning (ERP) systems. However, current enterprise systems have two main shortcomings regarding future enterprise needs. On the one hand, most applications are not integrated, meaning that companies often have separated

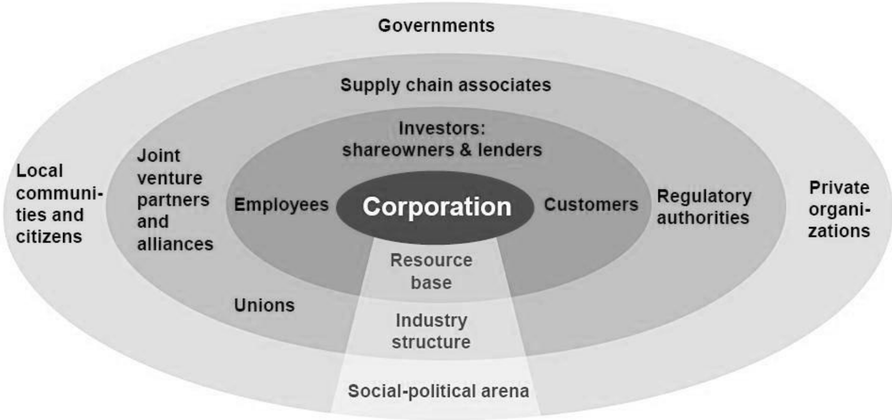

Figure 8.2: The stakeholder view of a corporation
Source: Post [364, p. 55]

enterprise applications such as ERP, CRM or data management systems. On the other hand, some stakeholder groups, which are mainly out of the social-political arena, are not yet covered by enterprise applications.

It can be assumed that integrated stakeholder management applications will be needed by enterprises in the future based on two reasons. First, data management is expected to improve drastically in the upcoming years. New technologies in the field of intelligent data management will introduce new opportunities of leveraging available data (refer to 8.2.1.3). Second, enterprise environments are expected to become more complex, dynamic and integrated [335, p. 4]. This means that a company's success in the future will be highly dependent on its capabilities to handle complex decisions with respect to the interests of many different stakeholder groups. Companies would require applications helping them to identify, prioritize and manage those stakeholder groups which could influence the corporation's success.

Future stakeholder management systems could be integrated within a company's larger data management system. Enterprise systems for individual stakeholders such as CRM or ERP systems would be included in one stakeholder management software which covers all relevant interest groups of a corporation. This software could analyze all information of a company and identify for which stakeholder group it might be interesting. One can think of an application which automatically informs stakeholders about relevant information. This would require strong relationships with all business partners. In order to also include stakeholders of the social-political arena, future stakeholder management applications would need to be shaped according to the specific characteristics of this group. Compared to private organizations, governmental institutions are usually organized more hierarchically and therefore would need to be handled more formally.

8.2.1.5 Business-to-Business E-Commerce

Enterprises see the Internet-based interchange of goods and services as a key to ensuring continuous growth in their business. Besides offering their products and services to consumers, business-to-business transactions are gaining importance. With the emergence of complex multi-enterprise forms of value generation this kind of e-commerce will be vital for success and significantly shape future business interactions.

Business-to-business e-commerce links suppliers, customers and logistic partners together and reduces costs between 5-35 percent, depending on the industry, compared to traditional communication [270, p. 10]. Optimization of the inventory on hand, shortening of production and distribution processes, efficient financial transactions, reduced overhead costs and world wide availability of services and products are some of the advantages e-commerce has to offer [219]. In some industries large e-commerce platforms, such as Elemica[1] in the petrochemicals industry, already exist today and further facilitate interactions between businesses by providing a single network where buyers, partners and suppliers can integrate their supply chain to improve their order fulfillment, procurement, logistics and sourcing. To successfully make products and services available to a large number of business partners around the globe, trust is an important issue. Getting unknown partners to trust in one's ability to deliver products and services is a challenge that needs to be addressed.

Showing large growth in the past and a forecasted EUR 636 billion market in Germany in 2010 B2B e-commerce is already playing an important role and can be expected to significantly shape the future (see figure 8.3). Growth rates of approximately 9 percent in business-to-business software until 2013 for Europe, Middle East and Africa [296], further underline the trend that business transactions could become predominantly web-based. Technological and regulatory advancements such as ubiquitous computing, the e-Brief[2] and legally valid e-invoicing could further propel this development.

The future of e-commerce is likely to lead to a tight integration of enterprises with their surroundings, creating an interdependence of many partners and demanding for the continuing development of online relationships. Small enterprises could profit from e-commerce software as a service and take part in this global marketplace. With the increasing acceptance in a business environment, web 2.0 technologies potentially enrich e-commerce offerings through community and social network concepts.

[1] http://www.elemica.com
[2] http://www.deutschepost.de

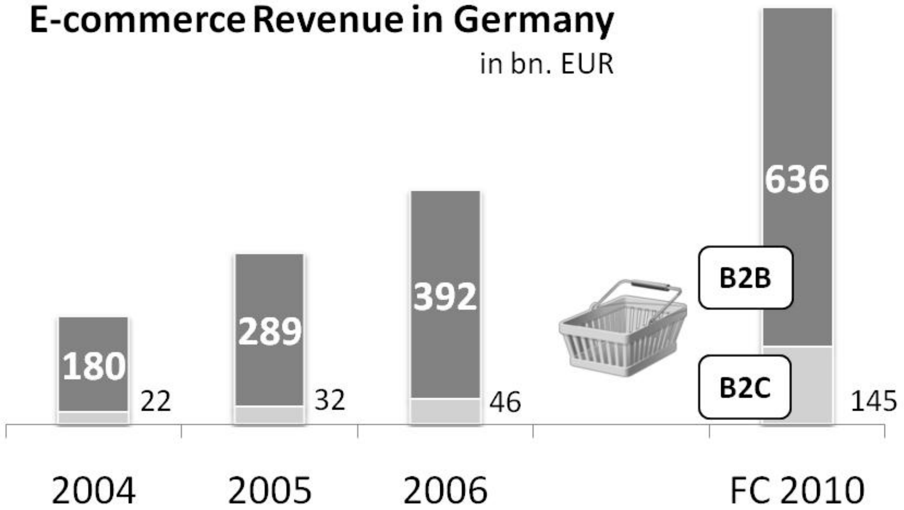

Figure 8.3: Market size of e-commerce in Germany from 2004 to 2006 and a forecast for 2010
Source: BITKOM [85]

8.2.1.6 Data Security Need

Data security is the means of ensuring suitably controlled access to data [246]. Enterprises are adopting distributed applications and thereby exposing themselves to increasing security risks. It can be concluded that the ubiquitousness of information technology will lead to a growth of data security regarding enterprise applications.

Under current governmental legislation, uniform rules to ensure a basis for data security are missing. Although there are some accepted norms regarding IT governance and information security such as ISO27001, many legal gray areas in the field of data security exist [250]. Rulings often rely on the interpretation of general norms of civil and public law, which most of the time do not consider the complexity of technology [15, p. 60]. This leads to a situation where enterprises approach security management very differently. As of today, most application providers guarantee a certain level of data security in order to meet the high requirements of enterprises. Nonetheless, enterprises increasingly tend to set up their own supplementary security management projects [112, p. 11].

That enterprises' data security need is expected to further increase in the upcoming years, is based on four aspects. First, the emergence of new technologies in the fields of workforce communication and collaboration could lead to secure authentication and identification becoming increasingly important. Enterprises would only adapt new communication and information technologies if secure intra and intercompany information sharing was ensured. Second, enterprises are expected to create an increasing amount of digital data mainly resulting from more online activities such as sales, services and marketing [cross reference e-commerce]. New possibilities to store, collect, provide and share data would foster this aspect. Third, organizational changes resulting in increased communication might drive the need for data security. Finally, there is the threat of industrial espionage from competitors. In past years, companies saw their data at risk primarily due to mistakes or a lack of awareness on the part of employees. Malware and external attacks only came in second. As this situation is expected to change, enterprises require business applications to be protected against potential attacks [15, p. 13].

8.2.2 Uncertain Drivers

The following section elaborates on unpredictable forces which influence enterprise services in 2025. The development of these drivers is ambiguous and has a vital impact on the characteristics of future outcomes.

8.2.2.1 Application Sourcing

Application sourcing is the procurement and maintenance of software applications and is vital for companies to efficiently use their resources. Despite being a key for all business activity, the sourcing of the right applications has often become a barrier to success and a major distraction from core business pursuits. This leads to a serious impact in the enterprises ability to grow and drive innovation at both a technical and business level. As an organization's efficient functioning is embodied in the complex portfolio of applications which represent its business processes, it is imperative from an application platform provider's point of view to house the right kind of applications to satisfy this need. Therefore, application platforms should be able to provide a wide range of software products to cater to enterprises spread across various lines of business.

Managing the applications that drive a business has become increasingly complex as organizations have to balance supporting their existing technologies whilst continually changing to take advantage of the latest technologies. This can be an enormous challenge especially when factoring in resource constraints and business risk impacts.

There are four broad forces that contribute to different aspects of application sourcing. Firstly, in a world where businesses are proactively adopting Service Oriented Architecture (SOA) principles into their business restructuring process, the role of IT within a company is changing. SOA enables reuse and interchangeability of services through modularity. This presents the possibility of companies to use a multitude of applications for their IT purposes.

Secondly, there has been a growth in developer platforms worldwide. These have further enabled application developers to build on ever improving platforms with robust and easy to use Application Programming Interfaces (API). With the various platform offerings on the rise, the challenge has been to get more developers on board than their contending counterparts.

Thirdly, most successful Internet websites have expanded to become a platform offering, leveraging from their large existing user base to attract developers. In fact a majority of Internet start-ups these days are application development companies focused at these very platforms [210].

Lastly, with almost all big Internet players such as Google and Microsoft venturing into application development platforms, a diverse market space of various products and services has been created. Communication service providers are looking to enter the platform space to enrich their service offerings. Having the network infrastructure in place, Communication Service Providers (CSP) are in the unique position to integrate their existing communication services such as voice telephony, SMS and MMS into platform offerings.

It is uncertain if enterprises will stick to their exclusive IT structure of proprietary systems or accept applications based on standardized platforms. Additionally, entities developing these application could be either independent developers or collective development companies. Lastly, the acceptance of SOA within enterprises as opposed to the complex hierarchical structure creates uncertainties regarding future application sourcing.

The uncertainties regarding application sourcing lead to two possible developments. The first possibility might result in a fractured market space with a lot of players. Developers would then create applications for various platforms. The long tail effect ensures that niche developers have their own market space. All businesses are structured according to SOA principles. IT functions within an organization are no longer a differentiator. There would be a growth in consortium based standardization across most platforms to enable similar APIs for developers. Additionally, a drastic reduction in cost due to reuse and high modularity is expected. Small and medium sized enterprises would increasingly adopt modular systems to benefit operationally. And lastly, the demarcation between users and developers fades away slowly meaning that the user would be enabled to develop apps for his own needs.

The second development would see few big players offering large platform based services. These platform providers would gain maximum importance due to exclusivity of applications on their platforms. They would then provide these platforms to enterprise customers with a plan to customize and refit applications as per the organizational needs. IT would become a very important feature within a company as each company has its own structure. Platform providers such as SAP or Telekom would be customizing applications on their platform for the specific use by the enterprises. Developers would be tied down through employment agreements and contracts to these large platforms. Lastly, SMEs would find it difficult to invest in such an expensive system of development and largely would not adopt it. This would lead to a market where only large enterprises benefit from the exclusive and customized nature of these services.

8.2.2.2 Enterprise Cloud Computing

Enterprise cloud computing refers to the utilization of cloud computing within enterprises. Cloud computing in general comprises of both the delivery of information technology services over the Internet and the infrastructure that provides these services. Enterprises display an exhaustive demand for fast and reliable data storage and processing. Against the backdrop of ever more integrated business processes involving a multitude of stakeholders this need might become insatiable. Cloud computing offers the opportunity for theoretically infinite on–demand computing resources, possibly solving this problem [69].

When thoroughly applied, cloud computing translates into a decentralization of storage and processing. Figure 8.4 depicts this separation of displaying and computing. Exemplary utilities offered in the cloud include:

- Software as Service (SaaS): The provision of applications running in the cloud with a prominent example being Salesforce.com [32].
- Platform as a Service (PaaS): The provision of a software development platform in the cloud. Microsoft Azure is a current example for a PaaS offering [306].
- Infrastructure as a Service (IaaS): The provision of computional resources. Amazon's Elastic Compute Cloud (Amazon EC2) serves as an example [56].

There are different deployment models of cloud computing. When using public clouds, enterprises employ generally available resources and services of external providers such as Amazon and Google. In contrast, a private enterprise cloud would utilize corporate data centers to realize benefits from decentralized storage and processing, while the term hybrid cloud embraces aspects of both models [77, pp. 120-122].

Potential benefits for an enterprise are plentiful. With the computing being taken care of in the cloud, a new level of data processing intensive mobile applications could revolutionize everyday business life. Furthermore, highly complex business analytic processes could be performed in next to no time. By utilizing the theoretically infinite computation cloud resources for parallel batch processing, huge sets of data can be analyzed. The elimination of high initial investments allows enterprises to rent computing resources on a short term basis and thereby lowers costs and increases flexibility. The projected ongoing growth of the cloud computing market in the near future underlines the awareness businesses have of these benefits. Figure 8.5 shows the predicted annual growth rate for cloud computing services until 2013 [375].

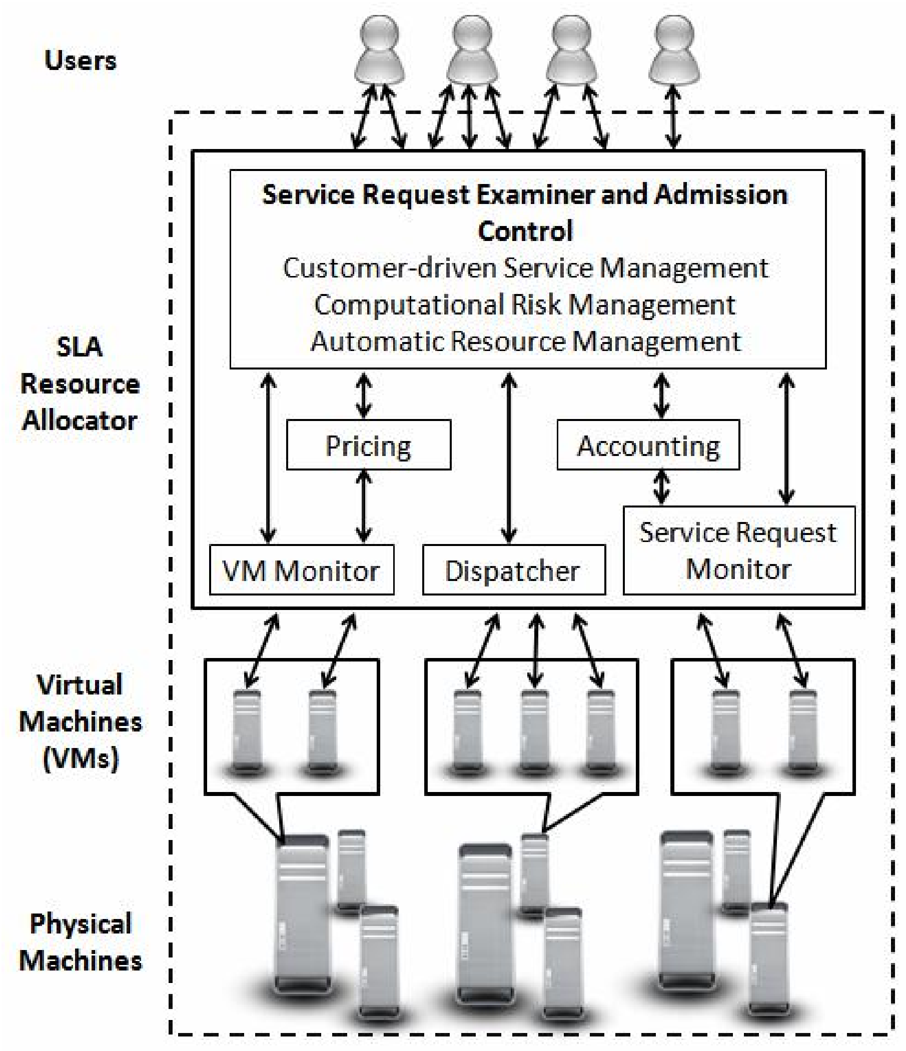

Figure 8.4: Cloud architecture
Source: adapted from Buyya et al. [111]

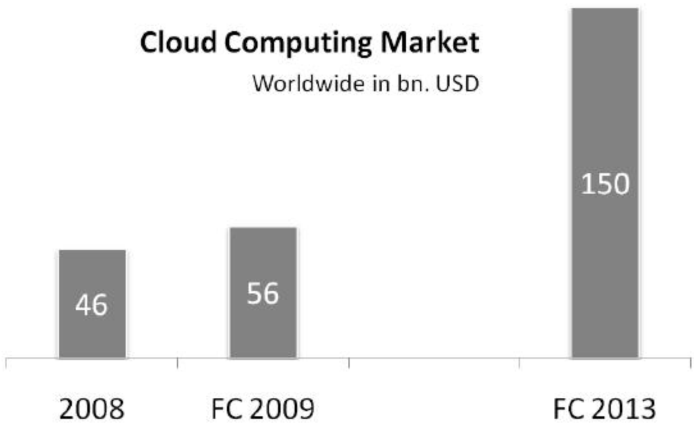

Figure 8.5: Market growth cloud computing
Source: Gartner [375]

Nonetheless, obstacles are associated with the general acceptance of cloud computing in the business world. For a thorough integration of cloud computing services into enterprise processes, the reliability and availability of these services are crucial points. Being dependent on a large-scale distributed system exposes businesses to external non-controllable risks. Furthermore, the outsourcing of all data storage and processing bears the risk of a vendor lock-in, hindering the general acceptance of cloud computing. Standardized APIs for the integration of diverse vendor offerings could help to overcome this obstacle. Data transmission into the cloud could constitute for more drawbacks. Besides doubts about data confidentiality and auditability, the necessity of ubiquitous high speed Internet access for a timely upload of huge data poses another considerable concern [69, p. 12].

The world of 2025 could envision a general acceptance of cloud computing services. Concerns might be overcome to such a degree that the use of a public cloud is common practice. In this development, cloud services are reliable and intercompatible and have become a vital part of streamlined business processes. Therefore, enterprises can realize mentioned benefits such as cost efficiency and location-independent computing power.

However, it also seems plausible to assume that external shocks, regarding e.g. privacy issues, have stirred skepticism towards cloud computing. In such a development, enterprises refrain from having their data migrate into public clouds, thus the deployment of proprietary private clouds would be a logical consequence. While basic benefits resulting from the decentralization of storage and processing can be realized within enterprises, the prospect of interoperable cloud services for inter-business integration will not become a reality. Enterprises could gain a competitive edge by investing into the development of highly capable private cloud systems. However, these would only unfold their potential within the boundaries of firms.

8.2.2.3 Ubiquitous Computing

The term ubiquitous computing refers to the integration of computing and networking into everyday objects in such a way that these smart devices weave themselves into our daily lives, providing computing, content, connectivity and sensors everywhere [315]. Besides enabling innovative end-user products this technology helps to address the problems of media breaks between the physical world and its representation in the information system (see figure 8.6). This opens up vast opportunities for enterprises by reducing integration costs and allowing for automation.

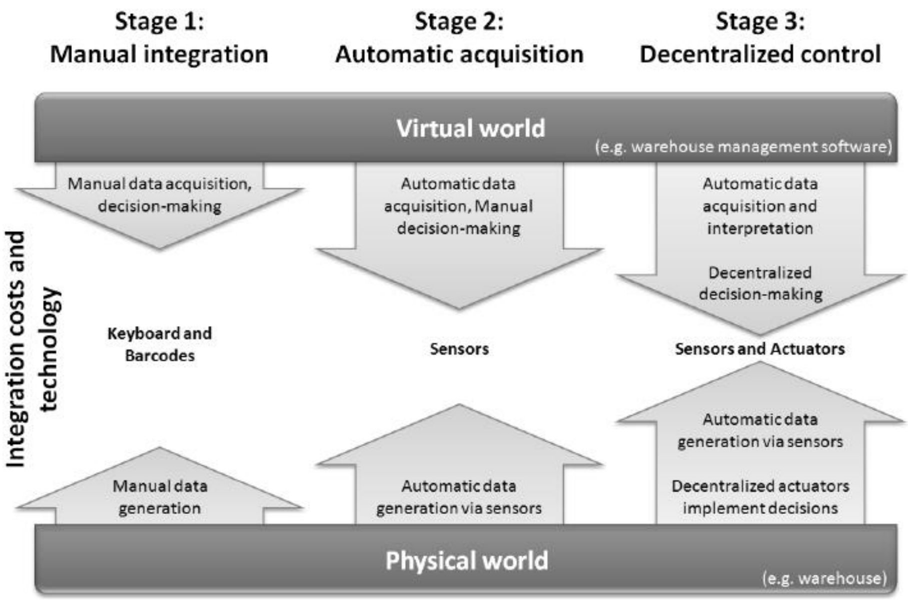

Figure 8.6: Media break between the physical world and its representation in the information system
Source: adapted from Fleisch and Dierkes [194, p. 6]

Ubiquitous computing is mainly driven by technological advancements in material sciences, communication and sensor technology. Visionary prototypes are directing lots of attention towards ubiquitous computing. Be it a medical cabinet able to detect the level of pollen and suggesting appropriate allergy medicine when sensing it's owner is in the vicinity [186, p. 84] or new forms of communication through smart devices [307], the technology has the potential to change our daily lives and forms of interaction. Currently, expectations in enterprises are mostly promoted by the use of Radio Frequency Identification (RFID), a technology closely related to ubiquitous computing. For example, RFID enables wireless part replenishment at Ford, fresh food tracking at Sainsbury and cool chain management at Infineon [414]. The forecasted growth of the RFID market to over USD 3.5 billion in 2012 with businesses expanding the use of RFID from initial pilot projects underlines its increasing importance. Nevertheless the RFID technology is far from wide adoption as functionality is still limited and many applications unfeasible [204].

Despite stirring lots of attention and expectations ubiquitous computing faces three main challenges, making its future outcome and impact highly uncertain. Firstly, further technological advancements are necessary to promote ubiquitous computing. Developing devices and sensors that can operate autonomously while at the same time having an adequate size and low costs will continue to be a key challenge. Additional infrastructure is also needed to leverage the full benefits of decentralized control, data and computation. Besides appropriate networks such as WiFi or the planned LTE for connectivity, standards and middleware are necessary to ensure proper and reliable connectivity and communication. With increasing amounts of data distributed and communicated among many devices, data management becomes an integral part of the technology. Additionally security needs to be addressed in an appropriate manner to prevent theft and manipulation.

Secondly, even if advancements in technology are made potentially allowing for a widespread application of ubiquitous computing, this alone cannot solve long known problems of businesses by itself. Enormous economical and societal challenges lie along the way. Building up the infrastructure for ubiquitous computing and integrating it into business processes requires large investments and efforts that need to be justified in terms of a significant value added and return on investment.

With transformational changes expected, acceptance needs to be taken into account as a third challenge. Especially the end-user might put increasing emphasis on undisturbed privacy in a completely networked world [300, p. 4], hindering ubiquitous computing at realizing its full potential also within the workforce. Health concerns including the radiation of the connecting networks could slow down the emergence of ubiquitous computing as well. Another point worth considering is the dependence on the connecting network as data and control is decentralized [300, p. 4].

Showing vast potential to disrupt markets, it is not certain to what degree the concerns and challenges can be overcome. Three future developments seem reasonable.

The vision of ubiquitous computing, presented in many texts on the subject, could be the first development. Ubiquitous computing could become a part of everyday life with standards ensuring interconnectivity between a multitude of new applications and systems. Platforms then enable enterprises to use ubiquitous computing for their business processes and to offer their services on their customer's smart devices. A full integration into business processes and interactions with customers and other enterprises would be expected. Sensor networks would enable full monitoring, automation and control of most business processes. Ubiquitous computing thereby changes internal processes and offers new possibilities of communication and collaboration within the workforce [307]. It would additionally redefine key aspects of enterprises' customer relationships including increased interaction through awareness, access and responsiveness [186].

In a second development ubiquitous computing could prove to be unfeasible from a technological point of view. Potential reasons include high costs and insufficient advancements concerning power supply, data management and standards ensuring interconnectivity. Therefore most businesses and end-customers are not willing to make significant investments as they perceive no significant value added. Only niche applications for specific industries, such as logistics, or applications, such as e-payment, could be available, whereas large scale implementation is never realized.

With the technology being available, ubiquitous computing could see only applications in the business world in the third development. Standards across enterprises could ensure interconnectivity in the business world but mainly acceptance problems are responsible for hindering the vision of ubiquitous computing. On a large scale production and business processes could be autonomously monitored and controlled by embedded devices. However, ubiquitous computing would not significantly influence collaboration and communication among employees and within large parts of the population.

8.2.2.4 Future Workforce

Main characteristics of the future workforce will not only stem from quantitative changes in the demography of aging societies and the international labor and migration flows but more so from qualitative aspects. Work-life integration and an inter-generational shift in attitudes towards digital technologies will predominantly shape the future workforce. The former is increasingly enforced by a growing employment of women, the latter sometimes referred to as the gap between digital natives and Baby Boomers [369, pp. 1-3].

There is already an increasing participation of women in the labor market. The female employment rate in Europe increased by 7.1 percent over the last decade and reached 59.1 percent in 2008. The average gap between female and male employment rates fell to 13.7 percent in 2008 from 18.2 percent in 1998 [174, p. 4]. Demographic change results in a shortage of skilled labor in many industries therefore strengthening the role of female labor.

Digital natives, born between 1980 and 2000 [372, pp. 8-13], are estimated to make up 11 percent of the workforce in Europe [256], but their effect on the professional workforce and business practices is just starting to have an impact. They are described to be the first generation that has completely grown up with information technologies. In contrast to the Baby Boomers, born between 1946 and 1964 with pre-digital roots, digital natives expect information technology to play a part in all aspects of their life [155, p. 17]. They are mobile individuals who instinctively embrace connectivity technology at the workplace. They like to parallel process and multitask as a way of life. They are learners who prefer graphics and short bites of information to reading text [371]. Furthermore, they demand and expect the integration of social software, unified communication as well as ubiquitous collaboration tools within enterprises. As a highly mobile workforce they ask for higher autonomy and flexibility regarding their working place.

Digital natives entering the labor market, the aging society and working women will drive significant change in the approach to technologies, business processes and organizational structures. However, it is highly uncertain how the future workforce will accept new technologies and the full integration of work into their lives.

There are two possible developments for the future workforce. Firstly, new technologies and work-life-integration could be completely embraced within the working environment. With a declining birthrate and the growing shortage of skilled labor in many industries it would be very important for companies to attract and retain their workforce [256]. Enterprises would need to build an office environment that fosters relationships, team and network building. Portal, content, communication and collaboration technologies could be offered. Social software would be fully established, challenging traditional work constructs. Enterprises would also provide possibilities to track and link knowledge within the company easily [396]. Flexible work environments and schedules would be provided to ensure that employees feel responsible and rewarded for job results rather than simply working the shift. Decision makers would abdicate hierarchies, moving towards more participatory structures promoting joint responsibility, reasonable actions and opportunities to act [81, p. 10].

Secondly, a reluctance towards accepting new technologies also seems plausible. Increasing retirement ages could lead to skill gaps and a dominance of non-digital natives. They would be rather skeptical due to privacy and security concerns and object full work-life integration. Enterprises would hesitate to invest in new technologies, which would additionally include providing education and training programs. Furthermore, mobile working would not unfold its full potential.

8.3 Scenarios

Analyzing the developments of the presented drivers, the future is expected to bring a world linked by new broadband and mobile infrastructure and connected through intensified relationships between various stakeholders. Vast amounts of data created in this interlinked environment will need to be handled and properly secured. Nevertheless, the exact form of the world in 2025 remains highly uncertain. Opening up a multitude of distinct paths for developments, the acceptance and feasibility of ubiquitous computing, enterprise cloud computing as well as changes in the workforce can be considered key drivers for future enterprise services. Looking at possible futures in a structured way raises awareness of different possibilities and associated implications for future product and service offerings. Developing these scenarios provides a framework for judging strategic options and helps to develop a common understanding of the future. In contrast to forecasting, multiple scenarios define a range of possible futures. They individually represent an extreme direction of development. In the following three possible scenarios for 2025 and weak signals indicating their likelihood are presented. The focus is on the development of the key drivers and the implications for enterprise services.

8.3.1 Scenario 1: It Was All Just a Hype

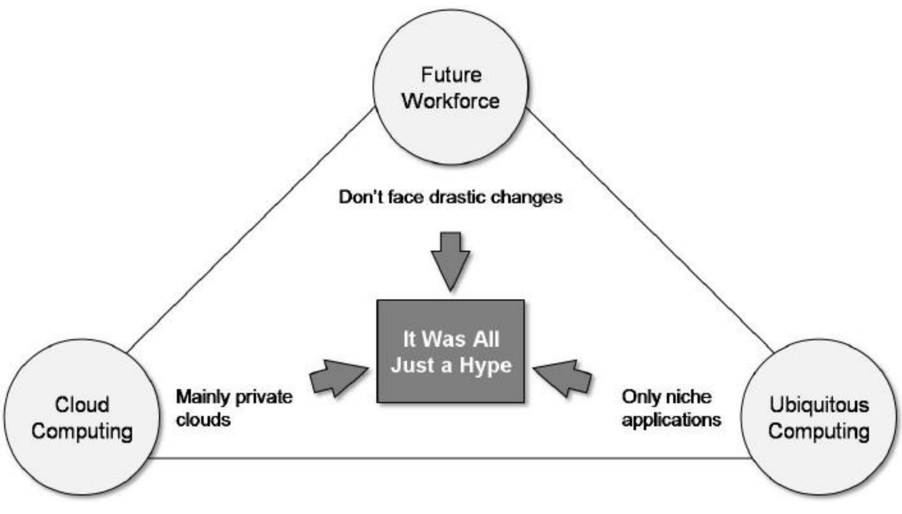

Figure 8.7: It Was All Just a Hype: Key drivers and projections
Source: own illustration

The scenario 'It Was All Just a Hype' is mainly characterized by the non-existence of industry wide implementation of ubiquitous computing and public cloud computing services. Enterprises are reluctant to outsource critical business processes into a public cloud mainly due to severe security issues. Ubiquitous computing is not widely spread because technologies are unfeasible.

In this scenario for 2025 the way enterprises do business and the way workers communicate is not significantly shaped by ubiquitous computing. Although communication technologies seemed very promising, large scale implementations of ubiquitous computing technology is not realized. When the hype around ubiquitous computing started, IT providers and research institutes spent much money on the development of sensor technologies including new forms of power supplies. They were euphoric about opportunities in this field and promoted them not only to enterprises but also to the public, leading to enthusiasm among workers and consumers. However, developments in sensor technologies, which are seen as the basis of most applications, have not progressed as expected. Small and fast sensors independent of external power supply cannot be offered at a price level which would enable large scale implementation in everyday life. Innovative solutions can only be seen in specific fields of applications rather than on a large scale. Sensor based warehousing solutions, as one example, enable enterprises to efficiently handle logistics processes. Enterprises are not able to offer adequate technologies to the workforce and thus no drastic changes in working environments occur.

In this scenario IT outsourcing is limited to non-critical processes, making an individualized IT strategy, infrastructure and security management highly important. Although widely accepted public clouds offered by large IT providers appeared to drastically change corporate IT landscapes, serious security breaches prevented this development. Additionally, network breakdowns resulted in the unavailability of cloud services. As companies outsourced critical business processes in public clouds, this lead to major economic damages for large enterprises. As a consequence, companies started to shift their IT services into private clouds and remain skeptic towards public clouds. Most enterprises use private clouds and thereby take advantage of efficient intracompany storage, processing and software-sharing. These cloud computing services are based on the IT infrastructure and network of enterprises and are managed independently by third parties. As companies have very different IT infrastructures and services, IT strategies can lead to a competitive advantage. Expenditures for Information and Communication Technologies (ICT) are very high with only few big enterprise solution providers. For large enterprises customization to industry specifics and implementation is done by solution providers themselves or associated system integrators.

The scenario 'It Was All Just a Hype' is significantly influenced by the importance of a company's individual IT infrastructure. An indication for this is that enterprises are mainly concerned about data security and data availability today and therefore refrain from outsourcing large parts of their IT. Future security scandals in the usage of enterprise cloud services would propel this development.

Additionally, this scenario is characterized by the infeasibility of technologies in the field of ubiquitous computing. Currently, there are doubts on the technical feasibility of low-cost, small and fast sensors [204]. High prices of sensors or the lack of accepted middleware in the future would make this scenario probable.

8.3.2 Scenario 2: Realm of Reluctance

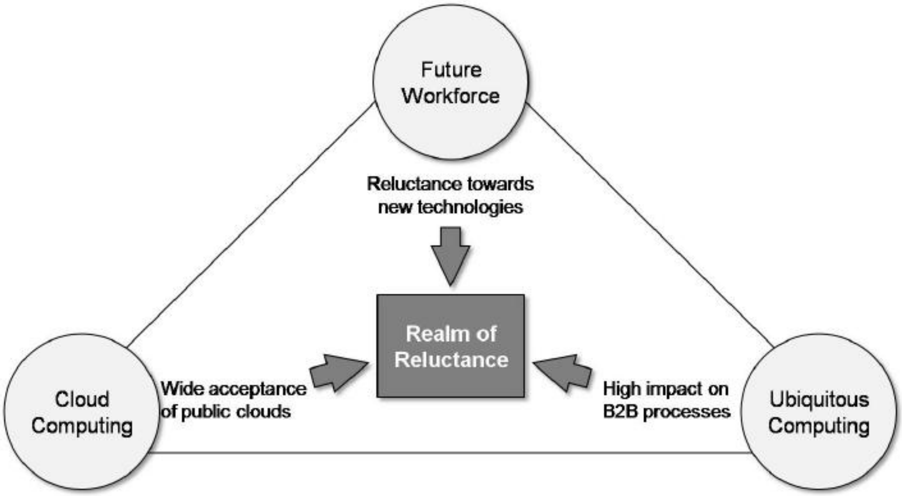

Figure 8.8: Realm of Reluctance: Drivers and projections
Source: own illustration

The scenario 'Realm of Reluctance' is mainly characterized by the future workforce's reluctance towards new ICTs. Although both cloud computing and ubiquitous computing are feasible from a technological point of view and widely accepted in business-to-business processes, these technological advances have not considerably changed the working environment.

'Realm of Reluctance' describes a scenario for 2025 where business-to-business processes are widely based on ubiquitous computing applications. However, the workforce's skepticism towards new technologies severely limits the usage of applications and their influence on the workplace. Information and communication technologies have not always been confronted with acceptance problems, but have rather dominated the way people have worked and lived. The workforce, ruled by digital natives, even demanded for the newest communication and collaboration tools and fully integrated work and private life. Devastating privacy scandals and cyber attacks on the one hand and serious health issues related to radiation exposure on the other hand have lead to the emergence of a new societal movement - the postmodern digital hippies. Followers of this anti-ICT movement refused to further let technologies rule their private and working life. The most radical adherents to this movement lead a life without any devices. The general population, while overtaking a rather skeptical attitude towards ICT, does not fully banish new technologies. Most of the population tries to minimize digital footprints as well as exposure to radiation by limiting employed technologies. Seeing the benefits of technological progress, enterprises initially tried to push for the technology driven working life by investing in trainings for mobile working, social software, communication and collaboration tools. With employees still fearing surveillance as well as a loss of privacy, enterprises hesitate to further invest in new communication and collaboration tools, the establishment of flexible carrel structures or mobile working devices. Consequently, companies only make use of ubiquitous and cloud computing for inter-enterprise processes. Providing the workforce with basic tools such as intranets, wikis and blogs, enterprises let them stick to their habits.

Standardizations enable interconnectivity among business-to-business applications, leading to highly efficient logistics, production and warehousing processes. Partnerships among enterprises have developed towards value networks where intercompany processes are fully harmonized. With ubiquitous computing and a growing number of integrated business processes, enterprises display an exhaustive demand for reliable, decentralized data storage and processing. Large IT providers offer cloud computing services to meet these requirements. Outsourcing large parts of corporate IT is fully accepted by enterprises. Companies use public clouds as they are convinced by their cost-effectiveness, reliability and security. Enterprises are proactively adopting SOA enabling them to use a multiplicity of applications for their IT purposes. The market for business applications is dominated by big players providing large platforms where many developers serve the numerous needs of enterprises. This has created a market space of various products and services for business-to-business solutions. However, the market for communication and collaboration solutions for the employees is mainly dominated by standardized solutions as the demand for applications in this field is low.

The 'Realm of Reluctance' scenario is very much influenced by the future workforce and their acceptance towards ICT. There are different factors indicating the occurrence and characteristics of this scenario. Firstly, health concerns associated with the radiation of mobile networks have led to public discussions [207]. These discussions continue to accompany new technological advancements. With the emergence of ubiquitous computing and the associated need of additional wireless networks, health concerns will be raised and investigated. If sufferings directly associated with radiation exposure were to be found, many applications would not be possible due to regulatory and acceptance problems. Secondly, the new technologies discussed already raise security issues. Additional data scandals would lead to a higher degree of data sensitivity among employees and thus to an increased skepticism towards ICT tools used in the working environment.

8.3.3 Scenario 3: Flat World

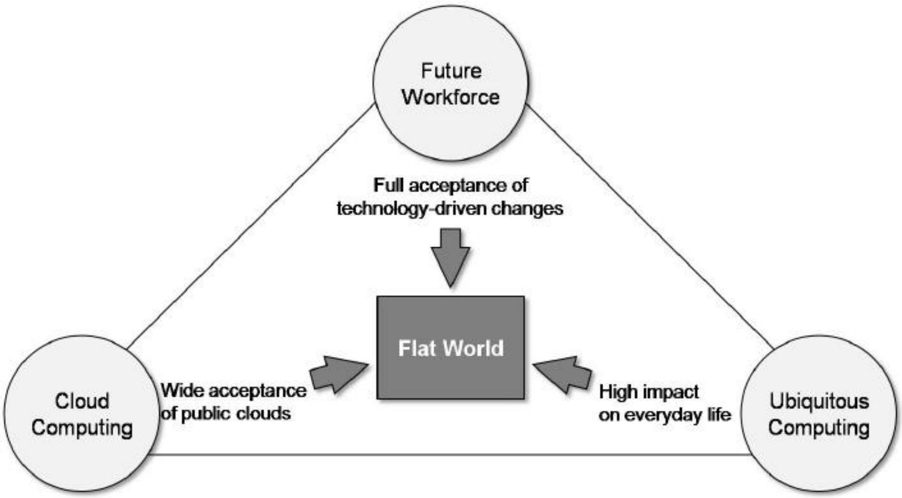

Figure 8.9: Flat World: Drivers and projections
Source: own illustration

The scenario 'Flat World' is mainly characterized by the wide availability and full acceptance of enterprise cloud computing and ubiquitous computing. Ubiquitous computing has become part of everyday life and has transformed the way enterprises do business. Cloud computing has shaped corporate IT landscape and the workforce not only accepts new technologies but also strongly demands them. In a flat world, widely available communication technology offers great opportunities for both enterprises and people.

In this scenario the world of 2025 provides an interconnecting infrastructure that allows for elaborate communication and interactions for enterprises, their workforce as well as the entire population. Using this interconnecting infrastructure to outsource large parts of corporate IT to public clouds is fully accepted by enterprises. Initially, when companies started to think about sourcing large parts of their IT from cloud service providers concerns about data security, availability and integration were widely spread. In addition, enterprises were uncertain about cultural changes resulting from the diminishing role of IT inside their corporation. As most technical concerns were solved quickly, drastic changes in IT departments lead to major intraorganizational conflicts. However, IT departments soon redefined themselves and shifted their focus towards selecting, sourcing and integrating different external IT services. They have developed to be the interface between business and IT service providers. Companies use public clouds as they are convinced by their cost-effectiveness, reliability and security. Cloud computing services are intercompatible resulting in enterprises commonly using services from different cloud providers. These providers are large IT companies with high computing expertise including CSPs, which are regarded particularly trustworthy as they are highly regulated by the government and prove to have technical expertise as well as close customer relationships. Through fully established service oriented architectures enterprises are able to use a multitude of applications for their IT purposes while benefiting from the reuse and interchangeability of services through modularity. The market for enterprise applications is highly fragmented. Developers create applications for various platforms which show a high level of standardizations and similar APIs. This has lead to a great variety of solutions for enterprises which are mainly used by large companies so far. Platform providers are striving to promote their solutions for small and medium enterprises as this segment is regarded to have high market potential. Broadband networks are widely available in western countries while governments of emerging markets are employing policies to promote the building of high quality landline broadband access. With this infrastructure becoming available, companies in emerging markets increasingly use cloud computing services and have become an interesting customer group for global IT service providers.

In this scenario working environments have faced transformational changes with ubiquitous computing being the main driving force. New communication and collaboration technologies and work-life-integration are embraced by the workforce. Advanced data security, authentication and identification make a widespread implementation of these technologies possible. New forms of offices, including home offices and shared work spaces, enable workers to flexibly integrate private and working life. This is appreciated especially by the high number of working women. As employees not only accept innovative ICTs but also demand them, enterprises highly invest in these technologies in order to improve internal communication and succeed in recruiting talents. Ubiquitous computing has become part of everyday life. Marketing and customer access has changed drastically, for example with billboards being able to adjust content based on consumer characteristics and allowing for the immediate purchase of the displayed products. The availability of high-end mobile communication infrastructure and large scale implementation of sensors has enable new forms of business-to-business applications revolutionizing fields such as logistics, e-commerce and CRM. As there are almost no limits in terms of data collection, storage and processing, providers have developed highly sophisticated business analytic tools which they offer to enterprises. Whereas large corporations fully integrate these technologies in their processes, SMEs do not yet commonly use them. SMEs are increasingly picking up on this trend and demanding for applications which specifically meet their requirements not only in terms of industry specifics but also costs.

The 'Flat World' scenario is very much influenced by the large scale implementation and availability of ubiquitous computing, cloud computing and the workforce's acceptance towards new information and communication technologies. There are several factors that indicate the occurrence of the Flat World scenario. Firstly, today companies expand the use of RFID chips, a technology closely related to ubiquitous computing, to optimize their business processes [204]. An indicator for the large scale implementation of sensors would be the existence of smaller and faster sensors without energy supply problems. Secondly, the popularity of cloud computing services and the willingness of enterprises to use third parties for the processing of business relevant information has increased [375]. Additional advancements in security technologies would lead to a faster and broader acceptance and adaption of public clouds in the future. Lastly, the increasing number of home offices, digital natives, working women and social software suggest the future willingness for more work-life integration and the acceptance of new technologies [371].

8.4 Product Idea: pluS ME

Developing a product for enterprises in 2025 requires a fundamental knowledge of the different possible futures and their implications for enterprise services. The three presented scenarios cover a wide range of possible outcomes and illustrate the different developments possible until 2025. Looking at the weak signals of today, it appears most probable that the Flat World scenario best describes future developments in technology and society. With technical advances in cloud computing, ubiquitous computing devices, networks and standardized infrastructure, there are signs pointing in the direction of a Flat World [121, p. 2]. The increasing penetration of the workforce by digital natives observable today underlines the likelihood of this scenario.

In the following, the product pluS ME (Platform for Leveraging Ubiquitous and cloud based Services for Small and Medium sized Enterprises) is introduced. PluS ME aims at integrating SMEs into the global information, communication and e-commerce infrastructure. It is a cloud based system that integrates a Service Delivery Platform (SDP), a front-end application and the interconnecting architecture between the two. The advantage of this system is that it empowers SMEs to leverage IT without owning an exhaustive IT infrastructure themselves. PluS ME comes in a pre-bundled package comprising of applications for business process improvement as well as offers to integrate ubiquitous devices using the mobile network owned by communication service providers. While providing abstraction of the complex underlying infrastructure from the easy to use interface, pluS ME also serves as a platform for externally developed applications.

The following sections present an analysis of the challenges SMEs face in the Flat World. The manner in which pluS ME addresses these needs is described in detail followed by the product's business case, including a market and competitor analysis as well as a description of the value network and associated revenue streams.

8.4.1 Small and Medium Sized Enterprises in the Flat World

Driven by an increasing communication infrastructure, IT advancements such as ubiquitous computing and cloud computing confront SMEs with a multitude of challenges in a an interconnected Flat World. With less than 250 employees and limited investment capabilities, SMEs will need innovative approaches for technology-driven changes.

To succeed against global competition, SMEs need to make e-commerce a cornerstone of the way they do business. The growing complexity of communication and collaboration with multiple stakeholders, that is required for e-commerce, drives the need for solutions simplifying complex interactions for SMEs. Large enterprises utilize ubiquitous computing to improve their business processes on a wide scale. Having implemented complex autonomous systems to monitor and control supply chains and business processes, they ask for seamless integration with all their business partners. SMEs need to implement advanced technologies to be able serve this demand and interact with large enterprises. Reluctant acceptance of these technologies will lead to a competitive disadvantage compared to other suppliers.

New types of customer relationships are possible with the increased ubiquity of information technology. Appropriate technologies and applications are necessary to ensure customer awareness and to enable the extraction of business relevant information and customer feedback from interactions. In addition to the above mentioned developments, cloud computing has a major impact on the role of IT in SMEs. With computation power and data management shifting from core competence to commodity, SMEs look to reduce costs and restrict investments by outsourcing most of their computing infrastructure to cloud service providers. The workforce of SMEs tries to incorporate its preferred productivity tools and social networks into the company structure. To leverage the full potential, SMEs need applications to provide a direct link to their business processes. Providing innovative forms of collaboration and communication helps SMEs to increase efficiency and make its workplace more attractive.

Using ICT to tackle these challenges is necessary, but not an easy task for SMEs [270, pp. 11-12]. Mostly, SMEs are facing ICT product offerings that are designed for large firms. Even though some suppliers might offer specialized SME versions, these still tend to be unattractive and unfeasible for SMEs because of their relative high complexity and high investments. Due to their size, SMEs often only have limited investments capabilities for realizing ICT infrastructure as well as associated maintenance and upgrade costs.

Additionally, adopting new ICT technology is an organizational challenge. Often causing the restructuring and streamlining of business processes, the effective implementation of new technologies is accompanied by organizational changes that hurt in the short run. Vendor relationships might have to be significantly changed or certain company functions downsized. Both are demanding tasks for the management of an organization. As SMEs usually have no central instance orchestrating the purchase and administration of information technology, they face the challenge of integrating and connecting the myriad of applications that are vital to survive in this technology oriented Flat World. In a highly fragmented marketplace SMEs therefore look for applications that encapsulate the complex underlying technologies. With little IT staff, SMEs regard intuitive control and easy integration that is manageable by non-experts as highly important.

8.4.2 Idea and Concepts Description

Enabling SMEs to develop new opportunities in terms of growth and markets, pluS ME allows SMEs to build and run their own unique IT systems. It allows for an environment where they can integrate various technologies into their value chain. The main advantage behind pluS ME is to keep it simple in the front-end but at the same time leverage technological advancements by allowing for tremendous complexities in the backend. There are three essential components that go into making pluS ME (see figure 8.10), which are structured as the following:

- Application Layer
- Smart Interface Layer
- Service Layer

Application Layer

This is the front-end of the system to the customer. It is constituted of a very simple Graphical User Interface (GUI) with a drag and drop facility (see figures 8.11 and 8.12). The simplicity of the GUI is an attempt to target non-expert users, who form a large part of SME's workforce. PluS ME comes pre-installed with some basic applications for business process management and includes functionalities to interconnect them. The basic applications include content management and billing apps, as well as logistics apps based on ubiquitous computing. Serving only the very basic functionalities, these applications will encourage SMEs to procure more applications.

The application layer is designed in such a manner that all applications are executed in the cloud. This directly benefits the user as the type of user-device is

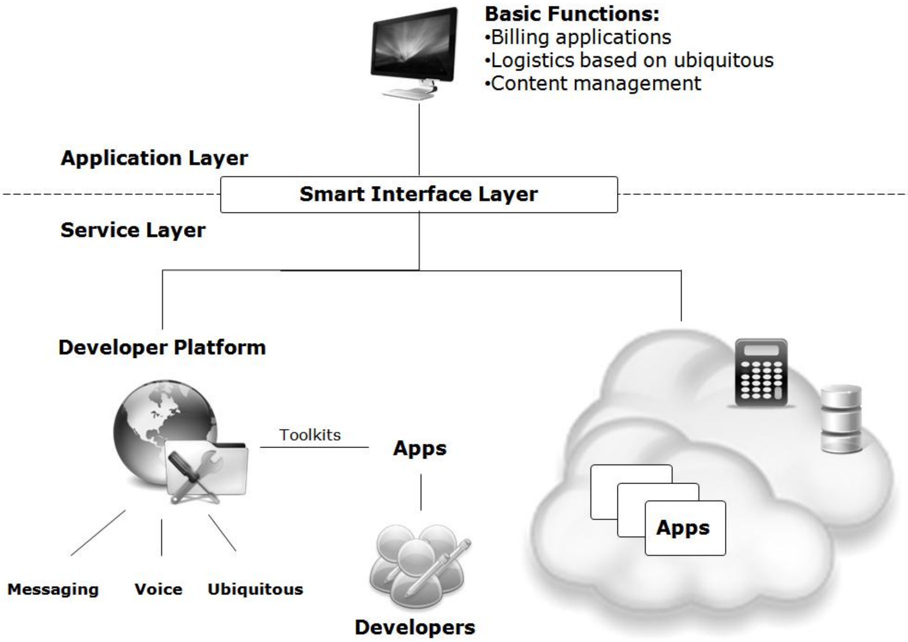

Figure 8.10: pluS ME network architecture
Source: own illustration

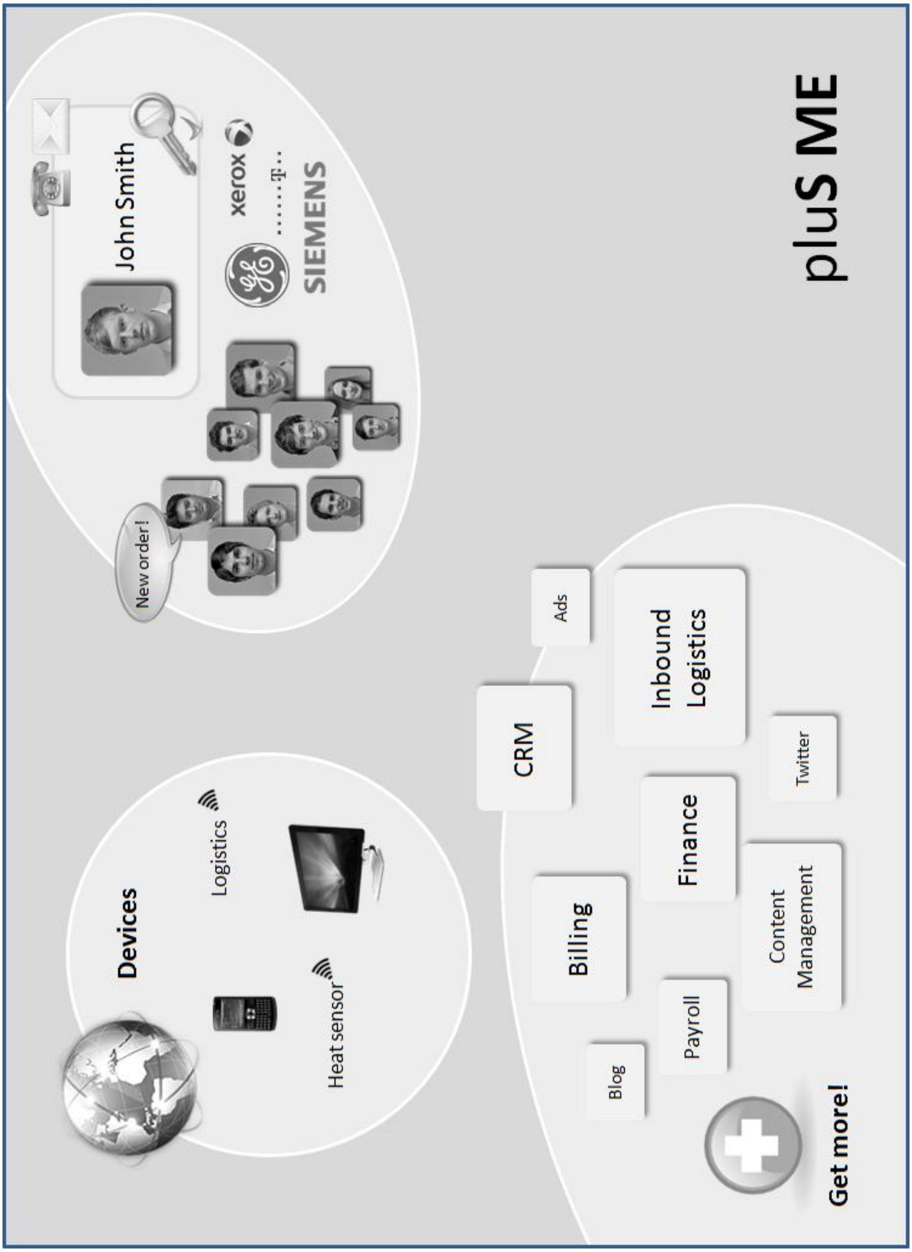

Figure 8.11: pluS ME front-end GUI. Start screen of pluS ME showing the available applications, connected devices and business network of the user

Source: own illustration

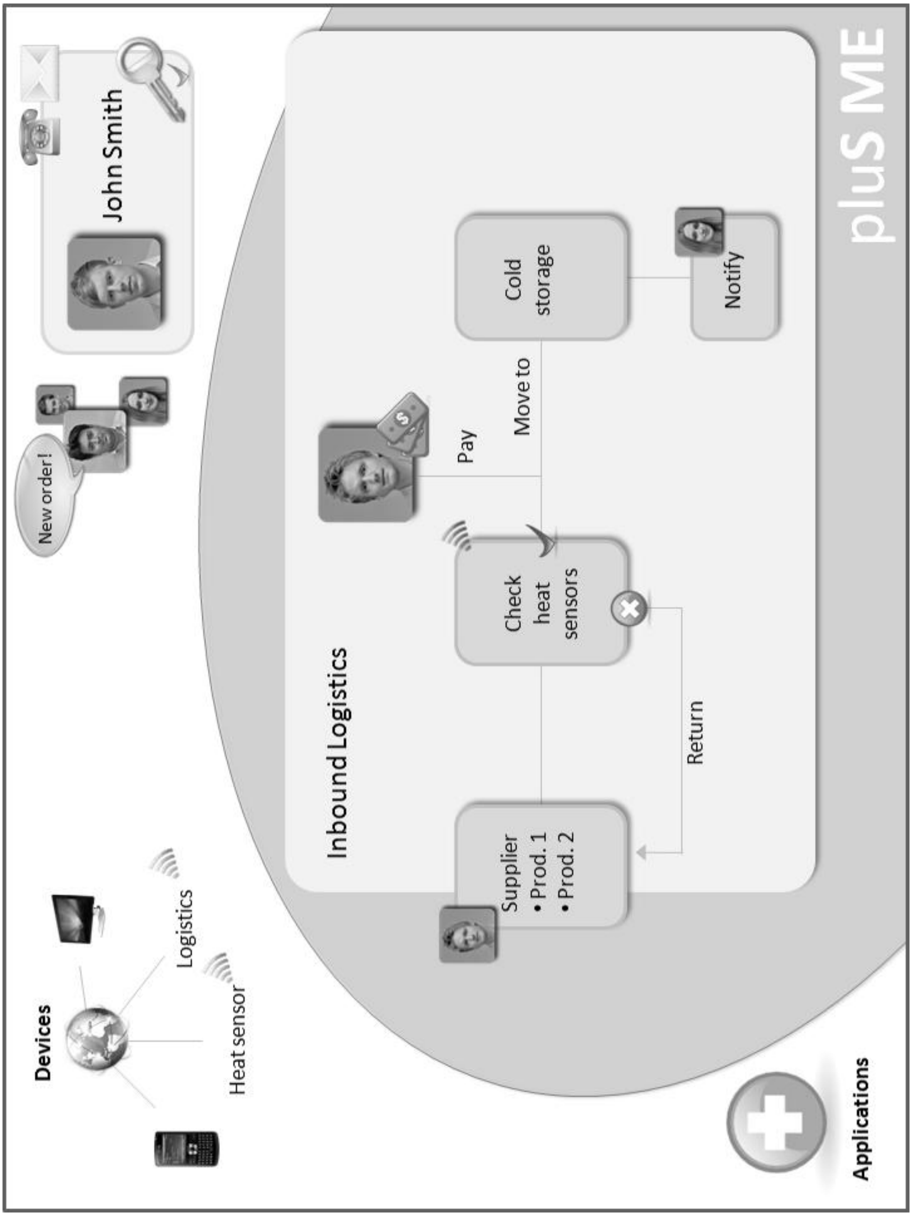

Figure 8.12: pluS ME front-end GUI. Detailed view of the logistics application. A basic logistics process using ubiquitous computing is shown
Source: own illustration

no longer important. As high speed networks are omnipresent, there is minimal noticeable delay in the back and forth transmission between the device and the cloud. Anything with a basic amount of processing power and a screen can therefore be used as the front-end, be it the console at the enterprise location, laptops or even smart phones. This setup allows for very complex applications to be executed on these devices.

There is a direct connection between the front-end and the platform to enable adding more applications when required by the user. This adhoc adding of business applications per business need opens up the possibility for SMEs to leverage innovation power according to the outside-in methodology.

A myriad of applications are available within the platform. The basic applications which come pre-installed are developed by developers who work directly for the platform. Further applications can be sourced from independent developers. As companies have restructured themselves as per the SOA principles, it becomes far easier for the developers to create these remaining applications. Applications can combine external modular services based on the SOA principles to gain greater market penetration and higher usage factors amongst enterprise users.

Smart Interface Layer

The Smart Interface separates the application layer from the lower layers by the use of standardized interfaces. The most important feature of this layer is shifting data and command instructions between the front-end and the cloud. It is to be noted that as all processing and data storage is done within the cloud, the interface plays a very important role. It enables the overtly simplified front-end to utilize a very complex back-end structure of processing. The Smart Interface enables the selection of cloud services based on factors such as availability of processing power and physical distance of the cloud to the user. It also enables message passing between the cloud and the platform for usage of services such as ubiquitous sensor networks data, communication and media content. The other advantage factor for the Smart Interface Layer is the ability to re-route data storage to private clouds.

Service Layer

This layer enables the myriad of functionalities by the integration of complex technicalities. The Service Layer consists of the service delivery platform, the ubiquitous network services and the cloud based offerings. The SDP is available to the developers who have full access to easy-to-use and robust API's for integration into their applications. The services that can be incorporated from the SDP includes messaging, voice-to-text converter, voice calls, media content, access to ubiquitous network data etc. Furthermore, the SDP hosts the application store. It also includes a separate simulation environment incorporated with an application tool kit for developers to play with, analogous to a sandbox.

The SDP incorporates functionalities of telecommunication and IT capabilities and enables the viability of services beyond technology and network boundaries. It expands to being more than just domain specific to include a service control environment, a service creation environment, a service orchestration and execution environment. The SDP benefits from the simplicity of front-end applications due to its abstractions from location, integration and other low-level communications capabilities. This acts as an enabler for developers to write applications for the front-end while still maintaining complexities handled by the Smart Interface Layer.

The possibility to use the ubiquitous network services is another advantage. The linking of sensors from different aspects of their business processes into the existing wireless sensor networks allows SMEs to benefit by leveraging applications based on semantic data. This is then used to garner greater efficiency into their business processes.

The clouds being used by pluS ME are separated per functionality into two parts. Firstly, public clouds are used for encrypted data processing and application execution. The second being private clouds which allow for secure enterprise data storage.

Favorable Market Positioning of Communication Service Providers

Communication services providers find themselves in a favorable position to implement a system comparable to pluS ME in a Flat World. This is due to technological aspects as well as an extensive targetable customer base. The following section will elaborate on the various reasons for CSPs to offer pluS ME.

Firstly, the telecom sector has been subject to strict regulation over the years. The legal machinery in place makes CSPs highly trustworthy. Their reputation of being providers of quality services also works in their favor.

Secondly, the possibility to guarantee reliable levels of bandwidth over their networks coupled with a strict adherence to network quality enforced through legally binding Service Level Agreements (SLA) make CSPs a preferred services partner. This enables the furthering of the pervasiveness of ubiquitous networks to fruition.

Thirdly, functionalities such as billing, network and data security have always been the core competencies of communication service providers. These functionalities have evolved to their current form by assimilation of experience over the years in this field.

Fourth, one of the biggest factors which works in favor of CSPs is their cost efficiency. They have strived to make communications cheaper and more affordable year over year. This, backed up by an accurate billing system, benefits them in gaining the trust of consumers when they switch to a cloud-based usage billing system.

Lastly, SMEs depend heavily on fixed line telephony and basic Internet for their operational needs. Therefore, SMEs already form a broad customer base for the customer service providers. This enables the lowering of the barrier in acceptance of technology from the same entity, who SMEs have come to trust over the years.

Innovation Focus

The following section describes the innovative approaches of pluS ME, which distinguish the product from technologies employed in 2010.

In 2010 there has been no concerted effort to integrate non-experts into roles of developing technology for their own needs. They formed a major part of the SME workforce and viewed technology as being extraneous to their working culture in the world of 2010. One of the reasons for this distance was the complexity of the technology coupled with its rapid change. Usually, applications used in SMEs were provided by technical experts. This division of expertise created a gap in what the non-experts 'had expected to get' and 'what they were served'. PluS ME aims to overcome this divide through a simplistic almost frugal approach in the application layer, thereby directly involving the end-user in the development process.

Additionally, pluS ME lowers costs significantly. Apprehension over costs, which posed the highest barrier for SMEs to implement IT systems, is addressed by flexible payment schemes and complimentary initial setup. Companies such as SAP and HP have tried to target SMEs with modified offerings of their services. However, they were too expensive. As per the UN Development Agency (UNDA) even the cheapest special editions of these software products targeted specifically at SMEs were in the range of 50 thousand USD [270].

Why pluS ME is not technically feasible in the world of 2010

In 2010 there were no real incentives to implement business process modeling software for SMEs. They viewed this as a large investment burden. In fact most SMEs did not even have a functioning IT department within their organization. Even when they realized the importance of IT, the initial costs of implementing a system have served as a deterrent. In 2010, ubiquitous computing was in its nascency and not fully established. This lack created a disassociation of connectivity, content and communication. Combined with the above mentioned reasons, it was a further impediment for most SMEs in seeing the bigger picture. This reinforced their preconceived notions towards the value of IT. PluS ME relies on incorporating all advantages of ubiquitous computing in an intuitive business process. Without it pluS ME can not overcome connectivity, content and communication issues.

Lastly, though the cloud infrastructure was available in some respects, it was not exhaustively applied to all aspects of computing in 2010. There was a general hesitation in the acceptance of cloud services amongst most enterprises. Additionally, most SMEs did not have a dire enough need to shift to cloud services thus restricting a wide implementation of pluS ME in 2010.

8.4.3 Business Case and Market Analysis

After having described the distinct needs of SMEs and how pluS ME addresses these, the following paragraph elaborates on the market structure and possibilities for monetarization. A thoughtful approach, taking into account findings from the scenario analysis, allows for identifying major forces shaping the competitive environment in which pluS ME has to prevail. In concordance, the following sections dwell on customers, competitors, possible new entrants into the market for SME business software and suppliers contributing to the value network in which pluS ME is embedded.

8.4.3.1 Customers

Enterprises of small and medium size have been identified as pluS ME's main direct customer target group. In 2008 SMEs accounted for 99.7 percent of all registered enterprises in Germany, generating 37.5 percent of all revenue [247]. This attractive customer segment can be considered sustainable even beyond 2025. In western countries, the advent of knowledge-based economies has given rise to a multitude of small, highly-specialized and service-oriented enterprises. Whilst having vast expertise in their business areas, these firms lack the time and know-how to incorporate innovative business software offerings such as ubiquitous computing offerings, cloud processing etc. The health industry is an apt example to illustrate the above. Here, the administrative complexity is overwhelming. Advancements such as e-Health offer an opportunity to facilitate patient record management. However, the integration of these new technologies into their existing health care structure is difficult. Resource consuming requirements include the purchase of software, the training of staff and the costly migration of data from legacy systems [360].

Small enterprises operating out of emerging economies form another attractive group of prospective direct customers. As of 2009, in the Asia Pacific region, SMEs employed as much as two thirds of the total workforce and accounted for 90 percent of the all enterprises [72]. While these firms are competing on a leveled global playing field in 2025, financial constraints prevent them from adapting sophisticated business software solutions. With a reasonably fast Internet connection being the only pre-requisite, pluS ME provides a suitable enterprise software suite for this target group.

An indirect customer group could be governments looking for opportunities to leverage innovative potential within their countries. SMEs are driving economic growth, innovation and thereby the prosperity of nations [270, pp. 3-5]. Therefore, governments in 2025 have a vital interest in enabling SMEs to incorporate the opportunities of IT advancements such as ubiquitous and cloud computing into their business processes. A concerted governmental push of pluS ME's services can help local SMEs to acquire a competitive edge and concentrate scarce resources where they are most needed: on innovation.

8.4.3.2 Competition

The Flat World features a fragmented market for enterprise applications. Enterprise software vendors comparable to today's SAP or OracleHyperion still dominate the market for sophisticated ERP platforms. Large enterprises use such platforms by customize them according to their needs. They incorporate suitable applications sourced from independent developers. With SOA principles being applied throughout the business world, applications based on modular service offerings are commonplace. Due to the long tail effect, even niche business needs are addressed by developments within the enterprise application community.

In the Flat World's business environment, the above mentioned vendors of ERP platforms are considered to be the main competitors for pluS ME. Though they are highly successful with their established business model, their efforts to tap the SME market have not yielded any significant impact [270]. By building upon their extensive know-how of ERP platforms, these vendors pose a considerable threat to pluS ME.

Another source of competition stems from highly scalable cloud based software offerings such as 'salesforce.com'. With the prevalence of broadband Internet access, the value proposition of these services appeals to a broad set of enterprises including those which comprise pluS ME's customer target group. However, while the business model of cloud based service offerings relies on a high scalability of well-engineered applications, pluS ME's unique selling proposition is an application integration approach. This allows for the possibility of coexistence and co-opetition with competing parties.

8.4.3.3 New Entrants

PluS ME's unique position in the enterprise application market is based on a forward integration approach. Using the CSPs' existing communication networks as a foundation, pluS ME taps the SME business software market. Possible new entrants could proceed in a similar manner while originating from different industries.

Firstly, Operating System (OS) vendors such as Microsoft could offer add-ons which enrich their current office suites. Such applications could also cater to the distinct needs of SMEs. Still, the uniquely intuitive user experience of pluS ME serves as a distinguishing characteristic.

Secondly, companies who offer web-based applications constitute another group of possible entrants. These companies would be faced with low entry barriers since they could benefit from several learning effects. The expertise to manage application platforms already exists within these companies. Furthermore, they could profit from economies of scale by addressing a plethora of possible users. Nevertheless, these companies face skepticism from SMEs due to a lack of trust resulting from little or no governmental regulation. Therefore they are in a suboptimal position to play a vital role in the business processes of SMEs [249].

8.4.3.4 Contributors to the Value Network

PluS ME is embedded into a user centric value network with various parties contributing to the overall value added. Besides the intuitive user interface, CSPs also provide the network infrastructure, basic modular services and an application developer environment. The platform is then further enriched by developers who leverage the attractiveness of pluS ME by creating a multitude of compatible applications. Cloud providers contribute processing and storage resources. In this user centric value network, 'prosumers' can actively shape the capabilities of their enterprise applications. The option to integrate smart embedded devices and external service offerings such as media content and business analytics modules can account for further value creation.

8.4.3.5 Revenue Streams

Revenue streams are a way of describing the various sources an enterprise can earn money from. With pluS ME being embedded in a value network, there are multiple and structurally different revenue streams. These are generated as a result of interactions between the CSP providing pluS ME and customers, developers, cloud computing service and ubiquitous computing device providers.

Customers
In order to keep customer investments in infrastructure and IT to a minimum and thereby making the product as attractive as possible, no set up fee is being charged. After signing up for the product and services, the customer has the choice of two payment methods. First, using the accurate monitoring and billing processes of CSPs, a pay-per-use license is offered. Customers can track the services they use, thereby allowing them a complete and transparent overview of the consumed processing power and data storage volumes. As there are only negligible costs for initially setting up an account, this approach could allow many customers to try out the product without the binding obligation for continued usage. This enables them to discontinue using pluS ME at any point of time without having to bear significant investment overheads.

The second payment method is intended for customers who regularly use the provided services and applications. They pay a fixed monthly fee for the services they plan to use. This pricing model features more competitive rates for the services as it results in a more predictable revenue stream for the CSPs. The fee is based on the variety of services opted in for by the SME. Prebundled packages include a flat rate for communication and ubiquitous services while featuring selectable levels of guaranteed computing power. This transparent payment method allows the enterprise customer to better plan their IT spending.

For some applications more customized forms of billing are possible. Success-based models find adoption amongst advertising applications. A share of the revenue, which is generated through successful advertising, is might be redistributed to the provider of the application.

Developers

Developers play an important part in pluS ME's value network. They need to be properly incentivized to ensure their loyalty to pluS ME's developer platform. Current revenue sharing models employed by most application platforms cannot be utilized here. This is because the usage of an application creates additional costs for the CSPs as it is executed in a cloud. As they bill customers for the usage of applications and associated resources, they can share some of this revenue with the external developer of the application. This incentivizes developers to write applications that are dependent on reoccurring usage of the customers.

Cloud Computing Service Providers

Cloud computing capabilities of the communication service providers are utilized as often as possible. Owning the cloud gives the CSP more flexibility since no contracts with third parties need to be made. With an increase in demand or due to a lack of adequate cloud resources on behalf of the CSP, contracts with external cloud providers become ever more pertinent. Long term SLAs guarantee access to sufficient computing resource. This enables pluS ME customers to be re-routed to clouds closest to their proximity. Complementing these basic resources, demand based agreements with external cloud providers can balance out peaks in computing and data needs.

Ubiquitous Computing Device Providers

PluS ME enables SMEs to incorporate smart devices into their business processes and use them in applications. Despite finding wide distribution in large enterprises, ubiquitous devices are not omnipresent in small and medium sized enterprises in the Flat World. If they choose to empower more of their devices with sensors, computing and networking capabilities, the CSP acts as an enabling intermediary. For successful implementation of ubiquitous devices in a SME through a recommended partner, the CSPs collect a small recommendation fee. The providers of these ubiquitous computing devices link the devices into the network of the CSP, thereby enabling the use of pluS ME in the respective enterprise. In this case the customer purchases the ubiquitous network capabilities either by a pay-per-use scheme or as a fixed monthly flat fee.

8.5 Conclusion

In order to analyze what future enterprises and applications will look like, ten main driving forces have been identified. They can be expected to shape a world linked by new broadband and mobile infrastructure and connected through intensified relationships between various stakeholders. Thereby, vast amounts of data need to be handled and properly secured. The acceptance and feasibility of ubiquitous computing, enterprise cloud computing and changes in the workforce can be considered key drivers as they significantly shape the exact outcomes for future enterprise services. They define cornerstones of three possible scenarios for 2025. The Flat World scenario is considered to be the most plausible. It is characterized by a wide availability and full acceptance of innovative technologies such as cloud and ubiquitous computing. Enterprises are expected to demand innovative communication and collaboration applications as well as intuitive, standardized solutions for large scale B2B interaction. By not only accepting but also demanding new ICTs, the workforce adapts to a constantly changing working environment in 2025. The market for enterprise applications is expected to be highly fragmented with developers creating applications for various platforms.

In the Flat World, CSPs can leverage their role as a trustworthy network provider by tapping the attractive market of small and medium enterprises. Based on the distinct needs of this market segment, the innovative service offering pluS ME (Platform for Leveraging Ubiquitous and cloud computing Services for Small and Medium sized Enterprises) has been introduced. It enables SMEs to take advantage of the highly developed technological infrastructure, such as cloud and ubiquitous computing, to streamline their processes and play an active part in the interconnected business environment. PluS ME is a cloud based system which integrates a service delivery platform, ubiquitous computing infrastructure and other advanced complex services in an intuitive front-end application. By offering developers attractive revenue share agreements for the provided platform, their innovation can be leveraged to develop innovative applications tailored to the needs of small and medium enterprises.

In order to evaluate all strategic options, communication service providers will need to pay close attention to future developments and the weak signals presented in the scenarios. If developments further endorse the emergence of a Flat World, CSPs should intensify researching the feasibility of innovative product offerings, such as pluS ME, and adapt their portfolios to meet future demands in enterprise services.

Chapter 9

Ubiquitous Computing Services

Daniel Akselrad, Stefan Hopf, Kaspar Hübener, Martin Kliebhan, Assif Sobhani, Jan-Paul Stein

Ubiquitous computing has turned out to be a field of intense research lately. It is expected to develop very fast within the years to come. When developing business models of telecommunication providers in the future, the opportunities offered by ubiquitous computing have to be considered. Telcos are in general well positioned as they have the necessary network capacities to enable ubiquitous communication of devices.

In order to find a future service idea, a scenario planning methodology is employed. In the beginning, the ten major driving forces of ubiquitous computing are analyzed to get an overview of factors that influence the future developments. Three key drivers have a particularly great impact on the future of ubiquitous computing and their development is highly uncertain. Advancement of smart device technology as the first key driver describes the progress of future technology. Development of the regulatory framework is the second key driver and discusses evolving standards and legal frameworks. The third key driver addresses increasing privacy concerns of people.

Based on the different directions in which the driving forces develop, three scenarios for the world in 2025 are derived.

In the scenario **Technological Wasteland** device technology is not advanced, as no technological standards are set. Thus applications of ubiquitous computing are rarely used. Due to the limited scope of ubiquitous computing, users do not have high privacy concerns.

The second scenario **High-Tech Islands** is characterized by disruptive technological advancements and rapid success of ubiquitous computing. Legal authorities do not regulate the market, so that many platforms with de facto standards are shaping a fragmented landscape of costly technical solutions. Users are willing to trade privacy for the high benefits offered by ubiquitous computing.

The third scenario **Secure Lowlands** appears to be the most probable. It describes a world in which ubiquitous computing is widely integrated and great user benefits were achieved. Nevertheless, due to various data scandals, the general public opposes to further share private data. Therefore, the capabilities of ubiquitous computing exceed what is actually realized in applications. The regulatory framework prohibits developers to access private data and therefore hinders the development of customized applications. Consumers face a trade off as they would like to use customized applications, but are not willing to disclose private data.

The business idea of the **Privacy Fortress** directly addresses the prevailing user needs for enhanced privacy within the Secure Lowlands scenario. The Privacy Fortress enables the user to experience all benefits of personalized applications and services within an ubiquitous computing environment without disclosing any private data. Personal data and information are stored within a cloud-computing environment. A digital ID Management System assigns every user a regularly changing ID number, which is used for any sort of communication outside the cloud. Therefore no privacy concerns arise, as external entities cannot identify the person via the ID number. The main areas this service is implemented in are smart user applications, public personalization services and personal payment.

Telcos are highly qualified to operate the Privacy Fortress. Due to the regulations and obligations imposed upon them by authorities, Telcos have strict internal policies. As a result Telcos are viewed as trustworthy. In addition, they are able to set up and operate the required network.

9.1 Introduction

The term "Ubiquitous Computing” (UC) was initially coined by Mark Weiser’s evaluation of the computer of the 21st century. According to Weiser, the vision of UC points to computing technologies that "weave themselves into the fabric of everyday life until they are indistinguishable from it" [462]. When Weiser wrote the article in 1991, he expressed strong doubts on the idea that a traditional personal computer could ever become an integral, invisible part of the way people live their lives.

Within the digital world of today, however, Weiser’s vision of UC could soon become reality. In line with his perception, UC today “is used to describe ICT systems that enable information and tasks to be made available everywhere, and to support intuitive human usage, appearing invisible to the user” [363, p. 2]. The advancements within the field of smart device technology led to an increasing miniaturization, an expanded functional scope and a convergence of devices. With an increasing personalization of computing services, these technological trends have the potential to enable a new form of human-computer interaction in line with the vision of UC. Thus sensors and devices could be built into objects, environments, and activities of daily lives. An implementation of sensor systems into a car would for instance enable usage of driving assistance systems; houses could evolve to smart homes; computers could be implemented in wearable computing solutions; supply chains processes could be optimized [93, pp. 45-62]. In figure 9.1, exemplary integrations of various objects into the UC environment are illustrated. Technically realizing these examples of use, an appropriate UC infrastructure is required. Telecommunication companies, with their expertise in network operation, would have the know-how to build and maintain UC infrastructure. Furthermore they could potentially raise the funds to finance a large scale infrastructural UC development. Leveraging the UC network ownership could ultimately open up new revenue streams and strengthen the strategic position of telecommunication companies.

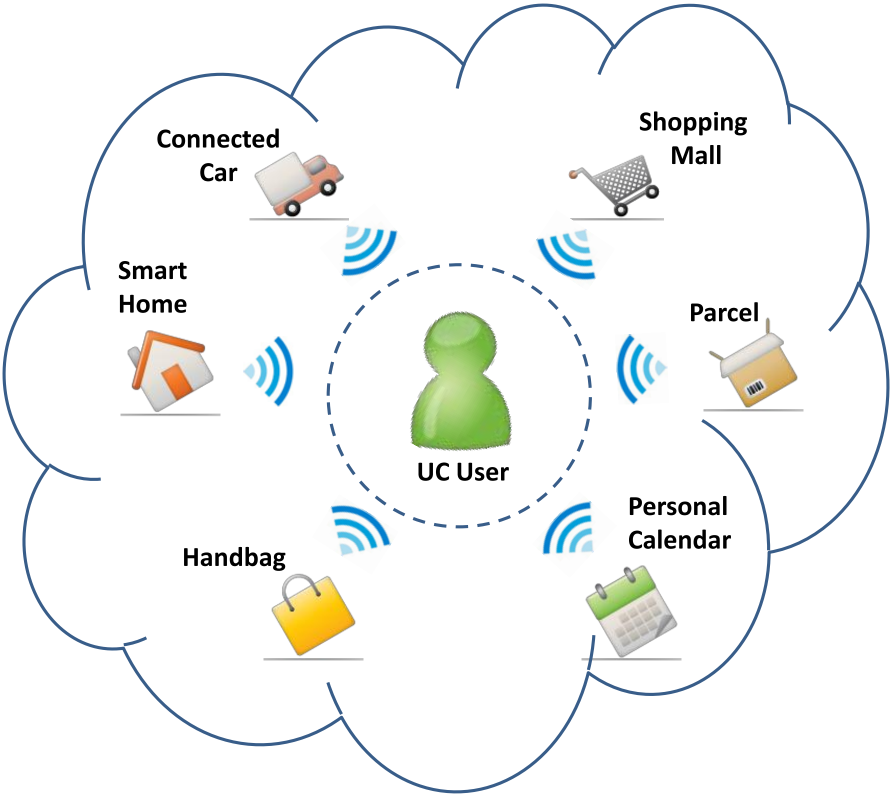

Figure 9.1: Ubiquitous Computing Leads to A Connected Multitude of Objects
Source: own illustration

The scope of this chapter on UC services is an evaluation of future developments in the field of UC and the design of a corresponding service idea. The chapter is structured in three parts: Driver analysis, scenarios and product idea.

In the first part, ten important drivers of UC are identified and analyzed with regard to their possible future developments and implications for UC. In the second part, three different scenarios for the year 2025 are derived, taking into account different developments of the three most important drivers. In the final section of this chapter the service idea of a digital identification management solution is described, based on the ecosystem the third scenario would create.

9.2 Driver Analysis

This section introduces the ten most important drivers that will shape the future environment of UC. Figure 9.2 displays an overview over the drivers, the degree to which their development is foreseeable and their possible impact on the future development of the UC environment. The three drivers in the upper right corner of the matrix represent the key drivers identified for UC. They have the potential to decisively influence a world with UC in the future.

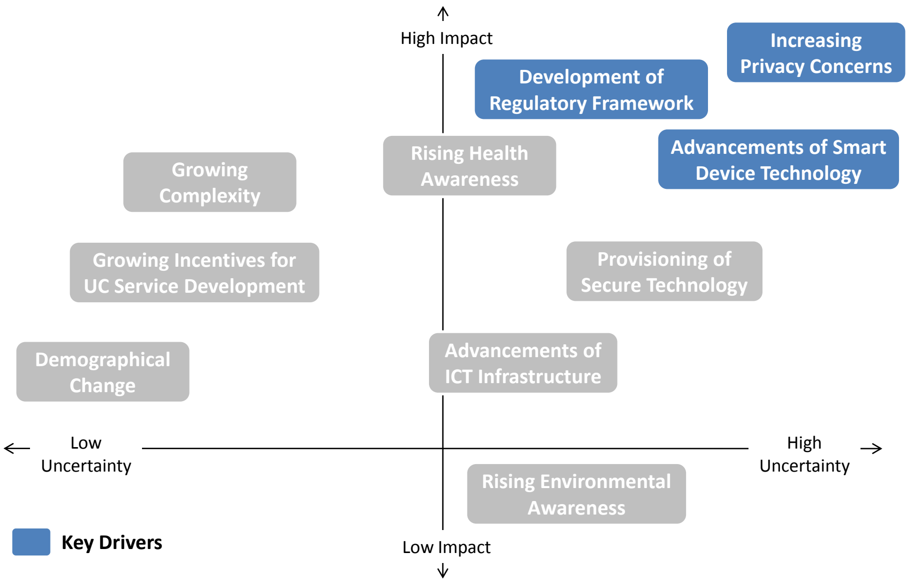

Figure 9.2: Map of Drivers for UC Services
Source: own illustration

These drivers will later be used to develop three different scenarios. The scenarios are not meant to be mere fictions but are derived from an investigation of the presented drivers. A profound understanding of what elements will shape the future, is crucial to comprehend the logic and the plausibility of the scenarios.

To form this understanding, the drivers are presented in two parts. The first part will introduce the certain drivers. They represent factors that change the setting in which UC services will be used in a foreseeable way. The second part addresses the uncertain drivers. These are factors that possibly exert a high impact on the future developments but it is unclear, in which direction they will develop.

9.2.1 Certain Drivers

The world is constantly changing but some of the changes are more likely to occur. The certain drivers will lead to a development that can be anticipated and thus determine the direction in which the world is going to change. These drivers form the basis of the future and will have the same impact in all three scenarios. Every certain driver will be described to provide an understanding of the elements incorporated. Afterwards a short overview of the implications for the UC world is given.

9.2.1.1 Demographic Change

Demography is a statistical survey of the development of a human population. It describes the structure, size and distribution of a population. The term "demographic change" refers to the dynamic shift of demographic patterns within a population. Analyzing the demographic change within a country can help to anticipate the future needs of the population, allowing deductions for the future acceptance of UC.

Demography changes in response to varying rates of birth, death and migration. According to the theory of demographic transition, countries follow distinct demographic patterns as they evolve from a pre-industrial stage to an industrial economic system [437]. By analyzing the past demographic transition of a country, structural developments can be identified and future developments can be derived.

Germany, as an industrial country, is in its final stage of demographic transition. This stage is characterized by low birth and death rates and thus a stable population size. Nevertheless, in Germany death rates slightly surpass birth rates leading to a shrinking population. While Germany in 2010 denoted 82 million inhabitants, the number is expected to decrease to 80 million in 2025 [410, p. 33]. Besides the population size, the population structure will change as well. Figure 9.3 illustrates, how the structure of the German population is going to develop in the next 15 years. The share of people above the age of 65 is forecasted to increase from 20 percent in 2010 to about 25 percent in 2025. The share of young people below the age of 19, in comparison, is expected to decrease from 19 percent in 2010 to about 17 percent in 2025 [446]. The German population therefore will be aging in the near future. This change of age structure might lead to an increasing demand for UC services for two reasons.

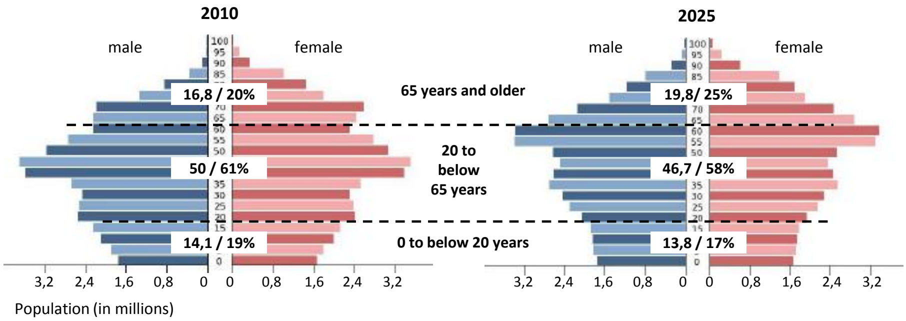

Figure 9.3: Demographic Change in Germany Between 2010 and 2025
Source: U.S. Census Bureau [446]

Firstly, as the population becomes older on average, the demand for assisted living solutions for elderly people will increase. UC services can thereby provide proactive and situation aware assistance to sustain the autonomy of the elderly. UC services can cover areas of comfort (e.g. home automation, safety, social contacts), autonomy enhancement (e.g. medication, training, shopping) and emergency assistance (e.g. detection, prediction, prevention). These services could increase the quality of life for elderly people and lower costs for society and public health systems as people live longer in their familiar environment and intelligent computing solutions would facilitate their daily lives [265, pp. 103-104].

Secondly, the share of a new generation, the digital natives, of the total population increases. The term “digital native” refers to people who grew up in the 21st century using the digital language of computers, mobile phones, video gaming and Internet [369]. This generation of people causes a major shift in the adoption and usage of technology in the future. Traditional devices like mobile phones might be regarded as commodity and the demand for sophisticated on-top services might rise. This will generate an increasing demand for UC services as users might push to transcend the boundaries of traditional computing services.

Concluding, the demographic change within Germany is expected to drive the demand for UC services by 2025. These services will address the needs of an aging German population facilitating the lives of elderly people. Additionally UC services will satisfy the demand of digital natives who will form a larger share of the total population by 2025.

9.2.1.2 Growing Incentives for Ubiquitous Computing Service Development

Literature about UC draws a very precise picture of revolutionary, life changing services available in the future. On the one hand, these services are driving the development of UC and its underlying technologies because they promise to facilitate people's life in various aspects. On the other hand, technological advancements are usually accompanied by applications in order to show customers the products' advantages and increase their market acceptance. Powerful, useful applications are crucial to overcome user skepticism and reach a broad user acceptance.

Technological development catalyzes sophisticated applications and vice versa. The speed of this catalysis is dependent on the number and quality of applications. Applications in turn are dependent on the number of developers. In order to support developers who will build applications for UC, it is necessary to understand their needs, which is why their perspective is described in this section. From which fields do future developers originate from, what tools and support will they demand, which data will they be able to access and how will they reach the customer? Examples for the supporting influence of UC on the future daily life cover manifold areas such as logistics, household or cars [93, pp. 45-62].

As the illustrated examples affect many industrial branches, a multitude of companies already invest in the development of services (e.g. manufacturers of cars, household devices and medical devices) [159]. This leads to a guaranteed number of developers building services for their companies.

Aside from these employed developers, third party developers will be attracted by promising technological advancements and size of the community. Commercial and non-commercial developers will have a higher interest if the used programming languages and interfaces will be accessible from outside the manufacturer's ecosystem. Mobility plays an important role in an environment with UC. Therefore developers from the mobile device ecosystems will be attracted. The more information about the technology used in the product is made accessible to external developers, the more sophisticated, disruptive applications they can build [160]. Service development platforms, development communities or standards for the same kind of device serve as further incentives and will likely be introduced within the next years. If the technology of UC evolves to a landscape of platforms, application marketplaces might evolve where applications would be distributed to customers.

It can be assumed that the number of contributing developers will increase within the next years. They will utilize all technical possibilities available. However, advancements of smart devices (see 9.2.2.7) and the introduction of standards (see 9.2.2.5) will influence the application's degree of sophistication.

In order to push the application development further, dedicated attention could be paid to service delivery platforms and access to information. By enabling third parties to contribute revolutionary services UC will make a big step towards becoming reality.

9.2.1.3 Growing Complexity

The world and the daily life of people are growing in complexity. For the individual it becomes increasingly difficult to orientate in such an environment and especially the demands for high flexibility in the working life is a challenge. The integration and continuous improvement of ICT will present a way to facilitate this complex lifestyle.

In addition to the enlarged possibilities of personalization, the complexity of the UC environment is mainly augmented by two factors. The first one is the increasing availability and accessibility of information, measured by the number of people using the Internet and the amount of digital content available. The second is the ascending average number of functions single devices can include on top of their main functions.

By 2011, the digital information that is available worldwide, will have grown by ten times compared to 2006 [202, p. 3], with the total number of Internet users in Europe growing by more than nine percent annually [422, p. 7]. Taking also into account the growing number of networked portable products and embedded computers, this will lead to an environment with rapidly increasing communication possibilities.

Overall trends such as the growing amount of information and selection of services and software will amplify this complexity even further. In such an environment finding the right information will be significantly harder and users will get increasingly more distracted from their intended action. As a consequence, there will be a need to efficiently deal with the complexity but use the advantages offered by the developments at the same time. As UC refers to intelligent devices that support users without much direct interaction [462], this technology will offer a way to reduce the perceived complexity for the users. Smart devices can facilitate some of the coordination and control tasks and not only reduce the effort for the users but also improve the results. The urgent need of users to find ways to simplify their daily life will therefore be an important driver of UC services in the future.

9.2.2 Uncertain Drivers

The drivers introduced in this section will exert an influence on the future environment of UC. However uncertain drivers might evolve in different directions and dependent on the actual development lead to a completely different overall situation. After a short description of the driver characteristics, the possible developments of each driver are therefore depicted and the implications for UC are illustrated. The most important drivers to consider are the three key drivers Regulatory Framework, Privacy and Advancement of Smart Device Technology.

How these drivers develop will decisively determine how the ecosystem of UC will be shaped. They set the path along which the future evolves.

9.2.2.1 Rising Health Awareness

The general idea of UC aims at an integration of technology into daily life routines. This means that humans would increasingly be exposed to the technology UC is built on. Therefore it is of crucial importance to verify whether this technology has an impact on human health, as this would greatly influence the acceptance of UC. It is not very likely that new scientific research will prove that the technology necessary to use UC services will damage health. With a small probability, however, this might happen and as a consequence the environment in which UC is developing would dramatically change. This driver can therefore be regarded as a "game breaker" and was included due to the high impact it would exert if the rather unlikely event of proven health damage would occur.

UC involves a multitude of electrical devices. Consequently the major health concern is due to the emission of electromagnetic radiation. Sources are stationary as well as mobile devices, whereas the two major sources of radiation are power supply and data transmission.

Devices installed in a fixed location operate via a standard grid connection. This generates a low frequency electromagnetic field, which can already be found in every household. Sources are for example the TV, the washing machine or the fridge. These low frequency electromagnetic fields are proven to have no impact on human health [103].

Existing technologies for the power supply of mobile devices are either built-in batteries or wireless energy transfer in forms of electrodynamic induction. In most of the cases, the data is transmitted via radio transmission technologies such as wireless LAN, Bluetooth, mobile phone connections (e.g. UMTS, LTE) and RFID. These technologies generate high frequency electromagnetic fields that have different physical characteristics compared to the low frequency fields. Both types are part of the non-ionizing radiation, which means that their energy is not sufficient to change the electronic structure of atoms and molecules. But high frequency electromagnetic fields are absorbed by humans and lead to a warming of tissue.

The existence of other non-thermal biological effects has not been proven so far. From a scientific point of view, high frequency electromagnetic fields have no negative implications on human health, as long as the prescriptive limits are not exceeded. But there are still open questions about the long-term implications, as these have not yet been entirely clarified.

The health impacts of new technologies that are currently under development such as data- and power-transfer via optical laser or sonic, cannot be assessed at his point in time. It has to be stated, however, that the technological structure for UC generally builds on existing technologies where some research about health impacts exists. This is also valid for bandwidth and efficiency advancements, as the physical basis does not change.

Still, there is a possibility that this assessment regarding the health impact could be changed by new scientific findings and as a consequence the technology behind UC might be considered as dangerous.

The latest research will probably turn out to be in line with the already existing research on electromagnetic fields and no health impacts could be proven. This would mean that no health issues or concerns about UC will arise.

In contrast, future research and long-term studies could reveal negative impacts on health which were unknown so far. This would lead to a radical change in the general attitude towards UC. People would become aware of the damage UC technology would do to their health and might reject to use the technology. Authorities could see the need to pass laws prohibiting the expansion of the UC infrastructure and maybe even demand, that existing capacities are removed. Such an outcome would be a game breaker to UC in general.

9.2.2.2 Advancements of ICT Infrastructure

Closely connected to UC is the term "Internet of things". It refers to a multitude of devices, like cars or fridges, connecting and communicating among each other. The expression "ICT" contains all kind of information and communication technologies necessary for the communication of devices. In a world of connected devices it is obvious that advancements of the ICT infrastructure will affect the development of UC.

In the future, different devices might be equipped with feature-rich sensors or high processing power. But essential for realizing UC is the devices' ability to exchange information with other devices; directly or via a network.

Today several technologies exist that accomplish this task. Telephone network including the Internet, cable network, communication over power grid, or direct connection are some wired solutions. For wireless communication over a distance of several meters Bluetooth or WLAN are possibilities. Over a longer distance the mobile phone network involving transmission via radio frequencies (from ultra high to super high frequencies [394, p. 26]), or satellite connection can be used. Most of the mentioned technologies require a network structure to connect two devices. But a wired direct connection or short-range wireless techniques can link devices directly without depending on a network.

All these technologies can again be utilized in different implementations that mainly differ in the bandwidth provided.

In the near future, devices that use or rely on IP will represent the vast majority of communication appliances. This development implies that fixed-line and mobile Internet access will have to provide maximum bandwidth to an inflated number of devices in order to ensure seamless transmission of increasing traffic. Broadband Internet (min. 1 Mbit/s) is available for 64 percent of subscribers in Germany today but a state initiative aims for a rapid increase in bandwidth (up to 50 Mbit/s) until 2015 that will be available for 75 percent of the subscribers [87, 105].

UMTS is currently the technology which is providing maximum bandwidth (up to 7.2 Mbit/s) for mobile Internet access but that is not available in rural areas of Germany. The upcoming LTE technology will provide up to 100 Mbit/s and will be primarily installed in areas where broadband Internet was not available before. Frequencies used for LTE are allocated in 2010 and adjustments of network infrastructure will start accordingly. LTE will also increase the number of devices that can simultaneously connect.

These improvements of basic ICT infrastructure are quite certain, but given a breakthrough of UC two future developments are possible.

In the first case, the infrastructure will be prepared to address the growing need for bandwidth. In almost all areas of Germany network coverage will be sufficient and provide simultaneous access to the growing number of devices.

In the second case, ICT infrastructure will still be satisfying for a rather high but limited number of devices communicating over the Internet. The quality of network coverage will be very diverse. Depending on position, number of devices connected, and bandwidth available applications of UC might be usable sometimes but are not reliable at all.

In addition to basic ICT infrastructure some other issues could arise which might contribute independently to both developments of the future infrastructure. In applications of UC cars or household devices might become intelligent whereas other things through addition of sensors receive a technical component (e.g. sensors in clothes). To ensure communication between devices of one kind (e.g. from car to car) or between different kinds of devices (e.g. from car to home) standardized communication processes would have to be implemented (see 9.2.2.5). This could either be realized through agreements between diverse manufacturers or through third party communication units that would have to be integrated. These units would belong to ICT infrastructure as they were necessary for device communication. One example of the latter is the introduction of the German system for toll collection in 2005. Every truck had to be equipped with a standardized on-board unit in order to automatically communicate with the toll collection system. Depending on the character of new UC applications, an entirely new infrastructure might even evolve in public areas like sensor arrays along highways or publicly accessible terminals.

If in future infrastructural issues like cross-kind communication or the need for a new infrastructure arose, these issues would be closely connected to the advancements of smart devices (see 9.2.2.7). Given a rapid technological development in this field, standards for cross-kind communication might evolve. But installation of cost-intensive new public infrastructure will be highly uncertain.

In any case telecommunication operators could provide access to their network that is a reliable and well-proven way of communication.

9.2.2.3 Rising Environmental Awareness

Environmental awareness is a social movement to promote sustainability and the conservation of the environment. In the past, a trend towards an increasing environmental awareness could be observed (e.g. Green IT) as people become more sensible towards environmental issues [203]. Therefore any company rolling out UC services on a large scale should assess the environmental impact of their operations to avoid consumer rejection and negative publicity.

From a consumer point of view the environmental impact used to be rather a hygiene factor [185, p. 38] that companies should be aware of but that hardly was a game breaker [302].

The increasing environmental awareness that can be seen today originates from the fact that people start to recognize the ongoing climate change and its negative impact on the planet. This is promoted by nongovernmental organizations (NGOs), like Greenpeace, that increasingly rally for environmental issues and aim at slowing down the process of climate change [218]. When assessing the environmental impact of UC services, one can identify negative as well as positive environmental aspects.

On the one hand a new technological infrastructure has to be built to technically enable UC at all. Components of the ICT infrastructure will require new communication networks like LTE antennas. They need to be placed somewhere in urban areas, rural areas and on the countryside. Additionally the entire communication network must be linked. At some places this will result in damage of the natural ecosystem, as trees need to be cut and cables need to be placed underground. Furthermore the entire ICT infrastructure will distribute electromagnetic fields. These fields might interfere with the communication used by some animals like bats.

Furthermore the vast energy consumption of the ICT infrastructure poses an environmental threat. By 2020, data centers and telecommunication networks will consume more than the combined current electricity consumption of France, Germany, Canada and Brazil [218].

On the other hand UC services offer various opportunities to create benefits for the environment. In the energy sector for instance, UC services enable the implementation of E-Energy solutions for intelligent energy distribution systems leveraging the potential of renewable energy sources and thereby reducing greenhouse gas emissions [357, p. 5]. Furthermore the industry will be using UC services to optimize manufacturing, retailing and supply chains. Increasing process efficiencies might then result in decreasing resource consumption and reduced waste production.

The extent to which environmental awareness will influence UC depends on the overall environmental impact of UC in the future. The ICT infrastructure for UC services certainly exerts a negative impact on the environment. But in contrast UC services also offer numerous opportunities to decrease the burden on the environment by increasing efficiencies. Analyzing the environmental impact of UC services two developments are plausible by 2025.

One possible development is that the environmental benefits of UC services could be outweighed by their negative impacts on the environment. A reason for this could be the low energy efficiency of the technological infrastructure and the devices. Furthermore the technical components could prove to be difficult to recycle and would therefore cause large amounts of waste. As people in 2025 may have a high environmental awareness, this would lead to concerns about the technology, slowing down the adoption of UC services.

Alternatively the environmental benefits of UC services could outweigh. Utilization of UC capabilities, combined with energy efficient devices, could leverage the full potential of the UC technology. This could result in decreasing resource consumption, reduced waste production and just in time management of supply chain activities. The green impact of UC services would thus foster an increasing adoption of UC services.

9.2.2.4 Provisioning of Secure Technology

Security, as one of the least visible property of a system, nevertheless has a high impact on the system acceptance of users. While users tend to demand the highest information security, it is often the technological constraints that prevent the provisioning of an adequate security standard. Technological security properties of UC services will thus be a determining factor for future user acceptance.

Security requirements can traditionally be clustered by the information security triangle of confidentiality, integrity and availability, depicted in figure 9.4. Confidentiality refers to the state that is harmed whenever information is disclosed to unauthorized parties. A break of integrity occurs when information is altered in an unauthorized way. Availability is not provided when a request by an authorized user is denied [406, pp. 4-5].

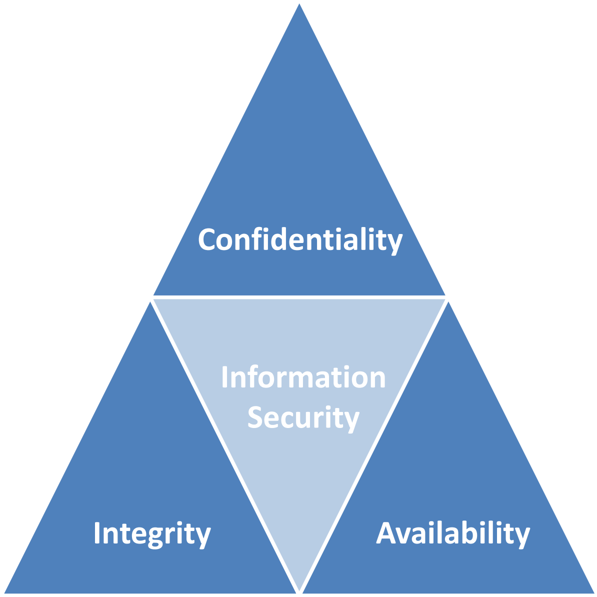

Figure 9.4: The Information Security Triangle
Source: own illustration

In traditional wired computing networks, information security is provided through a combination of authentication, authorization and access control. UC networks, however, incorporate numerous types of embedded and portable wireless devices to satisfy the user demand for omnipresent access and therefore consist mainly of wireless environments characterized by shared resources, node mobility and various transmission ranges. These unique characteristics make it more difficult to uphold traditional security solutions because such distributed systems lack central control and have flexible topologies. A mobile ad-hoc network for instance enables arbitrary nodes to freely move in and out which makes it hard to guarantee security. Additionally, the mobile nodes within wireless networks mostly have low processing capabilities which make it impossible to run complex security processes [98, pp. 1-2].

Analyzing the technical characteristics of UC networks with regard to the demands given by the information security triangle poses various technical challenges.

First of all confidentiality of information will be more difficult to maintain. This is because information is transmitted via wireless technologies and is thus distributed to anyone within the signal range. Developing security mechanisms to prevent unauthorized access to information will therefore be important.

Secondly data integrity must be achieved. Data integrity plays a crucial role for UC services as real world objects become part of the network. Equipping a patient with sensors to remotely monitor critical data is a possible future application of UC services. Alteration of this data can result in lethal damage to the patient as warning signs may be missed. Similar critical applications of UC services include transportation, energy generation and consumption and the like. It will therefore be essential to guarantee data integrity.

Finally the information data availability must be secured. As the vision of UC services builds on unattended devices ready to communicate with anyone in range, it will be easy for attackers to establish a connection to the system. Viciously denying the service to legitimate users might therefore be easy by using up all system resources for instance. Consequently there need to be security mechanisms in place to ensure the system availability for every legitimate user [406, pp. 4-5].

In the future, technological security standards must be developed in order to satisfy the user need for information security. This will be an important factor influencing the user acceptance for UC.

One possible future development could be that there are no high technological security standards within the UC environment. Hence, security specialists would fail to provide effective security frameworks to ensure information security. As a consequence, the acceptance of UC services would remain low and could possibly lead to a degeneration of the dynamic wireless network structures.

In a second development exhaustive information security for users of UC services could be provided. Despite the complex technological structure of UC, operators could pursue a new innovative approach to ensure information data security. This could be realized by leveraging the advancements in the field of identity- and access management technologies. Implementing new technologies, network security and reliability could be ensured by UC operators. As a result, the high information security standards could foster a widespread adoption of UC services among users.

9.2.2.5 Development of Regulatory Framework

The regulatory framework includes both the development of technological standards to secure interoperability and the development of a legal framework, mainly with regard to data security. Although the enforcement of data privacy depends on the legal framework, this aspect is discussed separately within the privacy driver (see 9.2.2.6) due to its high relevance for the development of UC. Technological standards are very important for the development of UC, as there are many smart devices from different brands that have to able to communicate with each other. Furthermore it is important that the legal framework guarantees security and fair competition to provide stable growth of UC.

There are several institutions that could push forward the setting of technological standards for UC services. They are responsible for establishing standards for Application Programming Interfaces (API), Resource Description Frameworks (RDF) and Interface Description Languages (IDL). But despite these efforts it can take years for different organizations and companies to agree on common standards.

On the one hand, widely accepted standards are very important for the development of UC as there are many smart devices in the system that require hardware and software standards of some sort to communicate.

On the other hand, leading companies in the market try to push through their own standards to gain an increased market power. Currently, for instance, Apple is attempting to position the html5 standard against the Flash Player for online games and videos [262]. One possible way of how a standard could be set, is when a company standard eventually reaches the critical mass of users and gains enough market power to impose the standard. If no single company is able to establish its standard, a group of companies could agree on a common standard within the institutions mentioned above. The least preferable outcome for the development of UC would be if neither a single entity has sufficient influence to set the standard, nor a mutual agreement can be achieved.

The legal framework refers to data security and how the government can protect user's data from illegal usage. As UC is a fast developing market, the legal framework has to adapt quickly in order to protect users and guarantee legal security. UC is not limited to national borders or to national legal frameworks. This makes international agreements and minimum standards necessary, as ambiguities will lead to legal uncertainty. The use of UC will face problems of acceptance, if no clear assignment of responsibilities can be achieved [93, p. 132].

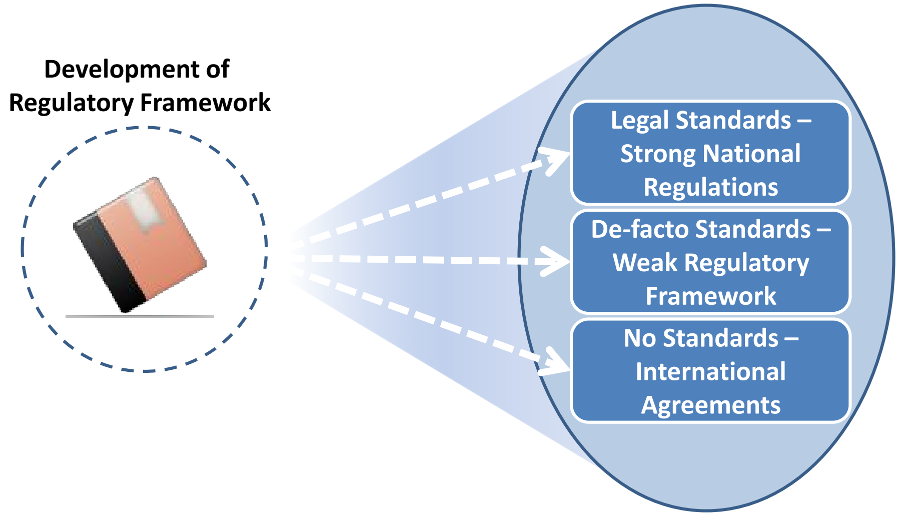

Figure 9.5: Possible Developments of the Regulatory Framework
Source: own illustration

The different aspects of the regulatory framework that were described above, allow for three possible developments, depicted in figure 9.5.

The first possible development could be that one company gathers sufficient market power so that it is attractive enough for competitors and other third parties to adopt their standard. With an increasing number of third parties adhering to this standard, it could evolve to an industry-wide standard. Consequently all UC devices would be able to communicate. On such a basis a common platform for developers could evolve, which would increase the value of UC products and networks even further. This implies that the government would not be required to take any actions to enforce a solution. An example is the Internet environment in which de-facto standards evolved without significant regulatory influence. The advantage of such a standard setting procedure is that the process is much faster than it would be if external force were required. Thus, the standards would be well established and further products could be supplemented continuously.

Although it is likely that data security will always be an issue, the fast technological advancements that can be achieved by third party enabling and de-facto standards, might render it impossible for governments to keep up with the pace and protect the data security of citizens. This could lead to frequent data scandals, which would affect both UC reputation and demand. That is why companies would then try to ensure security on a technological basis.

It might also be possible, that even though no de-facto standard could be established, several important legal standards could be set. The standards would not be very flexible and not all encompassing but at the same time the standards could be internationally accepted. On this basis, sub-standards could be developed that would not be regulated by legal standards. UC devices could be connected very easily and the communication would be guaranteed. As the setting of the standards would take some time, R&D spending would be rather low at the beginning.

As the development of UC would be slower, national governments could possibly adapt their legal framework to include specifically laws regarding UC and thereby protect users through guaranteed legal security. At the same time international agreements would be extremely hard to achieve, as they usually require longer negotiating than federal laws. As a consequence some countries might function as a basis for illegal activities that could also affect German users as there are no boarders within the Internet.

A third possibility would be that due to rivalry among competitors an agreement on a common standard could not be established. Companies, like for example Apple, might not be willing to open up their platform. As there are many powerful companies being able to push in the UC market, it is possible that no company will be able to fully gain a market leadership position. Realizing that the UC business cannot be conducted single handedly, companies from different areas could form industry consortia in order to cover a broad range of services. As a result there would be some standards, but they would not be the same across UC. It is conceivable that there might be some restrictive companies that would not allow other companies to use their standards. This would result in a heterogeneous market structure, fostering compatibility problems and high prices. It would then be hard to switch providers as supplementary products only work on one distinct platform.

As UC might highly affect daily life it is possible that security within UC becomes a very important issue for users. Thus governments would try to protect data security of citizens. Western countries could also exert pressure in the UN and other international organizations regarding security. Furthermore countries would have to sign international security agreements. As the technology of UC would not evolve fast without standards, international agreements could keep up with the development. Additionally, national governments would have more time to fix loopholes in the framework. Such an international legal framework could then increase confidence in the security of the system and foster the support for new technologies.

9.2.2.6 Increasing Privacy Concerns

Besides the technical feasibility, user acceptance will be one of the most important factors for UC. The degree to which users will accept UC will be primarily driven by privacy concerns. In the last few years, social media websites such as Facebook have seen a huge increase in terms of members. All of these members have to fill in some personal information to be able to use the services at all. This fact is a cause for concern for some of the users that do not want to abstain from the use of the services but at the same time are afraid that the data they reveal is not secure. In the last years some privacy scandals occurred within Facebook [162] and a recent survey from Stiftung Warentest has shown, that most of the social media websites still are not up to date in terms of data security [37].

The concerns about privacy regard two fields of data usage. The first is the control over the data. Users wish to control what happens to the data they disclosed or that was recorded about them on the Internet. They do not want to see their personal details being sold to some advertisement company or abused in some other way. Instead they demand to control who can see the data and who cannot.

The second concern refers to the possibility to hide in a world of UC. If all vehicles, IDs and even clothes are equipped with a RFID chip, people may feel restricted in their movements. This concern is not only important in terms of private movement but even more for employees. It would be possible to exactly track every step an employee takes and if for instance a package was directly delivered. The control of the physical movement is a bigger concern for the working environment than for the private life. In the working environment, the supervisor does have an interest to know where the employees are moving during their working time. The supervisor wants all the employees to work in the most efficient way. This may lead to an unpleasant working atmosphere with the permanent feeling that the manager is looking over one's shoulder. For the private life it would not be desirable, that parents can keep track of every move a teenager takes or if a stalker could use the technology to follow one's every move.

Closely connected to these areas of concern is the question, whether the authorities are able to provide a legal framework to address these problems. Are the laws that regulate the degree of self-determination about the data efficient and up to date?

The two aspects described above – the increasing amount of private data that has to be disclosed when using UC and the areas of concern regarding the use of this data – might develop in two ways influencing the view, people think about privacy. These are depicted in figure 9.6.

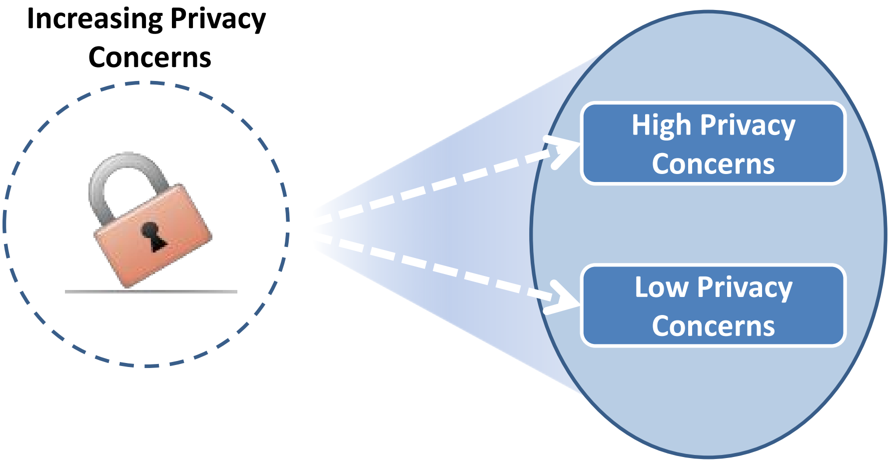

Figure 9.6: Possible Developments of Privacy Concerns
Source: own illustration

It could turn out that people do not regard privacy as overly important. They might realize that the data they disclose could be used against their will or that someone might keep track of their movements. However, they would still be willing to give away this information to social media websites or authorities. This would not imply that they do not care what happens to the data but they would see the risk of data abuse as a necessary evil to get connected, be part of the online communities and to reduce crime and violence. Especially with regard to the growing percentage of population that can be described as "digital natives” this might be a possible development.

If the public opinion towards privacy would develop like this, user acceptance of UC would not depend on such a high degree on the guaranteed data privacy but more on aspects like usability, the amount of features offered by application or the overall impact of the technology like crime prevention. In the latter case it can be assumed that people would be willing to sacrifice some of their privacy for the sake of the society’s security. This also implies that it would not be really important, whether the legal framework will be able to guarantee that every user is in perfect control over the data as they would be willing to share it to a certain extent anyway.

Another possible development could see a completely different view on privacy issues. People could feel that the growing involvement in social media websites, together with the possibilities of data collecting options UC offers, is making them increasingly transparent. Even the prospect of highly advanced applications and increased comfort of living would not be able to overcome their concerns. People might be very reluctant to give away any information about themselves and would be skeptical about using any devices or services that make it necessary to do so.

The user acceptance would be highly dependent on the guaranteed security of the data. Here the user acceptance will be more driven by privacy concerns than features or usability. In such an environment, the users would demand for a highly efficient legal framework that will guarantee them control over their data, otherwise they would not be willing to give away their data. Such a development would make it difficult for developers to create sophisticated applications. This would be partly due to the fact that the developments are not so much driven by the result but by a process guaranteeing security of data. On the other hand the high priority of privacy would make it impossible to realize the entire development scope.

9.2.2.7 Advancement of Smart Device Technology

Smart device technology encompasses all technological aspects of UC on a hardware level. Together with the aspect of price, the advancement of smart device technology has a high impact on how widespread smart devices will be in the future, who potential customers are and what fields of utilization potential are possible.

In order to facilitate UC, every appliance or product needs to incorporate a set of enabling systems besides its basic functionalities. These enabling systems are referred to as “smart devices”. Their tasks are multifold and can be as simple as providing fixed sets of information or complex like controlling or monitoring through various sensors. Depending on the particular product, the smart device is part of, it may also offer ways of single or multi-user interaction. One feature common to all smart devices is at least some basic capability of establishing a connection to other devices or the user. Smart devices that are already in use are for example RFID tags or sensors for distance measurements in cars [93, pp. 45-48]. In the future smart devices are not only embedded in houses or cars but in many other objects like clothes as the concept of wearable computing proposes [93, p. 17]. Therefore the terms "appliance” and "product” in the above definition of smart devices have to be seen in a very broad sense.

From a technological point of view the future of UC will clearly be driven by miniaturization, invisible computing, human computer interaction/multimodal interfaces, volatility and heterogeneity of execution environment and energy supply and consumption. Miniaturization of hardware means that for example a processing unit with constant speed and networking functionalities is becoming smaller, is a key factor as decreasing size greatly facilitates the integration of Smart Devices into objects of our everyday life [93, p. 15].

Even with miniaturization provided, invisible computing as part of the overall concept of UC still poses a technological challenge. Invisible computing refers to the fact that smart devices execute their tasks autonomously while remaining hidden from the user. The technological implication is that such a smart device cannot rely on interaction with the user to e.g. deal with errors and has to perfectly blend in with the environment [275, p. 48].

In case interaction with the user is required, the combination of information from various smart devices is a highly complex task. Interfaces that place the human being at the center of computing, incorporating new and even multiple modes of interaction become necessary [275, 93].

A different set of key technological challenges that highly influence the future of UC is associated with the volatility and heterogeneity of the execution environment of smart devices. This point refers to both how smart devices deal with other smart devices that enter an already existing network and how they handle communication with smart devices that fulfill a completely different purpose and have their own distinct specifications [275, pp. 43-44].

Energy supply and consumption of smart devices is the last major technological aspect shaping the future of UC that is mentioned here. The basic question is how technologies like wireless power transmission and mobile energy production will evolve and whether energy consumption of smart devices can be minimized and storage time can be enhanced [93, p. 15].

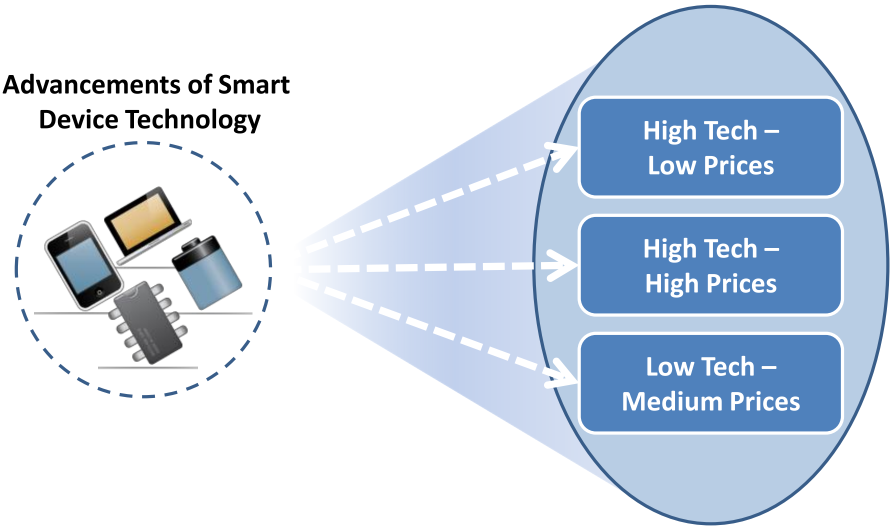

Figure 9.7: Possible Developments of Smart Device Technology
Source: own illustration

All different developments of "Advancement of Smart Device Technology” as a driver for UC have one aspect in common. If only one major technological factor is considerably less evolved than the others, customer benefits due to smart device enhanced appliances would greatly suffer. Consequently customer benefit is considered as one aspect to differentiate developments. Also the price of smart device technology as a second aspect has to be taken into account, since it greatly influences the number of potential customers and fields of utilization. Combining different levels of customer benefit with different price ranges, leads to three individual developments as can be seen in figure 9.7.

First of all, the technological advancements of smart devices as an enabler of UC could be high while prices remained relatively low. Smart devices would spread widely due to a high customer benefit. As a consequence of little manufacturing costs, smart devices could be produced in large numbers and would be integrated into most appliances of daily life. Since UC technology would run invisibly in the background and interaction with the user would take place in a very intuitive, user-centric way, even old people and children would quickly become accustomed to them. A huge group of customers with specific needs would entail many UC focused developers to get interested in creating software for smart devices. If customer benefits of UC technology were extremely high this would result in a lock-in effect since customer would not easily give up the advantages gained by employing UC. However, due to a plenitude of available smart devices and applications it might become increasingly difficult to determine which smart devices provide real value added.

If technological advancements were similarly high compared to the previous development, but prices were high as well, the environment around UC would be completely different. As smart devices would still offer a high customer benefit, mainly wealthy customers and businesses would adopt smart device technology. The small customer base of UC would result in comparably little diversity concerning smart devices. Thus, only a limited number of premium products would incorporate advanced smart device technology. Therefore smart device technology would not reach the majority of customers.

A third development could be that smart device technology barely evolved while prices were between low and high depending on the particular product and the area of usage. The public would not accept UC as a necessity and only few products featuring UC capabilities would be available to end-users. Since private customers would not utilize smart devices more than today, few to no new types of developer communities with a UC focus would emerge.

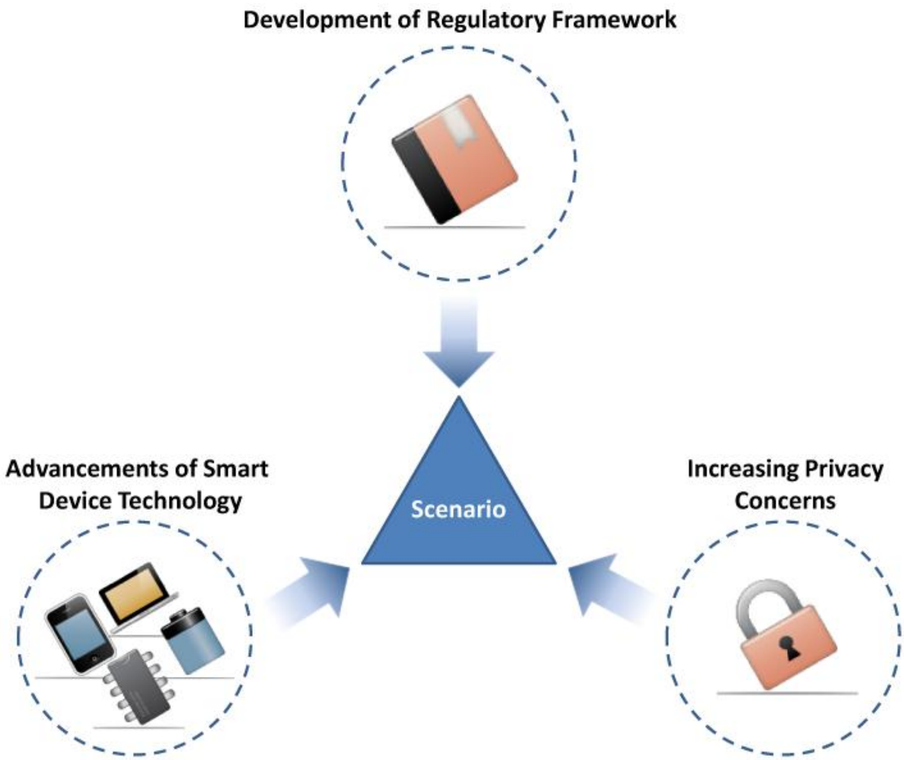

Figure 9.8: The Key Drivers Shape the Three Scenarios
Source: own illustration

9.3 Scenarios

Given the possible developments of uncertain drivers, distinct combinations of them shape the future differently. Three scenarios of UC in 2025 are described below, which base on the combinations of the key drivers' developments as illustrated in figure 9.8.

9.3.1 Scenario 1: Technological Wasteland

In the past, people expected UC to change the way they would communicate and utilize computing technologies in the future. But up to 2025, the development of UC technologies has turned out to advance slower than anticipated. The main reason for this development is a lack of common technological standards. Therefore products are mostly specialized on distinct aspects of life or tasks and only appeal to niche markets. Consequently, UC is not very attractive for many users as the interoperability of devices is limited and UC solutions are rather costly.

The specific developments of the three key drivers, that mainly determine the scenario, are depicted in figure 9.9.

Lacking Standards Limit Functional Scope of Ubiquitous Computing

For the last decade, no common technical standard for UC could be established. As companies tried to maintain their market exclusivity and no company could reach a critical mass of users in order to enforce their own technical standards, there is no platform to enable an exhaustive implementation of UC in every context of people's daily life. The lack of interoperability among technological standards slows down the development for UC. This is a major reason why applications cannot benefit from a large scope of standardized enabling systems. As it is very expensive for developers of supplements to develop a new product for each UC platform they cannot produce many innovative services. Additionally, due to missing technological standards the device manufacturers were not able to pool their R&D resources and establish cross-licensing agreements. Therefore the advancements in the field of smart device technology are rather incremental. Consequently, devices have a poor form factor and a low usability due to the limited modes of input. Due to the slow technological development, users feel comfortable with devices. Furthermore, governments have enough time to adapt to the technology and can therefore enforce data privacy and security. With the continuing globalization, international agreements are in place to support the goal of a secure UC environment on a global scale. Due to the legal frameworks, enforcing UC regulation and security user privacy concerns are low.

The ICT infrastructure was built several years ago. By that time UC was predicted to be all around in the future. But as no standards evolved, the usage of UC currently is not as high as expected. Therefore the infrastructure can easily handle current data traffic volumes. Throughout the last decades, organizations have tried to assess the impact of electromagnetic fields on health. Until now, no risks for the human health could be proven. As no long term studies exist yet, there is no sign of this to change and discussions about health risks of electromagnetic fields have lost public attention. Also the concerns about data security diminished, as both the legal framework grants safety and the technological security standards evolve fast enough to protect users sufficiently.

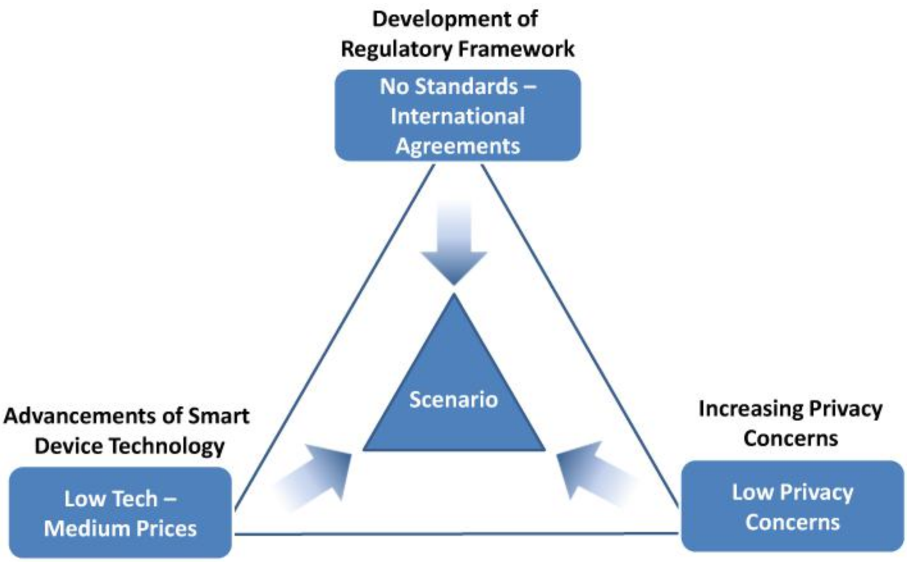

Figure 9.9: Characteristics of Key Drivers in Scenario 1
Source: own illustration

Ubiquitous Computing in Technological Wasteland

In 2025, the development of the UC ecosystem is coined by diverse technological standards, leading to a low interoperability of devices. This hinders an integrated UC experience for consumers, as they have to switch devices depending on the context they are located in. To implement a smart home solution, for instance, systems of vendors with different technological standards need to be combined. This cannot be achieved on an ad-hoc basis but there must be a central device or software in place in order to connect the different appliances of the smart home. Due to the technological complexity of the central linkage device, consumers need to hire experts to implement the solution. A central device can then control the smart home appliances. This device enables the user to remotely control functions within the house. Being located in a different environment the user nevertheless has to use other devices to perform the same tasks. In order to be able to communicate in every environment, users need to have several devices. The cost of purchasing these devices is obviously quite high. Therefore the overall scope of UC is rather limited, as the majority of the population has only access to a few UC networks with the corresponding technological standard.

Due to the lack of interoperability the development opportunities for software developers are rather low. Therefore less sophisticated UC applications are on the market. When for instance writing an exhaustive E-Health application, developers fear to be only able to address a small share of the elderly people due to the diverse standards and devices in place. Due to the limited target group it is unclear to the developers whether the application might actually recoup its development costs. This dilemma prevents many highly skilled developers from creating new applications. With the limited number and functionality of applications however, users are generally not concerned about their privacy. This is also because their data is stored in different sub networks of standards. The data from the users' smart home for instance is locally stored on different devices than the data gathered by the device used at work.

With dispersed technological standards in place, the small-scale networks, proved to be very maintenance intensive and high in energy consumption. Technological failures cause high equipment replacement rates. This results in a high level of waste production. Consequently NGOs publish studies criticizing the negative impact of UC services on the environment. Due to the technological failures the potential of UC services to optimize processes cannot be fully realized.

Within this environment Telcos mostly fail to foster third party innovation for UC applications. Even though a majority of Telcos runs SDPs to grant developers access to their UC network, the developers are spread across different platforms. Without the existence of a leading technological standard the developed UC applications are a minor innovation and redundant for every standard. As a result, the Telcos' revenue stream, created by over-the-top services and applications remains rather low. Thus the strategic role of Telcos in the telecommunication industry is mainly reduced to their function as bit-pipe providers.

Weak Signals and Signposts

Already today standardization is discussed controversially. Apple for instance decided to ban tools that allow cross-compilation from other languages into iPhone OS native code. According to Steve Jobs, the CEO of Apple, a cross standardization would dilute the iPhone-exclusivity. More specifically, he pointed out: "If that were to happen, there is no lock-in advantage (. . .) And, obviously, such a meta-platform would be out of Apple's control." [261]. With this statement Steve Jobs clearly indicated that Apple is not interested establishing a cross-industry standard for mobile phone application development. In contrast to that a number of large telecommunication companies and mobile hardware vendors just recently announced the Wholesale Applications Community, with the "aims to unite a fragmented market."[1] While the market impact of this consortium is still unknown, it definitely points towards a cross-industry standardization.

Signs pointing towards a development in the direction of this scenario can be identified when following future discussions on technological standardization in the ICT industry, which will form the basis for the UC environment.

[1] http://www.wholesaleappcommunity.com/

9.3.2 Scenario 2: High-Tech Islands

Due to highly advanced smart device technology and ICT infrastructure, UC is widespread in 2025. As UC offers a multitude of benefits, most customers disregard privacy concerns. Many island solutions exist as a result of legal authorities' continuing failure to regulate the UC market and companies' inability to agree on global standards. Island solutions fully leveraging all aspects of UC come at a high price for the customer. Secure implementation of UC requires high additional investments, as well. Figure 9.10 portrays the particular developments of the key drivers in this scenario.

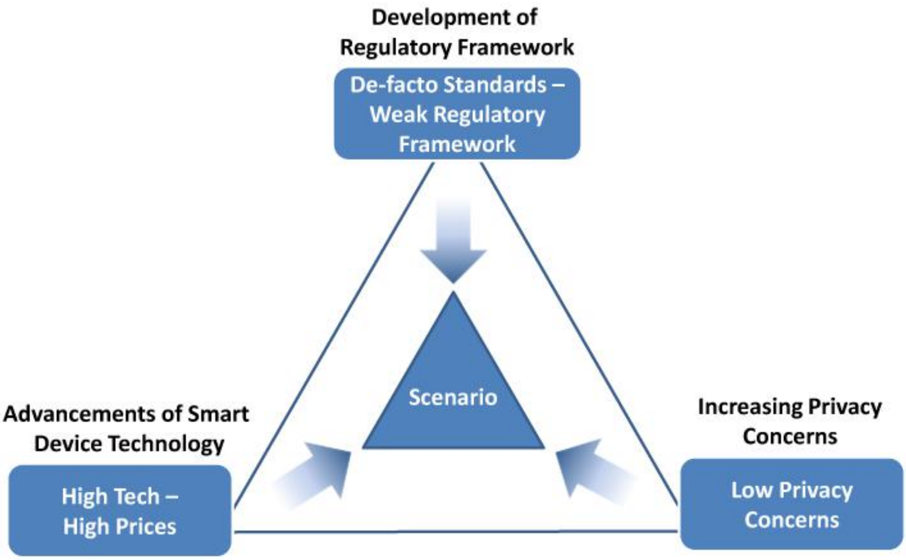

Figure 9.10: Characteristics of Key Drivers in Scenario 2
Source: own illustration

Technological Advancements Led to Rapid Success of Ubiquitous Computing

Several disruptive technological breakthroughs prior to 2025 caused smart device technology to quickly improve. These devices are now remarkably miniaturized and therefore can easily be integrated into most types of objects. Specialized sensors collect all kinds of information. Furthermore the connection of smart devices to the Internet is fast and seamless and energy supply issues are resolved due to wireless power transmission and efficient storage.
Early on many customers started to incorporate UC into their daily lives. Since users were attracted by the benefits of UC, the majority is not concerned about privacy. Users are willing to give away personal data in case the functionality

of their smart devices can be enhanced.

Access to growing amounts of private user data enables software developers to create applications tailored to every kind of customer need with a high level of usability. Sophisticated functionalities of smart devices allow context aware services and multiple modes of interaction to be implemented. The initial success of UC technology served as an incentive for more companies to increase their R&D efforts. Due to a high market potential many start-up companies emerged. Besides these small companies, many medium and few big players capable of leveraging economies of scale are involved. Hence many unique island solutions that offer full integration of all UC capabilities at premium prices emerged.

Typical interfaces only grant direct interoperability to smart devices from the same manufacturer. This causes many de facto standards to evolve. Solutions combining devices from different producers require the development of special software for seamless communication. Since legal authorities mainly focused on accelerating market growth utilizing financial instruments like taxation, they failed to keep track of the rapid technological advancement of UC. Consequently no impulses to impose real standards related to smart device interoperability are provided by the government.

Secure UC hard- and software solutions are only provided when it comes to ensuring general operability of systems or with respect to risk-sensitive processes and environments such as banking transactions. In effect everything that has been secure before the widespread adoption of UC is still well protected while private employment of UC is not safeguarded except high additional investments are made.

Ubiquitous Computing in High-Tech Islands

In 2025, UC technology is widely spread throughout Germany. However, sophisticated UC solutions are very expensive. Wealthy customers tend to purchase complete UC hardware and software premium solutions at a high price that integrate the entire functional scope of UC technology. As a result a multitude of small smart devices are found in their homes, cars, clothes and every kind of appliance. Due to the high interoperability within the premium solutions all objects communicate resulting in a fully automated and context aware environment with a minimum user input required. A premium user's smart car, for instance, automatically generates several routes for the user to select, based on an appointment's location and several other factors such as traffic. For the elderly generation premium packages with a particular focus on E-Health are commonly employed.

However, most German customers belong to the group of standard users, who cannot afford customized solutions offering full interoperability of devices. Thus, most smart homes feature less automation and instead of smart devices with full context awareness and autonomous decision making, more interaction with the user and manual setting of preferences is required.

All user groups have in common that they share little to no concerns related to touching points between UC and their privacy as they are outweighed by technological benefits. Hence, their private data such as location, activity, interaction with people and objects is openly available and spread at a high level of detail. This is due to advanced smart device technology with identification capabilities and broadband connections. People have accepted highly personalized advertisement and do not ask for opt-in or opt-out functionalities. Social media websites basically allow anybody to track somebody else and retrieve personal information.

In such an environment the development of new and highly specialized applications thrives on the open availability of private user data. Telcos' SDPs enable third party developers to create apps for smart devices of partnering manufacturers. In general, Telcos generate high revenues due to the enormous utilization of broadband Internet and standard customers high demand for specialized apps that increase the level of autonomous behavior and interoperability of low priced UC enabled products.

Weak Signals and Signposts

A direct signal could be users' reactions to a major change in Facebook privacy settings coinciding with the introduction of sophisticated functionalities. Also popularity of new devices demanding relatively free distribution of much private user data could hint at this scenario becoming at least partly true.

Signs hinting at this scenario could involve a general public willingness to give away their private data on social platforms.

9.3.3 Scenario 3: Secure Lowlands

What used to be unthinkable decades ago is now reality. Technological advancements have made it possible to connect devices of all kinds with each other. The high technical standards allow the development of applications that make use of data in a highly sophisticated way. The users, however, are reluctant to allow applications to access their data, as they are very concerned about the privacy of the data. As a result, authorities have established a regulatory framework that guarantees users, that developers or websites cannot access or aggregate any data without their explicit permission limiting the possibilities of services that can actually be implemented.
In figure 9.11, the underlying developments of the three key drivers, leading to the outlined scenario, are visualized.

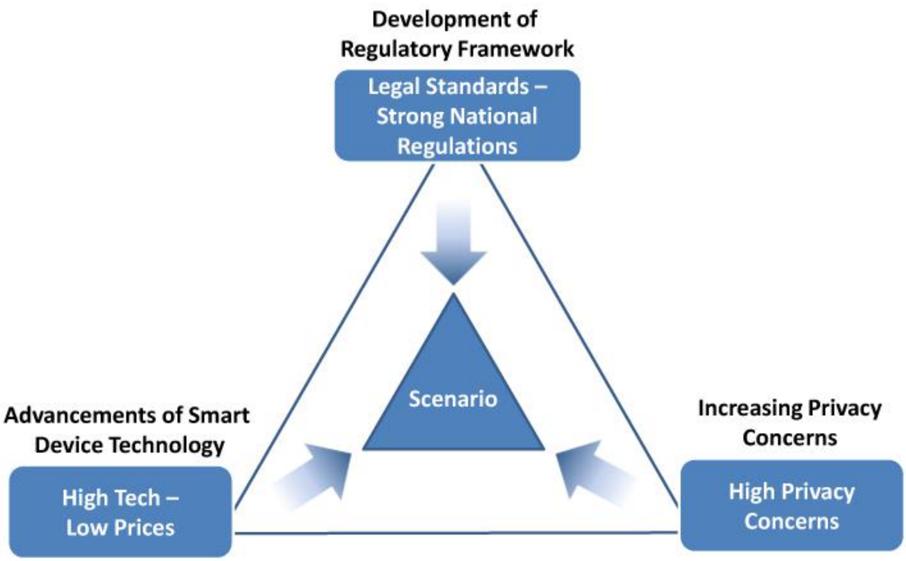

Figure 9.11: Characteristics of Key Drivers in Scenario 3
Source: own illustration

Data Scandals Led to Reluctance in Giving Away Data

After the launch of various social media platforms shortly after 2000, an increasing number of people started to use the services offered to get connected. With the growing complexity of the world, people were increasingly expected to be fully mobile. Social media sites seemed to provide an easy way to stay in contact with family and friends. At the same time, people appraised the commodity, websites that remembered certain user features, offered. But not only the working population jumped on the train. With an increasing percentage of the older population belonging to the digital natives, the demand for integration in the digital communities by the elderly rose significantly and a huge demand for applications that helped to increase their independency was formed. These developments resulted in a very attractive environment for developers who could reach a lot of users with their services.

As people demanded to have access to the Internet everywhere – both in terms of private and enterprise matters – the device manufacturers, offering smart devices that allow for ubiquitous access to the Internet, have achieved fast technological progress. The devices dispose of highly efficient power consumption, small form factors, advanced sensors, and huge storage capacities. This hardware allows the use of very sophisticated and reliable applications, even if they require large amounts of data to be transferred. The refined devices are complemented by a highly advanced ICT infrastructure that is standardized and accessible everywhere regardless of position and number of devices. Additional infrastructural advancements are not required and therefore have not been built.

The hype about the broad usage of the social media platforms and the developments around them came to a sudden stop, when some data scandals became public. In the need to create revenue, some social media websites had discovered that the large amount of private data people had fed in their system to use the service were an asset they could build on. But social media sites were not the only cause for concern. In the UC environment that was established, user data was collected everywhere. Not only search engines or online portals collected user data but also every store in town was able to create a profile of their customers. Complete identities could be remodeled by collecting and extrapolating the data traces that were left by everyone.

When this got known to the public, concerns about the privacy of the data increased. Users began to withdraw most of their data from the Internet and now are very reluctant to give away any private data. The trust in the security of data that the Internet can provide is deeply shattered. People are willing to abstain from benefits of employing social media or sophisticated applications if using them is only possible by employing their personal data. Even if some experts claim that people are overreacting, this does not change the way people feel and act about the situation.

After people started to express the need for a better control over their personal data, the authorities quickly reacted and started to enroll specialized laws and provisions to ensure that providers of web services were not able to abuse the data any more. The measures included a highly efficient supervision system that makes it possible to track down every data fraud and pursue it. This course of action however was only effective within the national borders of each country and people have no real trust that the laws can be enforced against worldwide operating companies. They do not know how they can actually protect themselves against those companies. So even with the regulatory framework in place, people still feel insecure about the situation and are hesitant to return to a state where they trust companies with their data.

The skepticism towards nationally operating companies is not as high as towards global players. However, these companies are not able to offer the same level of sophisticated services as platforms with millions of users could offer in the past. The possibilities of features are additionally cut down by the legal framework. As it is not allowed to store or process any of the personal data it is impossible to tailor applications or services towards certain customers. As a result the services do not exhaust what would be technically feasible. The developers would like to make use more of the potential presented by the technical state of the art but the SDKs offered to them by the development platforms hinder experiments and creativity.

Ubiquitous Computing in Secure Lowlands

The Secure Lowlands scenario depicts a world where UC has made a step backwards. A few years earlier, the network traffic of the globally expanded networks used to be much higher than today, the services offered were more advanced and the number of people making use of them was significantly higher. The ICT infrastructure and standards to enable more sophisticated services is therefore present, but companies are reluctant to develop the network any further or to invest large amounts in the maintenance. With the significant drop in demand, the revenues from network usage dropped to a record low.
Just like infrastructure providers the device manufacturers hardly develop any new devices. Investments in R&D of UC are therefore reduced drastically. Market share is mainly gained by increasing the security standards or the usability of the devices. A disruptive technological advancement is out of sight and people are shackled to their well-known devices. At the same time this implies that people trust their devices and know how to use them.
Developers of applications are competing in terms of the accessibility and usability of their services, as opportunities to differentiate services among features are limited. Without access to any personal data sophisticated services cannot be built. As a result the number of developers is rather small. It is not very attractive to create applications, as each country has its own regulations. Offering a service internationally would either require that the service meets the different legal requirements or it is customized for each country.

This also led to a difficult environment for start-up companies in the area of UC. These small companies are hardly expected to succeed in establishing a business. Hence it is hard for start-ups to raise any funds. Everyone interested in creating applications is therefore trying to closely work together with one of the companies that can claim at least some consumer trust.

Dependent on the legal regulations to protect user data, these developments had a considerable high impact on industries. As consumer related data cannot be easily collected anymore, many industries that based their financing on personalized advertisements such as online media providers, news sites, and social media sites have to search for new revenue streams. The same applies for the field of mobile and context-aware marketing and market research companies. Some companies might consider to move to other countries in order to still be able to collect user data. At the same time, as accessible user data becomes rare, the incentives for criminals increase as well.

Enterprises have to implement strict rules to store and secure data of their employees resulting in additional costs and an increasing complexity. Many applications of UC cannot be developed due to the data privacy constraints. Smart homes could for example autonomously trigger the process to prepare coffee in the morning, depending on the personal schedule. Remote home automation, including access to devices such as the fridge and the heating system would be possible, but users do not want to employ it. The necessary data is not sensible in the first place, but people fear that it could be used to get a comprehensive overview of them, to stalk them, or to break into their home.

Many applications regarding E-Health could even improve users' quality of life directly. Fields of usage would be monitoring the rate of heartbeat, blood pressure and body temperature through infrared cameras and special sensors within clothing. Combined with a fast link to local physicians and hospitals, early diagnosis would help users with some higher medical risks. But again, the public only views the disadvantages of this kind of data collection, as it would be possible for pharmacies and insurance companies to collect private details about the user's health.

Weak Signals and Signposts

There are some factors that indicate that the Secure Lowland scenario is not unlikely to become reality. Some social media websites have experienced a decreasing number of members in the past years. After changing the user agreements, StudiVZ has lost users and a large share of the remaining users changed their profile names so they could not be found using the search function without knowing their exact user name [470]. This indicates that an increasing number of people is not willing to use these services disclosing their real names. Another recent development is Apple's introduction of a new control function that allows the user to determine for every application if it is allowed to use location based data [211]. This may seem to be a rather small addition but it clearly reflects the user demand for control over their data streams.

Additionally it is possible to determine signposts that would point towards a future, as described in the Secure Lowlands scenario. The first signpost is some major data scandals that could occur either at social media websites where users actively filled in their data or at some other websites where user profiles were deducted without the users consent. If such an issue became public, it is very likely that people would become more aware about privacy issues.

Another signpost is the development of a national or EU wide legal framework concerning the requirements that every provider of data services has to fulfill. If tight regulations are introduced, it is very likely that developers are not able to create sophisticated applications.

9.4 Service Idea: Privacy Fortress

The Privacy Fortress enables the personalization of software and services within an UC environment while protecting users' privacy. This unique selling proposition (USP) directly addresses the extremely high privacy concerns of the people in the Secure Lowlands scenario. Data and information of the customer are stored in a personal profile within a cloud-computing environment. A digital ID management system (IDMS) assigns every profile a regularly changing ID number, which is used for any sort of communication outside the cloud. Users can approve external entities to process certain information of their profile. The only meta data disclosed to the external entity when providing it with the approved information is a distinct ID number as originator. When replying, the information is sent back to the user profile within the cloud, but cannot be tracked to the customer owning the profile. For the next transaction, a new ID number is issued. The operator of the Privacy Fortress acts as trusted partner, as being the only one able to connect ID numbers with the actual user. The main areas the digital IDMS is integrated in are smart user applications, public personalization services and personal payment.

Smart user applications are applications for computing devices that are created by external developers and run within the cloud. A customer can enable an application and grant access to certain information stored in his user profile or generated e.g. through sensors integrated in his home. This data is used to create customer-specific results and services. As the application is running in the cloud, the operator of the Privacy Fortress can guarantee that by default no personal information is disclosed to anyone outside the cloud. If the proper functioning requires communicating with external parties, this is done via the IDMS and has to be approved by the user first.

Public personalization services are applications built by third parties that run in public places and are installed on various external servers. These services enable the customization of certain aspects within the public environment. They constantly broadcast their identification details that can be received by the personal device of the customer and are then processed by the IDMS. Within the IDMS customers can choose personalization services they want to share data with. If sharing is enabled for that service, the IDMS provides the required data. The privacy settings can be changed at any time.

In addition, the user ID in combination with an authentication system on the personal device can be used for payment. While the IDMS charges the user, the payment cannot be traced back to the customer externally.

The main three revenue streams are payments from customers for using the IDMS, revenue streams from applications that run in the cloud-computing environment, and payments from public personalization services providers for the data requests running through the IDMS. Telcos are qualified to provide the Privacy Fortress as they are trustworthy and strictly regulated, have a large customer base and are experienced in operating high quality networks.

9.4.1 User Needs and Unique Selling Proposition

In order to establish a successful service it is necessary to understand user needs. The Privacy Fortress has to be viewed from an environment of distrust against web companies and strong data privacy awareness on the consumer side, due to exhaustive amount of user data and information that had been collected throughout the years. This collection of user information led to various data misuses, which caused the users of UC to stop giving away personal information. This did not only change the UC environment, but also the way the Internet is used. Providers of search engines and social networks have subsequently suffered from declining influence and less market power.

Before privacy concerns arose, users have already experienced the tremendous benefits of UC. A good infrastructure is currently available; computing interfaces to log on to with next generation networks access are widely spread and interoperability of UC systems is given. An enormous number of developers are craving for the chance of using personal data in applications to develop sophisticated applications. Furthermore the regulatory framework differs a lot between countries, thus applications have to follow different regulations and have to be approved according to different standards. The potential number of new developers from the generation of digital natives is not fully leveraged.

If personalized services did not reveal any private data, users would accept these services. The users want to control exactly what data they share. This leads to a growing willingness to pay for secure and transparent services.

The USP of the Privacy Fortress offers customers to benefit from the personalization and customization features of UC without facing any privacy issues. The Privacy Fortress allows for applications and other services to deal with personal data in a very strict way. The provider guarantees that there is absolutely no way for private data to leave the Privacy Fortress in a way that could be traced back to the user.

As users would give their data to only one provider of trust it would be easy to pursue any misuse. A German operator compared to international companies would have a market advantage, as the German market has strict regulation in place. This increases the trust of the end users.

9.4.2 Detailed Description of the Privacy Fortress

The Privacy Fortress enables the personalization of applications and services within an ubiquitous computing environment while fully protecting the privacy of the user. All benefits of personalized and location aware information, services, recommendations and automated processes can be experienced, without the downside of being transparent. A digital IDMS running in a cloud-computing environment assigns every user a regularly changing ID number, which is used for any sort of communication outside the cloud. These ID numbers are only valid for short time periods and cannot be traced back to the user they belong to. The first section explains the functioning of the digital IDMS. In the following sections different types of services this system is integrated in are described, the main revenue streams are shown and important external success factors are pointed out.

9.4.2.1 The Digital ID Management System

The digital IDMS is the link between the users and the demand-side for personal information. Users of the Privacy Fortress enter their personal details into a database that is connected to a cloud-computing environment. Within this environment the IDMS generates a profile for every user and assigns them a regularly changing ID number. The user employs a small mobile device that is capable of exchanging information tagged with this ID number. Users can log on to their profile through any network interface with this device and authentication. Any sort of personal files, documents and information can be directly stored within the cloud and are linked to the profile. The personal computing devices of the users are connected to the profile too. The users can approve applications running in the cloud or external entities to access distinct information on their profile. A strict opt-in policy is followed, meaning that sharing is disabled by default and has to be specifically enabled for every service or application. Extremely sensible data can also be stored on the mobile device, which requires for example additional authentication before this information can be accessed. The only meta data disclosed to the approved entity is an ID number as originator. When replying, the information is sent back via the ID number to the user profile within the cloud, but cannot be traced back to the customer owning the profile. For the next transaction, a new ID number is issued. Although personal information is distributed, the privacy of the users is protected. The operator of the Privacy Fortress acts as trusted partner, by being the only one able to connect ID numbers with the actual user. The database where this pairing is done is within the trusted provider's system. All processes inside the cloud are tagged only with ID numbers.

9.4.2.2 Services Enabled by the IDMS

The IDMS is used to ensure the privacy of users within three main areas of application: smart user applications, public personalization services, and personal payment.

The following subsections explain what these applications are and how the "Privacy Fortress" with the IDMS increases customer value.

Smart User Applications

deliver individualized solutions and results without harming user privacy. There are two categories: UC solutions and desktop solutions. Both are created by external developers and are installed within the cloud-computing environment. The developers do not have access to the data in the cloud the program is working with. The general information flow within the IDMS system for smart user applications is shown in figure 9.12.

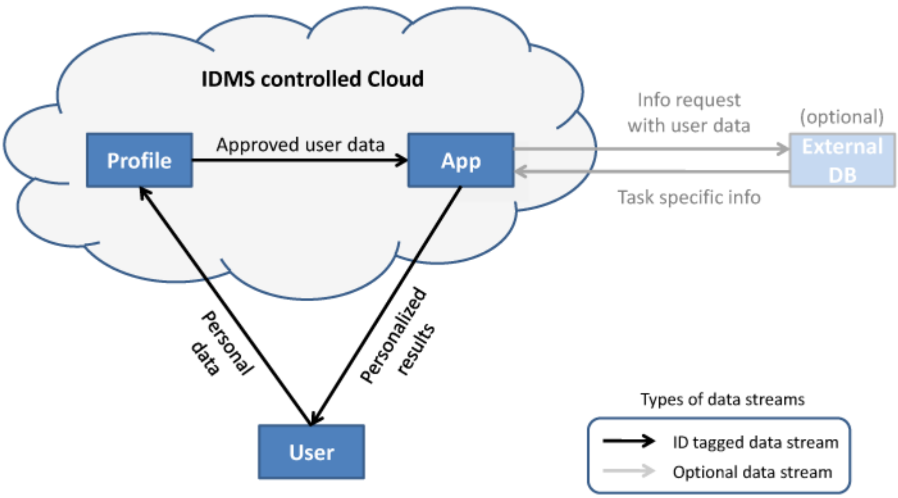

Figure 9.12: General Information Flow for Smart User Applications
Source: own illustration

- **UC Solutions**

  UC solutions are applications that connect different computing devices, sensors and services without much user interaction. Users can enable certain programs and grant access to different types of personal information via their profile through graphical user interfaces, such as on their mobile device. The information is either stored in the cloud, the mobile device or being generated through sensors for example integrated in their home. This data is then used to create personalized results and services. Additionally, applications can be linked to create synergies. As the application is running in the cloud, the operator can guarantee that data is only processed on an ID number level and that by default no personal information is disclosed to anyone outside the cloud. If the proper functioning requires communicating with external entities, this is done via the IDMS and has to be approved by the user first.

- **Desktop Solutions**

  Desktop solutions are applications that mostly require direct user interaction, such as programs formerly being operated on desktop PCs. To work within the cloud, customers use existing UC infrastructure and connect via their mobile device to their profile. All interaction with entities outside the cloud, such as web browsing, is done via the IDMS, the user is completely anonymous. The user has to explicitly allow websites to access personal information, and even then the information revealed can only be traced back to an ID number, which is valid only for a short time period. The ID number can also be used as a short-term email address with no risk of further spam. While privacy is the most important benefit, the cloud enables the user to access and work from almost everywhere with nearly unlimited storage and processing capacity, possibly replacing conventional desktop and mobile PCs.

Public Personalization Services

These software services are developed by third parties and are installed on external servers. They run in public places and do not require any initial user interaction. The mobile device of the customer is able to receive identification details of personalization services that are within a close range. This information together with a data request and the user ID are forwarded to the IDMS. If the service is listed as approved within the user's profile, the IDMS provides that service with the required data. This information flow is shown in figure 9.13.

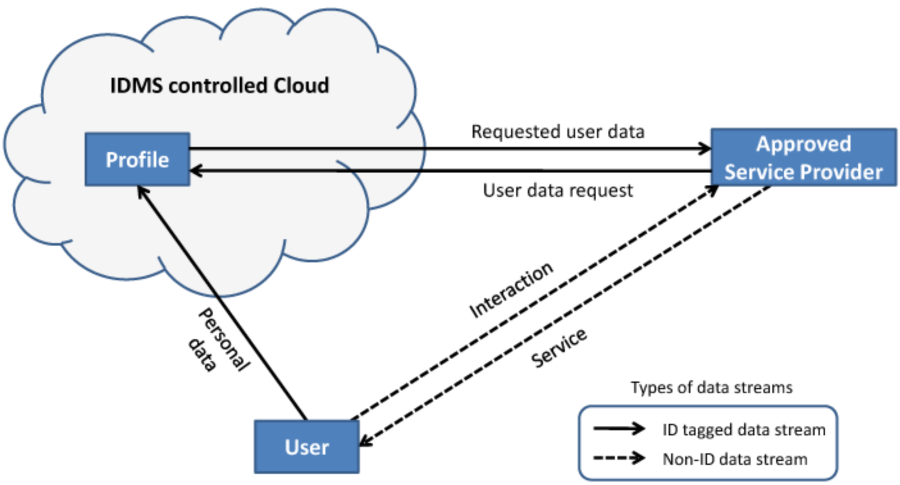

Figure 9.13: General Information Flow for Public Personalization Services
Source: own illustration

Users can choose via their profile in advance or in real time whether they want to share certain data with these services. This can be done on a one-by-one basis, for different categories or for different areas. Different data approval profiles such as "silent", "non commercial" or "everything on" can be selected. A user can e.g. receive news tailored to personal interests without leaving information or movement profiles. Special entity permissions can be enabled, so that ambulances in case of a medical emergency can always access prerecorded medical data of the user.

Personal Payment

The user ID in combination with the authentication system on the mobile device can be used for personal payment. The general functioning is depicted in figure 9.14.

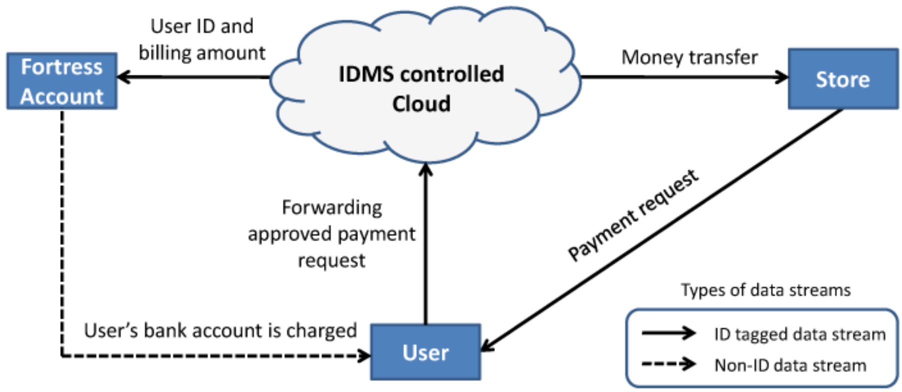

Figure 9.14: General Functioning of Personal Payment
Source: own illustration

When the user decides to make a purchase, the mobile device broadcasts the user ID to the store and receives a payment request in return. As soon as the user has approved the payment, the operator of the Privacy Fortress transfers the money to the vendor with the ID number as subject. Internally, the IDMS pairs the ID number with the according user details in the database and charges the amount to the customer's account. It is also possible to reverse this transaction if the customer decides to return the bought product. This type of payment can be used for example to pay in stores, for parking tickets or to pay online. In contrast to traditional forms of payment, the transactions cannot be traced back to the user. The vendor has no information about the buyer, except for the user ID that is valid in legal proceedings.

9.4.2.3 Revenue Streams

There are three main revenue streams for the operator of the Privacy Fortress within the underlying business model:

Customers have to pay a basic monthly subscription fee for the privatization service of the IDMS. This includes the user profile within the cloud and access through a mobile device, customization and ID broadcasting. Basic smart user applications are already pre-installed, enabling personal payment via ID is charged additionally.

On top of this basic monthly fee, additional revenue is generated by distributing smart user applications to customers. A broad range of UC and Desktop Solutions are offered to the user, which can be enabled by the user via his profile. Possible payment models include one-time payment, a monthly fee or pay per usage. This revenue is shared according to a predetermined ratio with the external developers who own the application.

Additionally, offering IDMS access to third party public personalization services to request ID related information about customers is charged. A monthly fee as well as a pay per request model is offered to the providers of such services. For users this is covered by their monthly subscription fee for the general IDMS access.

9.4.2.4 Important External Success Factors

The success of the Privacy Fortress is dependent on three critical external factors:

First of all and most importantly, the user has to trust the operator to manage their personal data. To achieve this goal, the safety of the data against unauthorized access has to be guaranteed. In addition, the functioning of the IDMS and the pairing of ID number and user details has to be communicated and made transparent. Optimal pairing would include automated processes in an insulated environment without human access or interaction. Very strict and clear contracts with voluntarily added penalties for any privacy breach would strengthen the position of the operator as trusted partner.

Secondly, a sufficiently broad range of smart user applications has to be offered within the cloud. This can only be achieved by cooperating with external developers. Most of the customers would not use these types of applications outside the cloud due to high privacy concerns. Therefore the developers are highly incentivized to cooperate with the Privacy Fortress, as this significantly increases their potential customer base and revenue.

A variety of public personalization services has to be available, too, in order to make the offering attractive. Although these third party services are free for the customers, they indirectly pay for them by buying secondary products that were originally complemented by the personalization services. In addition, the infrastructure for these services already exists from the past, as privacy was not such an issue and data could easily be collected. Therefore, only little investments of third parties would be necessary so set up these services.

9.4.3 Market Structure and Competition

As result of the various data misuses, UC developed into a very fragmented market. Network providers are now under pressure because investments in infrastructure did not pay off due to the low usage of UC. Without over-the-top services, there is hardly any differentiation between network providers and competition decreases profit margins.

The Privacy Fortress could be a great chance for Telcos to add value to their traditional services. An operator of the Privacy Fortress is supposed to be trustworthy, have a large customer base, be highly regulated and have strict regulations within the company. The Privacy Fortress also requires an infrastructure for payments and micro payments.

Telcos are able to offer all these aspects. Privacy breaches would be known immediately, as they are in the focus of the public. This causes them to be very careful with sensitive data by enforcing strict guidelines within the company. Telcos in general are financed conservatively and so have a sufficient cash flow to stem such an investment. Furthermore, they are used to running a network of high reliability, quality, speed and service.

As most of the data collected within an UC environment is transferred via the ICT infrastructure, Telcos would have the possibility to make this data anonymous before being sent to other entities. Another great advantage of Telcos providing Privacy Fortress is their close customer relationship that they have been able to build up throughout the last decades. This could enable rapid growth and the possibility of spreading their product to many users very quickly.

After being able to establish Privacy Fortress, the entrance barrier for new competitors into the market would be very high. They would not only have to make huge investments, but also match the above-mentioned quality requirements. Additionally, once people are customers of the Privacy Fortress they will be reluctant to switch to a competing service, as this would take a lot of time and effort due to the various offered individualization possibilities. Thus rivalry in the market is expected to be low.

Due to the users' desire for personalized applications, subsequently a lot of developer's would be willing cooperate with the Privacy Fortress. This implies that the developers have little bargaining power over the operator. As the willingness to pay for privacy increases, customers have only little bargaining power. This gives the operator of the Privacy Fortress a strong position within the market.

9.4.4 Example Applications of Privacy Fortress

The following two examples show how Privacy Fortress can be employed in a world featuring UC. They are providing a detailed description of Privacy Fortresses capability to allow personalized interactions without disclosure of private data. For this aim examples that resemble presumably common implementations of UC in 2025 and involve privacy issues have been selected.

Example 1: Personalized fashion shopping as a public personalization

service with personal payment

This example is centered on a customer of the Privacy Fortress who is shopping for clothes downtown. The user is receiving personalized product recommendations and is able to pay without revealing any private data.

Walking in the street the user's mobile device receives several identification details along with data requests from various stores to enable personalized ads and services. These data requests are denied by the IDMS since the user has not opted in for the services. Upon approaching the clothing store called Fancy Fashion, the user's mobile device forwards the store's unique identification details to the IDMS. As the customer planned to shop at this store and has already opted-in for Fancy Fashion's personalization service, the IDMS grants access to personal data.

In the next step communication only takes place between Fancy Fashion's UC environment and the IDMS. In detail this means that information which is stored in the Privacy Fortress like the user's dress size, exact weight, favorite color, recently purchased or damaged clothing, travel plans, etc. is utilized by Fancy Fashion's clothing recommendation engine. The information that the user is primarily looking for casual clothing is manually added via the mobile device. This data is stored in Fancy Fashion's database in a new data slot, tagged with the user's ID.

The recommendation engine combines the available information like the user's preference for the color green, a size of 34, recent purchases of shirts and jeans and plans to go on safari next month and recommends different pieces of clothing, such as a green khaki shorts that are especially suitable for hot and humid weather. The actual process of clothing recommendation within the Fancy Fashion store is achieved through interplay of location information coming from the user's mobile device, viewpoint recognition by the store's UC environment and highlighting of suitable clothes through visual cues. While waiting in front of the changing room, the user quickly opts-in for Fancy Fashion's personalized news channel through the mobile device. The device shows providers of personalization services that are in range. Currently activated services are highlighted. For each service a description is given and the user can choose what data is shared and the time period the opt-in is valid.

Despite using personalization services, private information never leaves the cloud in such a way that it can be retraced to the user or combined to create a full profile.

Payment at the cashier's is done via Privacy Fortress, as well. The user's unique ID is transferred to the cash desk, which in turn connects to Privacy Fortress to initiate the billing process after authentication via the user's handheld device. Privacy Fortress handles the subtraction of money from the bank account and displays the results. This transaction is completely anonymous since only the changing user ID and the purchased piece of clothing can be associated by the store.

Example 2: E-Health as smart user application

In this example a user of Privacy Fortress with health issues such as diabetes is employing an E-Health system. This system is constantly measuring medically relevant data so that long term developments can be assessed. Additionally a nearby hospital can be automatically alerted in case of suddenly occurring serious health problems. Data related to a person's health is of critical relevance in terms of privacy and therefore must be safe concerning disclosure to unauthorized parties.

The user's clothing and home feature multiple sensors that constantly monitor health indicators like level of blood sugar, chemical composition of urine and rate of heart beat to be aware of any negative changes. This data is stored featuring full control in the user's profile within Privacy Fortress. As the E-Health application is rented to the Privacy Fortress provider and runs within the cloud-computing environment, by default none of the collected information is disclosed to external entities. Within the cloud the E-Health application can evaluate all health related data that the user has opted for. The opt-in process for health indicators can e.g. be managed via a special application running on the user's handheld device. A mockup of this application's user interface is visualized in figure 9.15.

Figure 9.15: Mockup of the Graphical User Interface to Opt-in for an E-Health Application

Source: own illustration

If a health problem is detected, the E-Health application sends this information to an external database where a treatment recommendation together with a referral to an appropriate physician is generated. The recommendation and the referral are then transferred back to the user via ID. The only information the provider of the database gathered is health data belonging to a certain user ID. However, this information is of no value, as it cannot be traced back to one particular individual and the ID is only valid for a very short time period. Since the Privacy Fortress is secure and features full transparency concerning what kind of user data is processed how and where it is sent anonymously, it is close to impossible that insurances or employers can gain possession of this data. As an addition the user can change the settings in Privacy Fortress to opt for alerting a nearby hospital and providing them with address and medical details when an emergency occurs. In this case, the user accepts this privacy breach for the benefit of rapid medical treatment.

When using both Privacy Fortress and the E-Health application the user is paying an increased monthly fee that includes the basic fee for the Privacy Fortress and the application, which is partly shared with the developers. Without Privacy Fortress an E-Health application running on the servers of an E-Health provider, all of the data would be stored on the E-Health provider's server where an almost complete health user profile would be created. In this case the user has no direct control over the data. Also there is no guarantee that this health profile is not used e.g. by health insurances to regulate monthly payments or by the user's employer.

9.5 Conclusion

Ubiquitous computing is an evolving technology with the potential to change human-computer interaction in a revolutionary way. A myriad of smart devices with sensors is integrated into objects and connected. However, the analysis of the drivers of ubiquitous computing implies that it is unclear how ubiquitous computing will shape the future. Advancement of smart device technology, the development of regulatory framework and increasing privacy concerns were identified as uncertain factors with the highest impact. Different developments of these key drivers are the basis for three scenarios that create distinct images for the ubiquitous computing environment in 2025. Secure Lowlands, the most probable scenario, features a world in which ubiquitous computing technology is highly advanced. However data scandal arose; consequently most of the general public rejected to use ubiquitous computing due to the possible privacy breaches. If, however, data privacy could be guaranteed, users would again use ubiquitous computing.

The business idea of a Privacy Fortress directly addresses user needs and is based on the Secure Lowlands scenario. The Privacy Fortress allows the user to experience all benefits of the personalization features of ubiquitous computing without disclosing any private data. This is realized via a digital ID management system and applications that run in the Privacy Fortress cloud. Therefore Privacy Fortress would be the key to revitalize the initial momentum of ubiquitous computing by restoring its positive image. Privacy Fortress could easily reach a large customer base and involve a multitude of other services since third party developed apps offer endless possibilities.

Even if privacy might not be the highest concern of all customers a system like Privacy Fortress could still be successful in the future. However, this to a high degree depends on whether customers are willing to spend extra time managing personalized services and whether a sufficient amount of companies agrees to cooperate with the Privacy Fortress operator.

In general Telcos are highly qualified to take on the role of a provider of Privacy Fortress due to their core competencies. Thus, they could leverage the close customer relationship that Privacy Fortress requires and avoid to degenerate to a mere bit-pipe provider.

Chapter 10

Convergence of Multimedia Services

Christian Deger, Philipp Nägelein, Swaroop Nunna, Hauke Rapold, Stefan Rothlehner

The convergence of multimedia services, driven by the digitization of content, has disruptively changed the media landscape and has set the stage for future innovation. Technological advancements as well as social trends will drive the development of converged multimedia services within the next fifteen years. Evolving network infrastructure, cloud computing and media mobility will enable ubiquitous media consumption, personalized and enriched media content provides consumers with a new quality of individual and social media experiences. Uncertain factors like governmental content regulations, market structure and user concerns will be decisive for the success of future business models. Three scenarios in the area of converged multimedia services are derived within a comprehensive approach by analyzing the interaction of these highly uncertain key drivers.

First of all the **Media Magnate Scenario** describes a future dominated by a few large media conglomerates that shape multimedia convergence as they benefit from internationally standardized content regulations and low user concerns. In contrast, the **Media Bunker Scenario** pictures a future within which consumers' concerns and strict national content regulations limit the ubiquity and convergence of multimedia services. Finally, the **Media Bazaar Scenario** depicts a world consisting of a large number of media content providers

and prosumers who form a vivid ecosystem. Following the principles of self-regulating online communities, all multimedia content is open to third party innovation. This is driving convergence of multimedia services and creating innovative media formats on the user level. However consumers have to deal with a wholly fragmented market which makes it difficult to select and combine media of various sources and formats.

In order to address user needs within the Media Bazaar scenario, **Peersonal**, an innovative media service idea for 2025, is introduced. Peersonal combines various sources of user data to create a holistic media profile either for an individual or a group of users. Based on this constantly adjusted user profile Peersonal provides media recommendations by taking social factors such as group relationships as well as psychological factors such as emotions and memories into account. Thereby Peersonal allows users to gain the best individual and social media experience out of a vast amount of content offerings in the Media Bazaar Scenario. To leverage the whole potential of media profiles, Peersonal opens up its services to third parties through an application programming interface. This makes Peersonal an attractive business opportunity for developer platforms and communities in 2025.

10.1 Introduction

The increasing importance of Internet technology offers several opportunities for traditional media content providers. Especially the frictionless distribution possibilities as well as the associated increase of the potential customer base cause media content providers to move their services to the web. Users strongly benefit from that development as they are suddenly capable of accessing content from providers all over the world mainly independent from their location. In addition to traditional media formats that have been made available online, user-generated content such as blogging, photo-sharing or podcasting has created completely new types of media. Supported by increasing bandwidth and network coverage, video as well as music streaming services have become increasingly popular among users, disrupting business models of traditional media companies. So-called prosumers are actively sharing their personal experience via social networking websites or micro-blogging services and thereby significantly increase the amount of information available on the web.

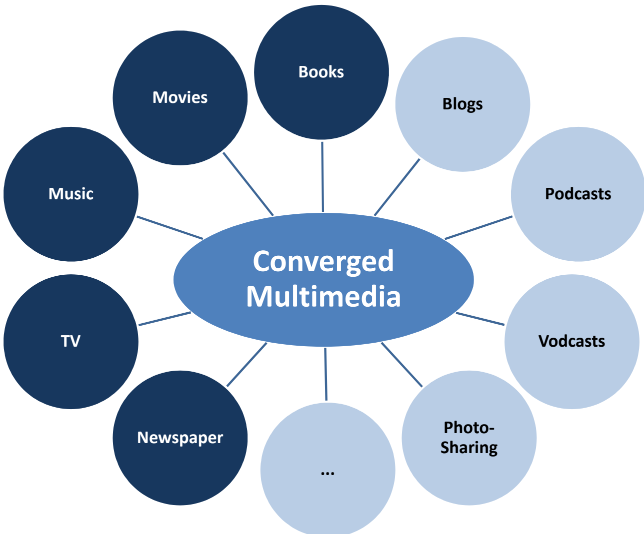

Figure 10.1: Converged Multimedia
Source: own illustration

The multitude of available sources and providers has shaped the media landscape and has led to an online convergence of multimedia services, with lines between different media formats blurring. As a result different companies have evolved, acting as media aggregators and serving as a gateways for many consumers. Facing significant threats from newly evolving media formats and the users' reluctance to pay for online content, professional media content providers are struggling to find ways how to effectively monetize their online presence. Even though there is a clear indication for the online convergence of media services, it is yet unclear how converged multimedia services will look like in the future and how developer communities and platforms may be used to offer innovative services for a converging media landscape. The question about the future development of multimedia convergence is of crucial importance also for telecommunication companies, as their voice-centric business models are being increasingly replaced by multimedia and content-driven services [75, pp. 193-208].

This report is divided into three major sections: driver analysis, scenarios and service idea. Within the driver analysis, ten main influencing factors for the convergence of multimedia services as well as possible developments are identified. These driving factors and their potential outcomes serve as input for three different scenarios. Being discussed in the second section, each scenario represents a possible picture of a potential future. Within the next section Peersonal is introduced, an innovative business idea addressing the specific needs of converged multimedia services in 2025.

10.2 Driver Analysis

The scenario planning follows a distinct process starting with the identification of ten driving factors, laying the foundation for future scenarios. Based on the most probable scenario, an innovative service idea for the future is developed.

The drivers are categorized according to their impact on future convergence of multimedia services on the one hand and the certainty of prediction on the other hand. Certain drivers are media enrichment, media mobility, personalized media content, cloud computing and network infrastructure. Even though they differ in impact, the possible future characteristic of these driving forces is rather predictable as current developments suggest a distinct direction. The future outcome of uncertain drivers such as media delivery platforms, revenue models, governmental media content regulations, user concerns and market power cannot be predicted to date. Three uncertain drivers perceived of having the strongest impact on future converged multimedia services are categorized as key drivers and are the major driving forces for the scenarios introduced in section 10.3. Those key drivers will fundamentally shape the future development of convergence of multimedia services in the next 15 years. A comprehensive understanding of the underlying driving forces enables companies to proactively adapt their businesses to evolving changes and helps exploit untapped business opportunities as early as possible.

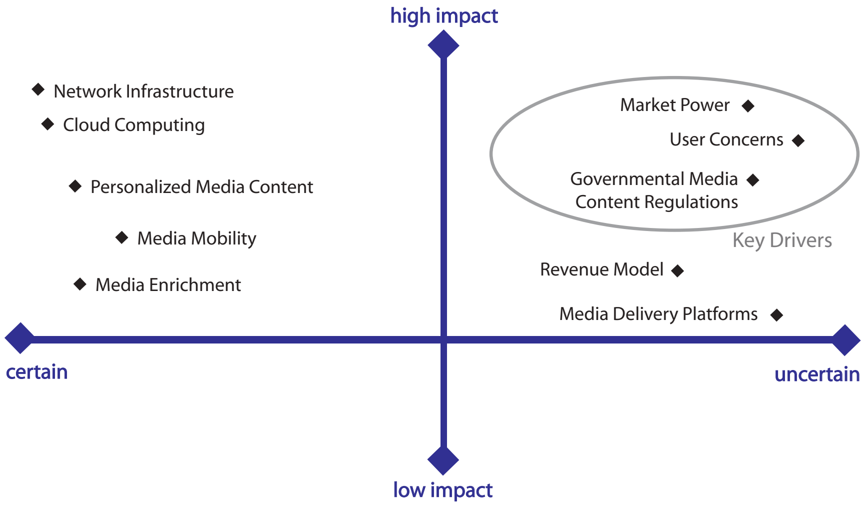

Figure 10.2: Drivers Matrix
Source: own illustration

10.2.1 Certain Drivers

The drivers discussed in this section have an important impact on converged multimedia services of the future. Their development, which can be predicted with certainty, is important for setting the basic requirements for the future advancement of multimedia convergence.

10.2.1.1 Media Enrichment

"Rich media service provides dynamic, interactive collection of multimedia data such as audio, video, graphics and text" [280, pp. 112-118]. With the advent of the digital world, media content has undergone revolutionary changes over the last century. Rich media content can also be attributed to the commercial success of products and brands [60, pp. 73-86].

Over the years, there have been continuous developments in the direction of enriching media. With wide spread penetration of Internet technology, media enrichment has taken new directions. Animation is playing a key role in producing dynamic content and user interactivity is successful in attaining user attention [137, pp. 24-28]. For example, the newspapers once composed of black and white text are now available over the Internet and offer a composition of text, audio, video and user interactivity in the form of comments. Additionally, modern day digital media offers the possibility of enriching media content with meta-data which facilitates annotation and categorization. Tagging of objects for example offers users the opportunity to browse through media content and collectively find and classify information.

User interaction which is currently a key factor in the success of online media content is rapidly spreading to other media forms as well. Success of reality television talent shows like 'American Idol'[1] wherein the users vote for their favorite contestant serve as a good example for this development. Furthermore, media enrichment is being constantly fueled by progressive digital devices. For example, the iPad can be perceived as an electronic book reader or newspaper but it can play various types of other media including music and videos as well [40]. With more digital devices available on the market, these developments will further continue. Moreover, rich media goes beyond the pure combination of different types of media. It is constantly progressing in a direction wherein it is correlated with not just content enrichment but also with online purchases and advertising experience. For example, through specialized online shopping portals customers are able to visually design their clothes and get them manufactured. In terms of folksonomy, social bookmarking and other innovative content tagging methods will gradually evolve enabling more and more users to share and classify meta-information about media. Media enrichment will increase exponentially in the upcoming years and might even appear in new and innovative forms.

10.2.1.2 Media Mobility

Media consumption will shift from being tied to a specific place or device to mobile media consumption. Mobility in this context has a rather broad sense and implies traveling from one city to another as well as changing rooms within the same building. Media mobility drives the convergence of media services because it demands for uniform media channels.

Media mobility can be analyzed from a technical and a user perspective. On the technical side, a progress towards ever smaller processors as well as the evolution of wireless technologies will lead to more sophisticated devices that allow rich mobile media consumption. On a device level, media mobility can be achieved either through multiple devices (e.g. a device integrated in a car) or through a single portable device (e.g. a device that can be connected to the car's system). On the user side, a growing need for mobility is due to various reasons. According to a study conducted by IDC, the number of people who work primarily mobile will exceed one billion in 2010 and is predicted to grow to nearly 1.2 billion in 2013 [243]. In addition, consumers have experienced mobility for standard services like telephony and demand the same for media services. During the world's largest consumer electronics trade fair, the IFA 2009, Vodafone presented "Connected Home products and services that network all kinds of home entertainment components such as video, music and photos"

[1] http://www.americanidol.com

[459]. This indicates that telecommunication companies are taking first steps to make media less tied to a specific device or place in households. Future devices could rather be seen as different windows through which users are looking at the very same set of data.

The urge for media mobility from business customers as well as private consumers is a driver for media convergence because it pushes forward the development of devices and media formats that are open for a variety of media. Mobility cannot be achieved with several distinct media channels that are location fixed like the DVD-player or a simple electronic book reader.

Digital music and print contents are already consumed mobile to a large extent although the usage is still limited and rather device centric. In many cases music purchased at certain online music stores can only be used on a limited number of devices and thereby restricts media mobility. Digital print media has gained a higher penetration with an increasing acceptance of electronic readers and tablet personal computers. The mobile consumption of digital news articles and books will further increase and is expected to double from 2010 until 2013 [374]. Mobile television will be the next step towards media mobility. Rupert Murdoch, chairman of News Corporation, one of the world's largest media conglomerates, stated that mobile television is "key to his company's strategy for remaining successful in the age of anytime, anywhere digital journalism" [16].

In 2025, the whole range of media content will be on track of a mobile and flexible lifestyle. For content providers, the implications of increasing media mobility are two sided. On the one hand, they will have to tailor their offerings more and more to mobile consumption and therefore to general mobile devices. At least in a transition phase this will limit rich mobile media because devices will no longer be exclusively produced for one particular media channel as it is the case to date. On the other hand, media content providers will be able to use location awareness in their media to include rich media features to mobile usage. An example of today is the weather forecast in online newspapers that adapts dependent on the current location of its reader. In the future, digital print media might for example recognize when the user is moving and increase the font size automatically. Media mobility will drive media convergence and enable users to access media content of all kinds in a private and professional context, regardless of their specific location.

10.2.1.3 Personalized Media Content

Emerging Internet technology and the associated opportunities in tailoring certain offers to the individual customer's needs are becoming more important. The development from standardized media delivery to a more and more personalized approach is an important driver for the convergence of different media services as it primarily shapes what media formats are delivered to the customers.

There are multiple ways to achieve personalization of content and the future importance of certain strategies will very much depend on the user himself and what data he is willing to provide (adapted from Yan and Ying [475, pp. 865-890]). Currently extensive research is being conducted especially in the field of web mining and collaborative filtering [405]. Depending on how fast personalization techniques will be developed further it will heavily influence on media delivery in the future.

Especially with the growing importance of third party development and the associated heavy increase in the number of applications, personalization does not necessarily demand for extensive user data but can also be achieved on the user level itself. By choosing certain applications for his respective platform, the user is able to personalize his device and therefore the media delivered to him without having to release private user data.

An approach which is increasingly used to achieve personalization would be to directly ask the user to specify the areas in which he is particularly interested. Accordingly this information is used to personalize the services offered by the respective provider. An example for this might be the subscription of newsletters or RSS feeds which cover a certain topic. Another example is My Yahoo[2], which provides the user with favorites such as news, weather or stock prices according to the user's preferences.

More sophisticated context related strategies demand for the highest amount of personal user data. Sourcing personal data from the user's calendar, email or social network account, a user profile is created which enables the provider to adapt his offers to the individual personality of the consumer. Collaborative filtering is an approach increasingly used by e-commerce websites which offer certain products depending on former purchases by the user or his peer group. Drawing conclusions from the individual user's web browsing behavior is a more advanced way of deriving context specific user data [Cross Reference BR Topic 1]. By using click stream analysis and web mining, it is possible to draw a clear picture of the user's objectives and thus develop a sophisticated user profile.

Personalization will play an important role in media convergence as it increases the variety of offerings and opens opportunities for niche content providers. Future media formats will have to take this development into consideration.

10.2.1.4 Cloud Computing

Within the media industry, cloud computing will be one of the most important developments [413]. With technically advanced media formats such as high definition television, an increasing amount of storage capacity is needed [479]. Moreover a lot of processing time is necessary in order to convert media into the respective formats which are required by media playback devices. This

[2]http://my.yahoo.com

will lead to an increasing demand for both larger storage and faster processing capacities.

Within cloud computing, it is worth looking at storage and processing in separate. On the one hand, information can be stored on data storage media such as CDs, DVDs or BluRay discs as well as on hard drives or on devices such as MP3 players or mobile phones. On the other hand, online storage is increasingly used not only by companies but also by private users [479]. However current cloud storage services mostly aim at enterprise customers such as Dynamic Services by T-Systems[3]. Nowadays, processing is almost exclusively performed on single devices. This holds especially true for private users who solely use their personal computer for simple processing tasks. In a corporate context, server farms are often used as processing centers.

As the demand for more storage and higher processing power already exists as of today, future capacities will increase. Upcoming cloud computing service providers will offer combined storage and processing solutions for enterprises as well as private users. In order to address the higher demand in an efficient way, storage and processing will be highly centralized in an interconnected cloud computing system, which can easily balance and scale its capacities. Storage will be almost completely decoupled from physical entities while hard drives will only be employed for running an operating system and applications such as a web browser.

Time-consuming processing tasks such as video encoding will be shifted to large-scale processing networks like cloud computing systems. These systems can not only handle high capacity-consuming applications, but also demand for high network connectivity. The possibility to access media anywhere at any time will be further driving media mobility. In the future cloud service providers will not only offer storage and processing but also streaming services to their customers.

10.2.1.5 Network Infrastructure

Modern day media transmission is heavily dependent upon underlying network infrastructure. Network infrastructure in terms of bandwidth and coverage is one of the essential physical factors which determine and limit not only the type of transmitted media services but also the quality of services.

In the near future, network infrastructure will be rapidly evolving towards higher bandwidths and wider coverage. This shift is primarily caused by emerging high speed access technologies such as optical fibers, WiMAX and LTE [268, 48, 41]. The 'Last Mile' bottleneck resulting from access lines made of copper wires will soon be overcome and network architectures like Fiber-to-the-Home (FTTH) and Radio over Fiber (RoF) will soon provide data rates higher than 1 Gbit/s [284, pp. 610-612]. Furthermore, governmental initiatives

[3]http://www.t-systems.de

such as BMWi's Breitbandstrategie in Germany and Broadband Technology Opportunities Programme (BTOP) in the U.S. are mainly targeting to provide nation-wide broadband access. In Germany, the Breitbandstrategie aims at providing broadband access to at least 75 percent of the nation's households by 2014.

With evolving network infrastructure, one can possibly expect a heavy rise in Internet based media services. For example, the digital television transmission which is currently in place might be completely replaced by Internet based high-definition television. 'Triple Play' services consisting of data, video and voice transmission will gain higher penetration not only in urban areas but also in rural households due to wider coverage of broadband access. Availability of high bandwidths might also lead to rapid evolution of new media technologies like 3D television. In short, rapid evolution of network infrastructure both in terms of high bandwidth and wide coverage will potentially increase the availability and accessibility of new and existing media services by many folds.

10.2.2 Uncertain Drivers

The development of uncertain driver is crucial for painting a complete picture of the future. At first media delivery platforms and revenue models are analyzed as uncertain drivers. Subsequently the three key drivers governmental media content regulations, user concerns and market power are described and possible developments are discussed. The key drivers fundamentally shape the future development of converged multimedia services.

10.2.2.1 Media Delivery Platforms

Media delivery will be a decisive factor for the convergence of multimedia services as it shapes the relationship between content producers and end-users. As platform providers are constantly elaborating on how to serve user needs best, the way media is being delivered will have a strong impact on future offerings and business models.

A distinction can be drawn between generalized and specialized media delivery platforms. For example, Apple's online store iTunes provides several types of media such as movies, music, TV shows and e-books. Thus, it can be classified as generalized media delivery platform. In contrast, Musicload[4] by Deutsche Telekom serves as paradigm for a specialized media delivery platform as its offerings are limited to music only.

Generally, media platform providers can impose limitations on the usage of digital content through effective digital rights management (DRM) [278]. Platforms differ in terms of service, architecture and quality of content. Market structure and consumer behavior will define the emergence of common standards

[4]http://www.musicload.de

and therefore will be crucial for success. As of 2010, it remains uncertain which platform model will be the preferred one.

First of all, generalized delivery platforms could be dominating, providing a single gateway to various kinds of media content such as movies, songs, books and applications. In order to address a broad range of customers, these media delivery platforms would mainly focus on mainstream media. In this case, niche markets and prosumers would have to overcome enormous difficulties when publishing and distributing their own content, whereas major platforms could even serve as media search engines. Generalized media delivery platforms would on the one hand accelerate the development of media standards and therefore push media convergence, but on the other hand they may also impose strict rules on the usage of the content they deliver.

Alternatively, specialized platforms could turn out to be addressing the respective user needs best and therefore serve as preferred model. However within this development, the progress of media convergence would be slower since most media delivery channels would concentrate on a single media format. Specialized platforms would provide a service architecture that is tailored to the respective branch of media. On top, media delivery platforms could enable users to actively produce content by providing the respective tools to increase customer retention. Within this market environment less proprietary standards for media delivery would emerge, as well as more DRM-free media would be offered.

10.2.2.2 Revenue Model

In the following, the term revenue model refers to a general description of how media providers monetize their content. The future development of the revenue model for content provision will have a significant impact on the extent of media convergence and especially on the way media is exposed to consumers.

With the emergence of online media, many content providers have struggled to generate revenue on the web. The music and film industries have to cope with illegal downloads and print media has experienced a certain reluctance to pay for online content on the consumer side. Today a large extent of media content on the web is financed by advertising. At the same time, revenue streams from advertising have declined for some traditional channels [330]. For example in the U.S. television market, revenue from subscription exceeded advertising revenue for the first time in 2007 [264, pp. 1112-1128]. These changes point out that the revenue model of media content provision is an uncertain driver depending on various influencing factors such as consumers' willingness to pay and the future development of the advertising market.

In this analysis, three different directions in which the revenue model for the media industry could develop are identified. Although there won't be a single revenue model that is applied by all content providers, either a direct revenue model, an indirect revenue model or a hybrid revenue model will be predominant.

In case the direct revenue model evolves as the predominant one, most media content providers would charge consumers directly for their content offerings. Charging could be handled either on a subscription basis that allows unlimited access for a certain period of time or by a one-time payment for specific media content. In the context of this discussion, no further distinction between renting and buying media content is made because customers are charged directly either way. The predominance of a direct revenue model has several implications for the future of converged media services. Consumers would perceive converged media as a real value-added that diminishes their reluctance to pay in order to have a truly seamless media experience without being interfered with advertisements all the time. Micro payment for media would gain importance and facilitate the distribution of smaller bits of content because consumers would pay only for what they value. The position of media content providers in general would be strengthened because they would generate revenue from consumers directly and thus are less dependent on the advertisement market that is highly influenced by macroeconomic developments. Especially smaller media firms and so-called prosumers will benefit from a primarily direct revenue model because they can be profitable without necessarily reaching a critical mass to be of interest for advertisers. Media content providers would offer only few media content free of charge in order to avoid substitution of paid content.

In a development where the indirect revenue model is prevailing, profits would primarily be generated by advertising in various forms. In this outcome, advertisers would increasingly value the possibilities of target marketing by using customer data while consumers would remain reluctant to pay and prefer advertisements to payment. A critical mass of consumers would be necessary to generate significant revenue streams. This could cause problems particularly for smaller media content providers and prosumers who are not able to attract a large number of customers. The seamless user experience of converged media services would be restricted to some extent due to advertisement exposure. To keep this interference as low as possible, media and advertisement would also merge in the sense that advertisement is tailored to the media content. Within this development, affiliate marketing could develop as a major source of revenue for many media firms. Users would for example see an advertisement for the dress an actress wears in the movie they are watching. In case they buy the dress, the media firm who provides the movie receives a provision granted by the seller. As media content providers were mainly dependent on advertisements, corporations with large marketing budgets would have significant influence on the media.

In a third development, neither a direct nor an indirect revenue model would prevail. Nevertheless, media content providers would not choose the revenue model randomly and most of them would opt for a hybrid revenue model. They would offer some general, easily substituted content for free and thus a part of their revenue would come from advertisement. In addition, they could offer premium content for consumers that can only be accessed via direct payment to the media content provider. Premium content could for example include in-depth articles, three dimensional videos or extra features for games. The online version of 'The Wall Street Journal'[5] serves as a prominent example for this kind of revenue model.

How the revenue model of media content providers will evolve depends on a great variety of factors and will have a significant impact on the extent of convergence for media services and on the way how media is exposed to consumers.

10.2.2.3 Governmental Media Content Regulations

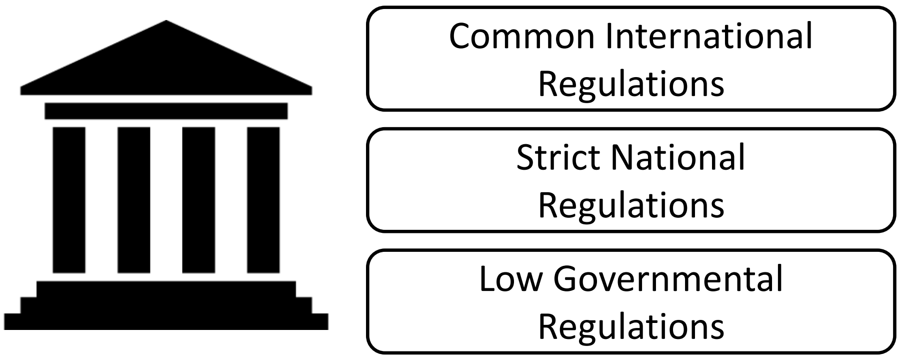

Figure 10.3: Governmental Media Content Regulations
Source: own illustration

The future of the media industry will to a large extent depend on the development of the regulatory framework as it strongly influences the way media can and may be delivered. As of 2010, it is highly uncertain how media content legislation will advance.

Over the last years, governments worldwide have been pursuing policies that aim at end-user protection and the establishment of a commonly accepted legal framework. In terms of media, this implies content regulations through laws on copyrights, censorship and net neutrality. The question whether or not such regulations can be internationally agreed on will significantly influence the way media will be delivered in the future. Overall, three developments can be distinguished.

[5] http://www.wsj.com

Firstly, governments could succeed in agreeing on global standards concerning both copyrights and censorship. Many years of discussions and negotiations could lead to a common trade agreement containing consistent copyright laws in the western hemisphere. Regarding censorship, an increasing number of conflicts between international Internet service providers and national regulatory authorities could make governments worldwide realize the need to take the necessary measures. Leading countries could manage to reduce their different attitudes towards content regulation to a common denominator and lay the foundations for global agreements. While unlawful content should be immediately deleted, governments could basically agree on preserving a free and open Internet. Media providers could benefit from being subject to the same regulatory framework worldwide as this development would mean a significant increase in planning reliability.

Secondly, countries could go back to establishing their own regulatory standards. In case international organizations turn out to be rather ineffective and unable of taking rapid and strict actions, governments would fear giving away too much power. Instead, they would more and more tend to rely on their national legislation again and would not want international bodies to decide on their national regulatory framework. Due to inconsistencies between different national regulations, many legal gray areas could arise. Users would always find a way to share media content and circumvent national copyright acts. Therefore, both media companies and platform providers would have to focus on developing business models attractive enough for users to choose them over illegal file-sharing methods and peer-to-peer networks. Depending on each nation's political system and attitude, also laws on censorship and net neutrality would widely differ around the globe.

Thirdly, there could also be very low governmental media content regulations. If internationally standardized media laws don't work or cannot even be agreed on, user-driven movements that pursue freedom of information would gain significant influence worldwide. Copyright and content law could be reformed in order to legalize non-commercial file sharing and reduce the length of copyright protections. Furthermore, surveillance and monitoring through the government would come to an end. Instead, the concept of informational self-determination would be pursued with users regulating themselves. Thereby, all Internet content would be subject to national criminal codes only, with no further regulations existing. Besides enabling law enforcement, the governments' only task would be to preserve a free and open Internet to all citizens. With the media landscape becoming less restricted and more and more user-driven, media services would be challenged to come up with similarly flexible offerings.

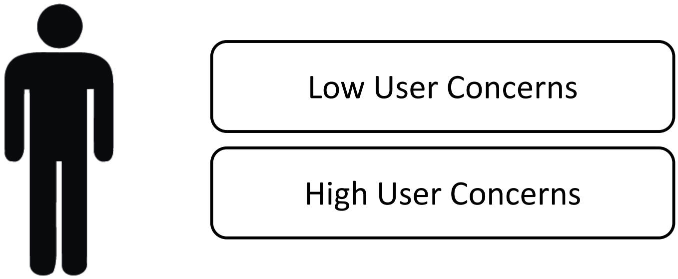

Figure 10.4: User Concerns
Source: own illustration

10.2.2.4 User Concerns

Although media delivery and convergence will see tremendous changes from a technological point of view, it can be argued whether or not society will adapt its media consumption behavior at the same pace and in the same way. Therefore, user concerns will always have to be closely observed and consequently addressed.

With Internet and media services increasingly penetrating everyday life, many users are more and more worried about data security, their privacy and the implications of a permanent media coverage. Thus, appropriately addressing the users' concerns and needs will be one of the key factors for media companies' future success.

Security concerns will always be a major issue. "In this age of universal electronic connectivity, of viruses and hackers, of electronic eavesdropping and electronic fraud, there is indeed no time at which security does not matter" [407]. With the ongoing digitization of media content and delivery, the handling of user credentials as well as electronic payment will make data security a topic of vital interest.

Besides, the development of privacy concerns and the acceptance of technology as well as new media are highly uncertain. It has not yet turned out if consumers will finally perceive the increasing distribution and usage of private data as rather positive or negative. This is closely connected to the question whether or not permanent and ubiquitous media coverage will be commonly accepted. Altogether, two future developments can be distinguished and have to be taken into consideration.

On the one hand, users could increasingly adapt to new media if perceived benefits outweighed concerns. Assuming that social networks and Internet companies have been handling personal data responsibly over the years, they could eventually be regarded as reliable and trustworthy. As there would be no reason for general distrust towards the Internet and new media, people would be more and more willing to share private data, media and personal information online. Digital technology would become an integral part of everyday life, as so-called digital natives (i.e. persons growing up with 21st century technology) would take it for granted. But even so-called digital immigrants (i.e. elderly people who had to adapt to digital technology) could increasingly appreciate the benefits of new media if governments took huge efforts in terms of consumer education and protection. The establishment of a transparent and trustful atmosphere in this sector could boost the acceptance of omnipresent media services. As a consequence of this, the prospects of consuming media offerings everywhere at any time would result in an ever-increasing demand.

On the other hand, the media world could also be dominated by high user concerns. In terms of data privacy only one major scandal, within which the misuse of personal information is made public, could be sufficient to generate an atmosphere of incertitude and suspiciousness. Internet users would fear being completely transparent since search engines and various service providers could possibly scan their surfing behavior in order to collect data. People would consequently tend to use a variety of services and service providers as they don't want to give their whole data to one or only few companies. Moreover, also the general acceptance of technology and new media could be questioned. With people having a variety of devices and information systems around, combined with a general compulsion to be available at any time, permanent and ubiquitous media coverage could be considered a curse rather than a blessing. Consequently, a lot of people would be constantly distracted and could increasingly suffer from stress symptoms and burnout caused by media overload. Thus, the major challenge for media content providers would be to promote innovations cautiously and provide simple and transparent offerings.

10.2.2.5 Market Power

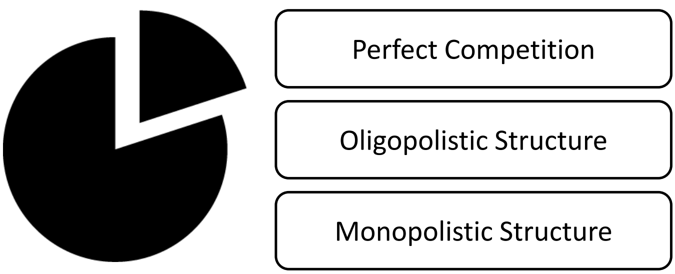

Figure 10.5: Market Power
Source: own illustration

The market power of media content providers and its implications on technological progress as well as on content restrictions is an important driving force for future developments. With the rise of Internet technology, the telecommunication and media industry are facing important changes. Players are moving into the Internet market and amid this multilateral structure the question about future distribution of market power arises as one of the crucial influencing factors for media convergence.

Traditional media firms are impelled to find profitable online business models while they are facing serious competition from substitutes like peer-to-peer file sharing networks, online broadcasting services or news aggregators such as Google News. At the same time, telecommunication firms need to identify their distinct value added services as their classic proprietary services are increasingly replaced by IP based solutions. Furthermore, individual consumers are increasingly participating in content creation and distribution and are therefore challenging traditional content provision and media delivery companies. The market power of individual players will significantly impact what kind of content will be published, how media is delivered and how fast the convergence of multimedia takes place. Even though corporate strategy will be a major driving factor, the future distribution of power among players will also depend on governmental actions and the sustainability of joint antitrust efforts by governments all over the world. Three possible developments have to be considered (adapted from Mankiw[298]).

There might be a large number of specialized players, leading to a fragmented market structure with a self regulating mechanism. Market power of players would be limited due to free entry and exit to the industry with low entry barriers. Content restrictions by single players would not be possible and a multitude of prosumers might be actively taking part in creating and providing information. Convergence of media could take place primarily on the user level as there are multiple delivery channels. Even though there might be some intermediaries evolving who filter the content for the end-user, those providers would not have any power to influence or even restrict the information delivered to the user.

Another development which seems plausible is the evolvement of an oligopolistic market structure. The industry would be dominated by a larger number of mid-sized firms whereas none of the companies has enough market power to take a significant influence on the type of content and the way it is distributed. Within countries with very strict regulations, there might be some "micro monopolies" evolving, where a small number of players serve the whole national market. Entry barriers to the market would be rather high and only prosumers who have proved themselves to deliver high-quality content would be actively competing with larger content providers. Media could be converged either on the corporate level or by the user himself by selecting his own media and information mix from multiple sources.

A third possible development could be a monopolistic structure, characterized by only two or three players that serve the whole market for media and entertainment. Entry barriers would be very high and new competitors would hardly enter the market. The few players would have full control of the type and the way content is delivered. Users would depend on those dominating players and it would be impossible for prosumers to provide content without having it filtered by the large media companies. Media convergence would exclusively occur on corporate level with large media conglomerates developing their preferred format. The individual user would be taking a rather passive role and would depend on what formats are offered to him.

It is not the provision of content which will shape the distribution of market power among competitors but it is media delivery which will be very important for the future. The distribution and number of players who deliver media content to the end-users in the future is of crucial importance for multimedia convergence.

10.3 Scenarios

Based on possible developments of the drivers, three plausible scenarios for a future converged multimedia landscape are developed. The three key drivers and their potential developments have served as the corner posts which span the field for the scenario framework. According to that framework, the development of the remaining driving factors has been defined, creating a concrete picture of potential futures.

10.3.1 Scenario 1: Media Magnate

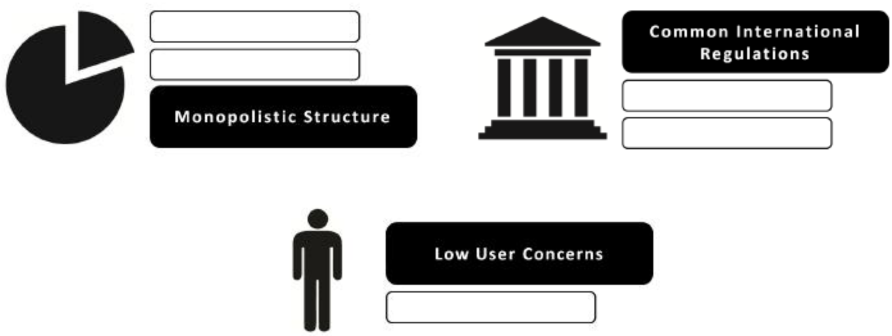

Figure 10.6: Media Magnate
Source: own illustration

The Magnate scenario is primarily characterized by only a few large players which control media delivery leading to a monopolistic market structure. The companies are operating within an environment of common international regulations concerning copyright and user data policy. Users do not have major concerns about their privacy and data security as the large media companies have proved to be trustful in the past and can be easily supervised by governmental bodies. Furthermore users are used to permanent media coverage and know how to handle it in their daily lives.

After many years of discussions and negotiations, leading countries pass a common international agreement on copyright and content regulations. As a consequence, countries worldwide feel impelled to implement this anti-piracy resolution in order to avoid international trade embargoes. The international agreement fosters the evolvement of only a few large media delivery companies, which developed mainly through major cross-sector acquisitions among Internet, media and telecommunication companies. Those companies have driven hardware and software innovation over the previous years and have established their predominance against smaller competitors. Most of the customers are subscribed to one of these big companies and use them as major media delivery channel. Even though users depend on only a few media companies, there is a trusted relationship between consumers and the company. This fact, together with the well-considered and effective common regulations, make users willing to share their private data in order to be offered a unique and highly personalized media mix. Media magnates are able to assemble a very sophisticated user profile, which is based on personal user information as well as on advanced click stream analysis and data mining. They have revolutionized user data gathering by consolidating any given user information on the web and put it together to a progressive picture, imaging the user's habits, their preferences and their social graph. Some people argue ironically that media companies know much better what the user wants than the user himself.

Content creation is primarily done by the media delivery company itself, but also by third parties. As all content is filtered by a generalized media delivery platform operated by one of the large media companies, only a few highly specialized content providers have established themselves. The few large media companies have the possibility to arbitrarily restrict content and applications. This is accepted by the users as a measure to maintain an overview of the media landscape. However, this has led to a significant decrease in prosumers or small content providers.

Users of all age and background have a very open attitude towards media and new technologies in general. While there has been a separation between the younger and older generation concerning media acceptance in the past, this inconsistency has dissolved as elderly have been encouraged to use new technology by very seamless and straight forward interfaces. Following the example of successful manufacturers, most of the hardware companies started to develop intuitive devices, putting the entry barriers for older people very low. They have learned to understand the benefits provided by innovative media delivery formats even though this demands for a high amount of personal user data. The younger generation, so called digital natives, grew up with technology right from their birth and can hardly imagine a life without seamless information and media provision.

By providing advanced authentication methods as well as highly secure data transfer mechanism, media magnates have made the infrastructure of private Wi-Fi access points available to everybody. Also, mainly in rural areas, huge antennas with an extensive range have been installed in order to ensure 100 percent network coverage already by 2015.

Backed by this early availability of Wi-Fi hotspots as well as the high media acceptance by the public, companies have started to introduce media delivery formats in nearly every area of life. It has become common standard that private homes include advanced media and entertainment systems, which have access to all kind of media content through proprietary interfaces to a large media delivery company.

Different media formats are being converged by the delivery company, which constantly releases new media formats to its customers. Mainly driven by the advertising business, the technology of augmented reality has been on the rise and moved into media delivery. Advertising companies started to place their products virtually in users' homes and enabled them to directly purchase this certain kind of good. Media delivery companies picked that up and developed progressive media formats, giving the user a unique experience of media consumption.

In March 2010 the proposed text for an international standard on intellectual property rights was accidentally released. The ACTA project (Anti-Counterfeiting Trade Agreement) was introduced by the U.S., the European Commission and other leading countries in 2007 and has been pursued since then. If participating countries manage to pass this international agreement, the basis is set for the development of globally operating media conglomerates introduced in the scenario above [339]. That this development is not unlikely shows the example of Google, the company which started as a simple search engine provider and has evolved to one of the largest Internet companies worldwide by 2010, offering a multitude of different services and eagerly trying to expand their influence. A week signal for hardware manufacturers focusing on seamless user interfaces in order to make technology accessible for a larger user base can be seen in the example of Apple. By 2010 Apple acts as role model for a lot of other hardware manufacturers in terms of user friendly devices seamless access to technology for users of all ages.

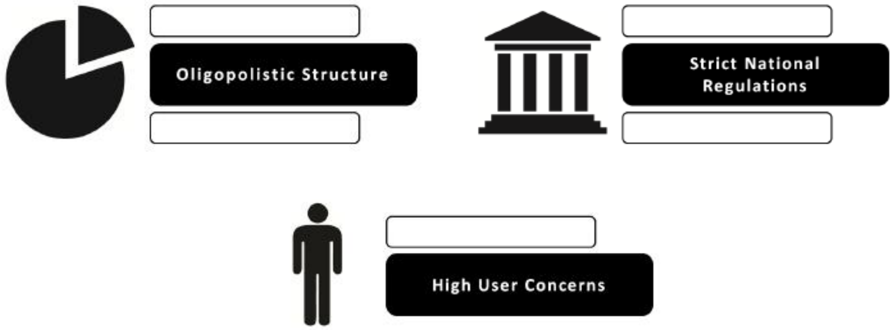

Figure 10.7: Media Bunker
Source: own illustration

10.3.2 Scenario 2: Media Bunker

The Bunker scenario is mainly driven by high user concerns. As people are constantly worried about their privacy and security of their data, they only share as little information as possible via the Internet. Through this general distrust, ubiquitous and permanent media coverage is seen as rather annoying. The price people have to pay for media is much higher than the benefit they perceive. Trials and tribulations have forced governments to no longer pursue internationally standardized regulations but to impose strict national laws on the Internet and media world instead. Since copyright and content laws widely differ around the globe, the market has moved towards an oligopolistic structure with a lot of specialized players located in different countries.

Even though countries worldwide have managed to agree on internationally valid regulations like the ACTA in the first place, these resolutions did not last for a long time [339]. As they have always been the least common denominator, they have turned out to be hard to enforce and therefore not effective enough to address serious problems like the illegal file sharing through peer-to-peer networks. Moreover, many cases concerning the misuse of data have been made public over the years. As a result national regulatory authorities strictly monitor major companies. In this context, also the so-called "Big Ten"[6] media conglomerates are closely observed as American and European policies aim at promoting competition among media and Internet service providers [17]. With governments worldwide imposing anti-trust laws and strengthening their national companies, the market structure does not see major changes. In

[6] AOL/Time Warner, AT&T Corporation, Bertelsmann, General Electric, Liberty Media Corporation, News Corporation, Sony, Viacom Inc., Vivendi Universal, Walt Disney Company.

addition to the few major players that already exist, only a small number of new media service providers enter the market since it is difficult to meet the strict regulatory requirements.

Besides privacy and security concerns, it is mainly the media overload that has defined this scenario. A lot of elderly people were overstrained with the rapid evolvement of information and communication technology as well as the ongoing digitization of daily life. The vast majority of people has been lacking both the ability and willingness to constantly adapt to new media. Also the younger generation who has grown up with digital technology has been increasingly overwhelmed - “not necessarily too much from a marketplace point of view, but from the perspective of consumers who might become oversaturated with the number of media options available” [297, p. 21]. With more and more people having suffered from burnout syndromes, governments felt impelled to take unprecedented measures. In 2025 consumer education focuses on the dangers of excessive media consumption and more and more signal-jammed media free areas are established. Having been increasingly common in the beginning of the century, by 2025 most of the screens within restaurants and bars have been removed due to customers’ concerns. Against the past trend of seamless personalization, in the Bunker scenario, media is rather pulled than pushed.

Within this development, a hybrid revenue model has been evolving. On the one hand, many people are not willing to pay for high quality media content. On the other hand, an indirect revenue model is not promising at all since too many advertisements would deter and annoy many potential customers. Therefore, the so-called “freemium” revenue model is widespread at which the majority of media services is for free whereas special, high-quality offerings have to be paid for.

Innovation of new converged media formats and associated hardware devices has been stunted during the course of time as customers did not demand for those innovative products. With governments having set strict rules and regulations on content, copyrights and media delivery, companies have mainly focused on meeting those requirements. Even though there has been some personalization through different kinds of applications developed by third parties, those programs mainly just deliver a specific kind of information and do not drive convergence of different media services.

In terms of market and competition laws, Google serves as prominent example as the company has become one of world’s most valuable enterprises within only a short period of time. Currently Google is “facing a lengthening list of antitrust investigations in the U.S. and Europe” as these governments aim at promoting competition in order to prevent a monopolistic market structure [114]. Besides, there are also some signals showing that users are increasingly worried about their privacy in the Internet. For example, many initiatives have been founded for the purpose of preventing Facebook from not passing on user data to third parties [52]. Furthermore, recent medical studies indicate that the “excess of information is seen to act against the benefits that are sought - information can be invalid and people may not have time to reflect and act on excessive information loads. This can result in irrationality or disinformation” [466, pp. 175-180].

10.3.3 Scenario 3: Media Bazaar

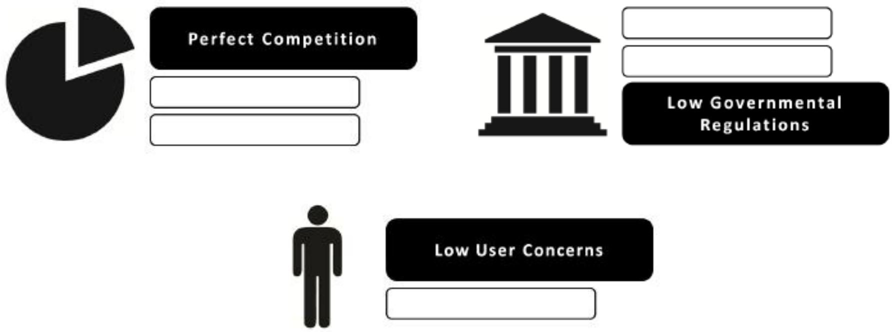

Figure 10.8: Media Bazaar
Source: own illustration

In 2025, the media landscape can be compared to a bazaar where numerous professional media producers as well as prosumers are providing their content to a global market of media-enthusiastic customers. Big media players lose their market power and are not able to cope with the rapidly evolving and changing online media market. Instead a vast number of prosumers who benefit from easier ways of producing user-generated content shape the media landscape. Tools for creating media content have become widespread and have enabled digital natives to create high quality music, films, games and other kinds of media. Thus an overwhelming amount of media content in every genre is available through multiple media delivery channels. The Internet serves as the dominating medium for delivery and production of media content. Media consumption is ubiquitous and becomes a seamlessly integrated part of private and professional life for people in all strata of society. Furthermore open acceptance of widespread media coverage has led to low privacy concerns.

Market power has shifted from major media companies to the original content producers. Authors and musicians simply sell their e-books and music online directly to customers thus making intermediaries such as major music labels or big publishing houses obsolete. Professional journalists are not bound to a single newspaper anymore but write their own blogs that people can subscribe to. Traditional newspapers do not exist anymore and are replaced by online news aggregators who serve as a prominent gateway. In addition the concept of prosumer journalism is further rising. The distinction between television and video on the web has blurred resulting in broadcasting channels selling their content online mostly on an on-demand basis. Movies are still produced by big production companies who also use the web as major distribution channel. Movie theaters have almost disappeared due to a wide penetration of home entertainment systems among common households. Social networks and community forums are main marketing channels for content producers and have replaced traditional models of advertising to a large extent. National market boundaries have disappeared and content is seamlessly produced and consumed all around the globe.

Because more and more users are actively taking part in producing media content, their consumption habits have also changed. The vast majority of people is embracing new kinds of media formats and is willing to make it an integral part of their daily life. Media is present everywhere including every room at peoples' homes, cars and public places. The concept of an e-Home is widespread. Benefits from ubiquitous media outweigh privacy concerns and people are willing to openly share their personal data. The vision put forth by Mark Zuckerberg in 2010 has triumphed: "People have really gotten comfortable not only sharing more information and different kinds, but more openly and with more people [...] That social norm is just something that has evolved over time" [94]. Privacy concerns are also low because informational self-determination as "the right of the individual to decide what information about himself should be communicated to others and under what circumstances" [465] has become a common standard. Due to a large number of independent vendors providing media content, data security is still an important issue on people's minds. However the concerns are appropriately addressed by rapidly advanced technologies in the domain of cryptography and authentication that are widely available for an easy use by consumers.

The very fact that users have rather low concerns about media in general leads governments to assume a passive role when it comes to content regulations. National governments are no longer competent enough to impose a strict legal framework to the highly dynamic and global media market. In addition they lack resources to control the huge number of content providers. Thus the online media community has adapted and evolved through self-organizing mechanisms making national governments merely providing a basic regulatory framework. Users who observe inappropriate, unlawful or obscene content report directly to the corresponding authorities who in turn take the necessary measures. Such self-regulating mechanisms have evolved from early open-source media networks. Many political parties push forward loose copyright regulations, making media content open for non-commercial use. In a broad open source sense, the media content is no longer proprietary and everyone is open to redistribute it with or without modifications for non-commercial purposes.

Besides regulations, the media community and open source projects also managed to push forward quasi-standards for media content. Device compatibility is no longer an issue as manufacturers extensively adopt these standards. In addition, common standards eventually result in either a joint developer platform or a single application programming interface (API) compatible with multiple developer platforms. Media content is an integral part of developer platforms and application development. Applications that imply recommendation systems are of particular importance because they allow users to find the appropriate media content out of the vast amount of offerings. Established common standards also allow more and more users to become prosumers as programming and the use of tools for media content creation have become an essential part of their educational curriculum.

Although most of the user-generated content is available for free, consumers perceive more sophisticated media content as a value add and are willing to pay especially for content that suits their individual preferences. Consequently neither a direct revenue model nor an indirect revenue model is predominant and most content providers adopt a hybrid model in order to widely distribute their products. Similar to the early iTunes App Store most of the applications offered are for free while some premium applications are charged for. In this context micro payment has evolved as a major payment system and allows billing even for small bits of media content from diverse sources. Telecommunication companies leverage their competitive advantage in providing a secure billing platform and operate as major players in this market.

In this wholly fragmented market none of the players is large enough to push forward media convergence. Small companies and prosumers rarely provide more than one type of media content. However, common standards and a vivid user and developer community have gradually improved ways of combining media content and have thereby driven implicit media convergence at the user level. For example, applications are able to enrich news articles written by journalist with photos taken by independent photographers. Tagging media content has become a community driven way of further combining and semantically linking different media sources with each other. Device compatibility makes user experience seamless and consistent among diverse spheres of media consumption. The openness of media content has also enabled the development of meta-information for different forms of media like movies and has eased redistribution of converged modified content. Recommendation systems and other self-organizing mechanisms ensure the quality of media service offerings. To sum up, in this scenario an underlying media convergence eventually evolved through active participation of prosumers, developers and open-source communities.

As of 2010, various weak signals for the media bazaar scenario can be identified. Music bands like Radiohead have independently merchandised their music successfully on the web as early as 2007 [9]. This suggests that content producers might move in the direction of selling their media directly to customers and hence circumvent intermediaries in the media business. The success of Google News indicates the rise of online media aggregators in a fragmented market [8]. The Citizen Journalist section on CNN's IBNLive website serves as an example for the fact that the boundaries between professional content producers and prosumers are gradually blurring. Initiatives such as GSMA's OneAPI signal the evolution of a common standard for application programming interfaces and device compatibility. Wikipedia, the popular online encyclopedia demonstrates the immense potential and capabilities of self-regulating online communities. The evolvement and growing popularity of the Pirate Party movement in Europe stresses the rising awareness among people for Internet related political topics like online content regulations and informational self-determination [131].

10.4 Service Idea: Peersonal

In order to address user needs within the Bazaar scenario, an innovative media service idea called Peersonal is introduced in this section. The platform allows users to gain the best individual and social media experience out of a vast amount of content by creating holistic media profiles. Peersonal takes into account that media is strongly connected to emotions, memories and personal traits. Third party developers are enabled to build innovative application based on this service.

10.4.1 Customer Needs

The world in 2025 as described in the media bazaar scenario offers plenty of media to the end users not just in terms of content but also with regard to value added media services. Low content regulations and active online communities build a highly dynamic ecosystem in which innovative media is constantly generated. Users are embracing innovative media and are driving the development by not just consuming but also contributing content. Enriched media is part and parcel of everyday life for a vast majority of people and a highly developed network infrastructure as well as new storage and processing solutions like cloud computing has made media consumption ubiquitous.

On the one hand, the users are blessed with a wide choice of media offerings whereas on the other hand this paradox of choice leaves the users with a huge problem of deriving the best media experience out of these offerings. Elderly people for instance accept new media as they recognize the major benefits it offers to them, but they are easily overwhelmed as well. Choosing media content is especially complicated since media - unlike most other consumer goods - is strongly connected to emotions, memories, surrounding environment and personality traits. The task of customization becomes even more complex when media is consumed in a social environment in which these highly diverse and personal factors of different individuals have to be taken into account. A simple example could be a social event wherein it is often difficult to play music that suits everyone's preferences and evokes a good atmosphere.

People in the media bazaar scenario consume media through a variety of delivery platforms and new media channels rapidly evolve. Users are active on multiple social networking communities and forums, planning their daily activities with sophisticated online calendars and purchase movies, music, news articles and other media from a large number of fragmented providers. These platforms can only generate a user profile from one perspective and thereby fail to address the user preferences in a holistic approach. Moreover these profiles lack awareness for example in terms of personal attitudes, past experiences, mood and present surrounding circumstances. The media experience is therefore not seamless and fails to address the emotional and social aspects of the user's media consumption.

On the flip side, companies which incorporate media into their products and services have difficulties to tailor their offerings to an individual user or a particular target group. New emerging media platforms fail to account for the preferences that users had before they got active on these platforms. Although customization of media is already a huge issue as of today, its relevance will exponentially increase when media becomes ubiquitous. This poses a major obstacle especially for developers and prosumers who intend to build their media applications and services based on holistic information about users but lack resources to do so. In addition, addressing corresponding data security concerns is even more challenging. The user need for a secure channel that provides comprehensive individual or group customization of media preferences is reflected on a corporate level.

10.4.2 Service Idea

An innovative solution to the aforementioned problems lies in the provision of a whole new service which takes into account both individual and peer media profiles: media consumption goes Peersonal. Peersonal addresses the needs of users and media companies by providing a platform that for the very first time combines and aggregates various sources of user data in order to create a holistic individual or group media profile. This media profile serves as a basis for a large variety of applications that enable a new quality of media consumption.

On an individual level, these applications will facilitate customized media provision and enrich user experience. In contrast to existing solutions, not only the explicit preferences provided by the user but also his implicit behavioral patterns, social environment and state of mind are taken into consideration. On a group level, Peersonal enables a whole new kind of social media consumption by creating a mass individualized media profile. As a consequence, customized media content will no longer be restricted to individuals but is further extended to large customer groups.

The Peersonal platform will be able to meet highest requirements in terms of data security and privacy concerns. Generally, it acts as an external trustworthy channel that provides third party developers and prosumers with a wide range of innovative opportunities to develop media applications and services by leveraging user preferences. At the same time, it safeguards the security and integrity of user data by simply providing extracted media profiles instead of actual data and by employing state-of-the-art encryption technology. Applications based on Peersonal can be applied by companies and institutions that want to add a valuable media component to their core products and services.

From a technical point of view, Peersonal can be described by applying a layer model. The user initially provides the Peersonal user interface with information on data sources upon which his media profile shall be built. These could for instance span from online social networking profiles, past media purchases and sensors of different kinds to information extracted from personal calendars. The data collection layer crawls these sources and links them to the Peersonal platform. The platform then mines the media related data on a second layer. Finally, the data combination layer creates a holistic media profile based on either just one data mining layer of a single person or various data mining layers of a group. Applications can then access the media profile through an API.

In the following, the different layers are described in more detail with respect to music as the media of focus. However Peersonal is not limited to music and can be applied to various media forms such as movies, books or news articles.

Data Collection Layer

The data collection layer is the first step in deriving a media profile. Initially, users have to link sources to the Peersonal platform to include them in their media profile construction. Such sources cover a wide range and can be divided into four major categories: web-based, environment-based, activity-based and ubiquitous computing-based. Web-based sources could be for example online social networking profiles, search histories, blogs by media critics, online music purchases or web-radio profiles. Environment-based sources could include weather information, precise geographical location and current date and time. Online calendars, job profiles, travel histories or hobbies could form activity-based sources. Ubiquitous computing-based sources use innovative sensors and databases that are likely to evolve in the next 15 years such as fatigue sensors in e-beds, mood sensors or e-health profiles.

Data Mining Layer

The data mining layer filters the huge amount of information gathered previously and extracts relevant information on the users media consumption behavior. For example an e-health profile, a mood sensor or a personal calendar could allow concluding sophisticated approximations of a user's current emotional state. Assuming that these sources provide information that the user just had a long working day, suffers from a minor headache or has only had few hours of sleep

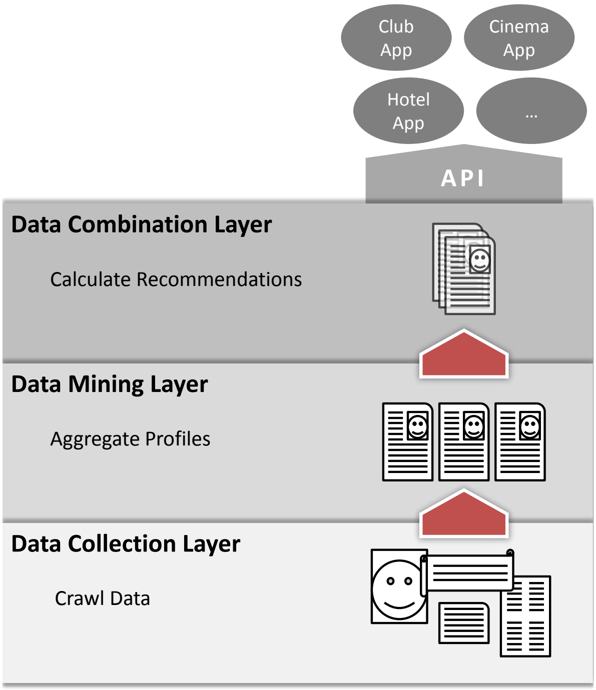

Figure 10.9: Peersonal Layer Model
Source: own illustration

the previous night, the data mining layer is able to extract meta-information indicating that the user feels exhausted and stressed out. In a similar way, information can be obtained about the user's general music interests including his music listening history and music library. Additionally, ubiquitous sensors could even provide information that for example the user's partner is in the same room. On a more abstract level, the data mining layer gathers meta-information of various kinds.

Data Combination Layer

The data combination layer takes the meta- information of one or more persons' data mining layers and combines this input to eventually generate a holistic media profile by recognizing the underlying patterns. Following the example introduced above, the data combination layer is capable of combining meta-information provided by both the user and his partner. This data can be linked for instance to the meta-information that they both had heard a serene song during their last vacation. Recommending and playing this particular song would trigger emotions through recalling a positive experience of the past. Altogether, the data combination layer follows a comprehensive approach to derive a combined media profile and takes into account emotional and psychological aspects.

Subsequently, the Peersonal platform provides media profiles through an application programming interface (API) for further use by third parties. Peersonal thereby addresses the users' security concerns through a twofold approach. The API only provides access to pre-specified parts of media profiles and never passes on the actual underlying data. Furthermore, individual media profiles may only be accessed by applications explicitly authorized by the user. Besides providing value-added services, applications that implement Peersonal's API serve as a back-channel to the data collection layer in order to constantly improve the process of creating media profiles.

In the following, three exemplary Peersonal applications are introduced. Although these examples include the usage of devices and media libraries, Peersonal itself is not bound to specific devices or linked to particular media sources.

Club Application

Night clubs bring together people who want to have a good time and enjoy music. In order to evoke the right atmosphere, music clubs engage disc jockeys who try to suit the music taste of the visitors. A club application could revolutionize the music club experience by embedding the Peersonal API in order to create a music media profile of all club visitors. Thereby, the application would become a collaborative disc jockey. Whenever users enter a club using the application, they could sign in and thereby authorize the music club to access their media profiles. This could for instance be done through using user identification software that is installed on every mobile phone. The identification is then transmitted to the Peersonal platform which is running in the cloud, providing information about customers currently present. The night club has linked its music library to the Peersonal platform beforehand. Peersonal then processes the input through the different layers described above and delivers a peer media profile to the club application which suggests what song to play next. Such a club application could not only serve as a sophisticated disc jockey but especially enable consumer involvement on a new level.

Hotel Application

Hotels mostly promise their guests to tailor all services to their individual preferences. Nevertheless especially business hotel rooms are mostly anonymous and do not evoke the comfortable atmosphere of feeling at home. In 2025, hotel rooms will be equipped with next-generation ubiquitous media devices but still lack personal adjustment with regard to the guests' media preferences. A hotel application could use the Peersonal API and thereby enable hotels to offer their guests a more personalized service. Whenever a user checks in at a hotel that supports the Peersonal platform, he could authorize the hotel

Figure 10.10: Mockup for Club Application
Source: own illustration

to use his media profile. The media system in the user's hotel room as well as the hotel's overall media offerings are connected to the Peersonal platform. The hotel application incorporating the Peersonal API would then be able to customize media offerings to the guests by taking into consideration their media profile and the hotel's media library. Such media services could evoke positive emotions and ensure a comfortable stay.

Sneak Preview Application

Sneak preview events in cinemas comprise of showing a movie wherein the audience is unaware of what movie they are going to watch until it is actually screened. These events mainly target to surprise the audience. However, often it might be the case the majority is disappointed if the screened movie turns out to be the exact opposite of their personal preferences. In this context the Peersonal platform could maximize the overall satisfaction through a sneak preview application. Every viewer attending the movie could initially authorize the sneak preview application to derive a movie recommendation through Peersonal. Combining media profiles of all the viewers, suggestions can be made which movie fits their preferences best. This way customer satisfaction could be maximized introducing a whole new kind of social event.

10.4.3 Business Model

In order to describe the business model of Peersonal the value chain with its actors is examined. Subsequently a potential revenue model is introduced which points out the relationship between the different players and explains the revenue and service streams.

Value Chain

The value chain describes all value-added activities starting from data gathering until the use of the actual application. As a first step, relevant user data is acquired from several sources. As described in section 10.4.2, these sources not only include information from existing social network profiles or similar online data bases, but also various sensor data. Especially through the latter, particular information such as the personal mood or the current environment can be taken into account. This aggregation of a large amount of data to specific pieces of information is conducted in the second phase. Therefore the single data fragments are structured in a way that a uniform media profile can be created for each user. The profiles serve as a basis for the third step, within which media recommendations for either one or multiple persons are derived. Using these recommendations, a whole new kind of applications can be built which take into consideration individual as well as group preferences. Possible applications like those introduced in the previous section cover many different areas of life. Application usage is regarded as a last step since it also represents a value-added activity. By the usage of various applications that include a back-channel, media profiles can be constantly improved and developed further.

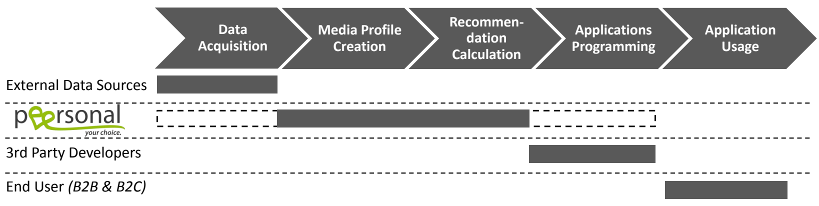

Figure 10.11: Value Chain
Source: own illustration

There are multiple parties involved in the depicted value chain. The key competencies of Peersonal lie in the field of structuring the gathered information, creating media profiles and enabling third parties to include combined media recommendations in their applications. The approach of opening this service for third party developers and the consequent orientation towards open innovation bears a huge potential. It ensures that applications are not only limited to strong-selling areas of usage but can also be created by developers aiming at niche markets. This strategy entails a wide distribution of the service and could therefore lay the foundation for Peersonal's strong competitive position.

Revenue Model

The revenue model is based on two levels, taking into consideration the relationship between Peersonal and the third party developer as well as the relationship between the developer and the end-user of the respective application.

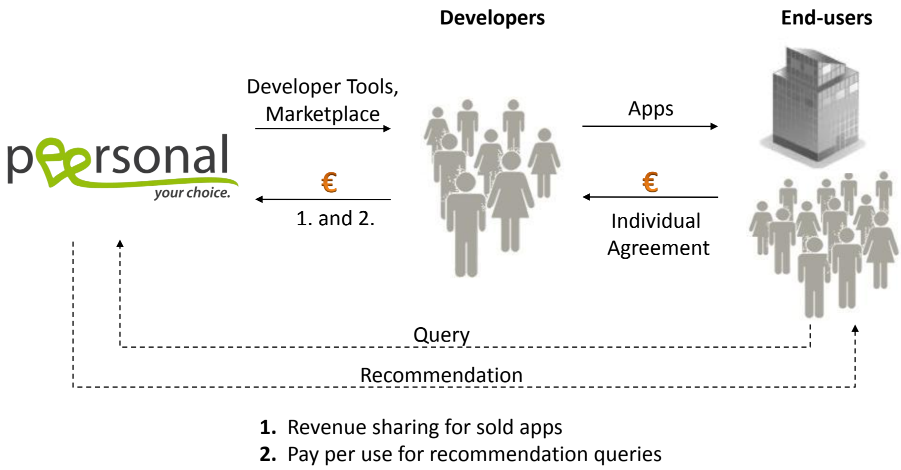

Figure 10.12: Revenue and Service Streams
Source: own illustration

The developer is provided with developer tools including the actual API and the respective documentation. In addition to that, an online marketplace for the sale of applications is introduced. Moreover the developer is granted the right to sell his applications through additional channels. However before an application is released, it needs to be approved by Peersonal in order to ensure highest quality possible.

The developer can decide independently on how to structure his relationship towards the end-users, thus also the decision how to monetize his own applications is left to each individual developer. Whether he charges the end-user with a monthly flat rate or a certain usage fee does not directly affect his financial relationship towards Peersonal.

Apart from that the revenue stream between the developer and Peersonal consists of two basic elements. Firstly, Peersonal receives 30 percent of the revenue the developer realizes through selling his applications to the end user. Secondly, as the processing of every recommendation query is generating additional costs, the developer is charged for any traffic caused by his particular applications. This two tier revenue relationship towards the developer ensures a sustainable revenue stream for Peersonal throughout the life cycle of any application.

The business model introduced above could be extended into several directions. Especially the billing relationship between developer and end-user may be subject to external service features as most developers lack resources in the field of micro payment. Furthermore, media purchases could be directly integrated into certain applications. This would make it an interesting business opportunity for providers of generalized media delivery platforms. Such extension options for the basic business model could open opportunities especially for telecommunication companies as most of them are already experienced regarding the competencies mentioned and are actively looking for ways how to leverage them.

Brand Positioning

Offering a distinct service, Peersonal may be introduced as a single brand among other platform services. The brand positioning enhances the recognition value of the service and a successful introduction elevates entry barriers for competing services.

Figure 10.13: Peersonal Logo
Source: own illustration

The naming “Peersonal” emphasizes the media recommendations on a personal as well as on a peer level. This is literally underlined by the slogan “your choice.”, addressing individual persons as well as whole groups. The illustration within the name - two letters forming a heart- suggests the inclusion of personal emotions into the recommendation system and promotes the service’s potential to even trigger certain feelings.

10.4.4 Market

As the service idea is tailored to the Media Bazaar scenario, Peersonal will have to cope with a very fragmented market and a large number competitors. Direct competition mainly evolves from existing developer platforms which are eagerly trying to introduce new services in order to attract third party developers. An efficient incorporation of Peersonal would generate a unique competitive advantage in that field. Since a stand-alone solution might experience heavy competitive pressure in the beginning, prospects could be significantly improved through integration into an existing service delivery platform.

With the Internet, media and telecommunication industry converging, there is a multitude of potential new entrants. Especially Internet companies have proved to be very innovative and flexible when it comes to new business opportunities. However this challenge might be met best by telecommunication companies as they are able to bring in their core competencies such as micro payment or own media delivery channels. Having always stood for maturity and security, the trusted relationship with their customers is another key advantage over new entrants. Combining this, Telcos might be able to provide superior services to third party developers by integrating Peersonal.

In the fragmented market depicted in the Bazaar Scenario, none of the companies is in possession of proprietary user data as individual users have the right to demand for their rich profile information at any time. With the shift from traditional value chains to more open value networks, companies are sharing information about the users with each other as long as the respective person agrees. The Peersonal approach makes use of this user centricity and explicitly puts the user in the position to independently decide which sources to include in his personal media profile.

Bargaining power of customers in the context of Peersonal's business model is a minor issue as the service is intended to be used by a large number rather than by only a few developers. Even though there might be a smaller number of professionalized developers creating very successful applications, none of them will have significant power to enforce certain benefits. Bargaining power of the end-user needs to be taken into consideration by the developer himself as his revenue depends on the pricing scheme of his application. Revenue streams of Peersonal are mainly decoupled from that relationship.

10.4.5 Critical Outlook

Peersonal's future success is associated with several risks and opportunities. Many obstacles have to be overcome within the next fifteen years. First of all, security concerns have to be addressed properly. As users always care about their personal data, advancements in cryptographic technologies are crucial. Furthermore, a lot of technological problems still have to be solved although the required infrastructure, especially widespread wireless broadband access, will certainly be there soon [Cross-reference BR Topic 3]. There is need for cross-device compatibility and mood sensors in order to generate a holistic user profile and to integrate semantic information as well as for an efficient algorithm which has to be developed.

From a social point of view, Peersonal's business model strongly depends on user acceptance. Users should be willing to give out their personal data and have the feeling that the benefits generated through Peersonal outweigh their initial privacy concerns. Within this context, it is also important to be surrounded by an appropriate regulatory framework as far too strict laws could significantly limit and influence the usage of data.

Finally, it has to be taken into consideration how different market players and the end-users act and react. When launching Peersonal, a critical mass of customers can be regarded as prerequisite. Hereby, especially the establishment of value networks and co-operations should be pursued in order to boost Peersonal's success. The idea is not only limited to the combination of media profiles but can be extended into various areas of life. Given a favorable development there could be a whole new ecosystem evolving around the combination of individual user profiles.

10.5 Conclusion

Governmental content regulations, user concerns and the market power of media companies have been identified as main drivers for the convergence of multimedia services. Based on the potential developments of these key drivers, three major scenarios have been developed in order to draw a thorough picture of the possible future. The Bazaar scenario has been selected as the most likely one since as of 2010 multiple weak signals are suggesting this development. Within that scenario, the media landscape is very fragmented and professional media content providers are in intense competition with actively participating prosumers. Intermediaries such as publishing houses or large music labels have diminished as most individual artists make effective use of the various distribution channels with which they are provided on the Internet. Due to full control of their personal data as well as the effective self-regulating mechanism of the market users do not have major concerns about their privacy.

Taking the Bazaar scenario as the current state of the media landscape in 2025 Peersonal was introduced as an innovative business opportunity for future developer communities and platforms. The business idea is focused on the customer needs evolving from the specific characteristics of the Bazaar scenario. Peersonal combines various sources of the user's personal information and creates a distinct media profile which is constantly adjusted. Through the calculation of media recommendations for either a single user or a group of people, a distinct service can be offered to third party developers. They are provided with the necessary data to create applications including personal or group based media recommendations. The third party enabling approach triggers developers and end-users similarly to come up with new ideas for innovative usage. This guarantees an optimal coverage of emerging user needs as well as a strong competitive position of developer communities integrating

Peersonal into their platform.

The online convergence of multimedia services is inevitable and telecommunication companies need to find ways how to profitably participate in that development. As suggested in this report, Telcos need to leverage their current core competencies by combining them with newly emerging services. The early identification of these services as well as their efficient deployment is crucial. This report has suggested an innovative business idea which has the potential to serve as such a service and to provide telecommunication companies with a competitive advantage in the future.

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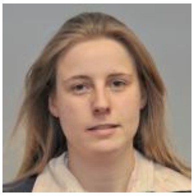

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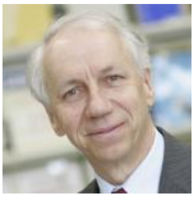

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