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## ABSTRACT

In telecommunications, increasingly complex service systems evolve which have the objective to produce ICT services. The increased complexity is due to the convergence of the industry sectors information technology, telecommunications and media. Telecommunication network operators are challenged to modify their business strategies: they can not any more produce ICT services in a vertically integrated fashion but need to market preliminary services as suppliers for other ICT service providers. For this task, modular service concepts known from Service Science and IS research can be employed. ICT service modules, so called Enabling Services, are provided on Service Delivery Platforms to support service development. In this work, an Enabling Service conceptualization is developed. Based on a case study, a process for the specification of Enabling Services is presented.

### Keywords

Service Engineering, Service Science, Service Oriented Architectures, Telecommunications, Service Delivery Platforms.

## INTRODUCTION

The evolution of service systems in telecommunications is mainly driven by technological innovations such as the development of high capacity all-IP networks and multi-access terminals. The merging of the branches telecommunications, information technologies and media in recent years is commonly referred to as 'convergence in ICT' (Nystrom and Hacklin, 2005). Due to the development of new business models for ICT services und the emergence of new content and service providers, network operators increasingly take the role of preliminary service providers (Li and Whalley, 2002). ICT service providers independently develop services based on a standardized infrastructure, mostly IP-networks (Fransman, 2007). These services are also referred to as 'over-the-top' services in non-academic literature. By developing Enabling Services network operators try to identify and provide attractive preliminary services for these ICT service providers (Wulf, Zarnekow, Sidler, Brenner, 2008). Up to the present, neither the economic meaning of Enabling Services in telecommunications has been discussed in research, nor methods for the design of Enabling Services have been proposed.

TV over Internet is a suitable example: Throughout decades, carriers controlled TV services on most stages of the value chain (i.e., from network operation up to distribution). Today Internet-TV providers, such as Zattoo, Joost or Babelgum, increasingly manage to attract customers. These ICT service providers only source the connectivity of their servers to the IP network and require a broadband IP access at the end customer's side. Without the cost-intensive operation of networks, they are capable to offer TV services, mostly based on advertisement-financed business models. Network providers could carry out the distribution and quality transport of the content of Internet-TV service providers as an Enabling Service. In order to facilitate the transport of data-intensive content via IP networks, carriers need to establish the required basis by building server networks, installing route optimization technologies and extending network capacity. Based on these technologies, carriers are able to market the quality transport as an Enabling Service.

Simultaneously, industrialization concepts are introduced in the IT sector (Zarnekow, Brenner, Pilgram, 2006): Systems and methods are being developed to adjust IT services with end customers and at the same time enable a cost efficient production. It is envisioned to reach a high degree of division of labour and automation based on standardized production techniques. Regarding technology, this is supported by systems and architecture concepts such as virtualization technologies, and service oriented architectures, which enable the development of customer oriented products based on standardized and preconfigured modules.

During the development of Enabling Services, telecommunication network operators are also facing the challenge to produce cost efficiently and at the same time to enable the development of customer oriented services. For this reason, in this paper concepts of IT service management are employed in order to create a conceptualization of Enabling Services as well as a structured process to specify Enabling Services.

## LITERATURE REVIEW

Service Science, Management and Engineering (SSME) is a research discipline, which deals with the specific characteristics of services and the derivable requirements and methods for the design and management of services (Buhl, Heinrich, Krammer, 2008; Chesbrough and Spohrer 2006; Demirkan, Kauffmann, Vavghan, Fill, Karagiannis, Maglio, 2008). Services are defined as the application of competence and knowledge to create value between providers and receivers, which work together to coproduce value in complex value chains or networks, referred to as service systems (Spohrer, Maglio, Bailey, Gruhl, 2007). Based on the constitutive attributes of services (Corsten, 2001), some authors present conceptualizations of services (e.g., Bullinger, Fähnrich, Meira, 2003), which emphasize on specific characteristics on three dimensions: In the potential dimension the focus is on the design and organisation of production capacities. The process dimension addresses the design of production processes and particularly the integration of customers. In the outcome dimension the focus is on the precise definition of required service levels, which is important due to the intangibility of services. Based on this conceptualization, various authors design methods and techniques for the design of services (service engineering, Boehmann, Junginger, Krcmar, 2003; Edvardsson and Olsson 1996; Uebernickel, Bravo-Sanchez, Zarnekow, Brenner, 2006). Zarnekow et al. (2006) give an overview on the management activities required to realize a customer orientation and industrialization for IT services. Boehmann et al. (2003) design the concept of modular IT service architectures, which supports the industrialization of IT services.

In telecommunications research, some authors address the issue of the impact of convergence (Fransman, 2001; Li and Whalley, 2002). Another focus of research is the technological design of Next-Generation-Networks and platforms in telecommunications (Knightson, Morita, Towle, 2005; Magedanz, Blum, Dutkowski, 2007; Muller, 2006; Pavlovski, 2007). The identification of requirements, which emerge from company and market situations and concern the design of services and technological architectures as well as the associated design and management techniques are poorly addressed in telecommunications research and are subject of this publication.

In the following, a common understanding of ICT services is established (Section 3) and a conceptualization of platform based service modules in telecommunications is presented (Section 4). Subsequently, a structured process for the specification of Enabling Services is presented (Section 5) and applied in the course of a case study (Section 6).

## ICT SERVICE MODEL

Before we discuss ICT service modules and their specification, a short overview on the general design layers of services is given.

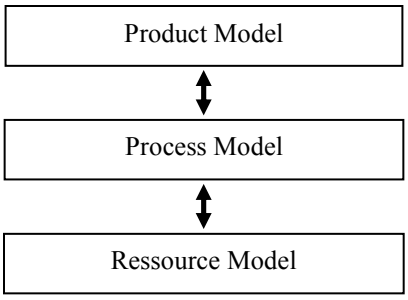


**Figure 1. Descriptive Model for Services**

As depicted in Figure 1, for the modeling of services, one differentiates the following layers (Scheer, Grieble, Klein, 2004; Bullinger et al., 2003): the product model, the process model and the resource model. At the product model layer the service offering for the end customer is described. For each product of a service provider, all characteristic features, namely the value propositions and the target customer groups, are presented. Services can address private consumers, e.g., voice services like mobile telephony, and business processes of professional consumers, e.g. the operation of payroll accounting as a service. On the process model layer, it is described, which activities are necessary for the production of services. Internal production activities as well as customer interactions are regarded. On the resource model layer, it is described, how human resources

and ICT production systems (networks, servers, data storage disks etc.) are used. For each process activity, required subtasks including the provisioning of hardware resources and the operation of application systems are allocated. E.g., for the activity 'transmission of location information' the operation of data base applications and servers is required, in order to save and update location information, as well as the operation of network infrastructure, which enables the communication between the database and terminals.

In order to enable an industrial production of ICT services, resource management can be carried out with the help of modular service architectures and platforms (Boehmann et al., 2003). Preliminary ICT services are then offered as modules. Platforms allow to access distributed ICT production systems via well defined interfaces and coordinate the provisioning of ICT services at run-time.

## ENABLING SERVICE DEFINITION

In telecommunication network architectures, a modular concept is introduced, which is referred to as Service Delivery Platform (SDP). Even though SDPs are being developed and already in use, there does not exist a generally accepted conceptualization. From the existing literature about SDPs (Muller, 2006; Pavlovski, 2007), some central characteristics of SDPs can be identified: SDPs are IT Platforms. They are software applications, which are accessible via well defined interfaces. SDPs provide functionalities for the support of ICT service development (e.g., search and retrieval of modules), for the support of ICT service operation (e.g., coordination at runtime) and for the support of ICT service management (e.g., charging and billing). Additionally, SDPs also provide means for developers to integrate and distribute their Enabling Services. Enabling Services offered on SPDs are network agnostic: They run on heterogeneous physical networks and software implementations. Based on the specific application context of the end user (e.g., terminal and access network), they make use of appropriate network functionalities. For this work SDPs are defined as follows: Service Delivery Platforms (SDPs) are IT environments, which support the development, the provisioning and the management of ICT services and provide preconfigured modules with network agnostic functionalities.

Within these architectures, preliminary services are designed as reusable, technology-oriented service modules with well defined interfaces. On the economic level, these modules are benchmarked by their value contribution to the ICT services: They are perceived as enablers of ICT services on the preliminary services level. For this reason, we refer to the service modules in the ICT sector as Enabling Services: Enabling Services are well defined software modules and accessible via a Service Delivery Platform. As preliminary services, they support the production process of ICT services. They are provided in order to support ICT service development and provisioning. E.g., the coordinates of a person's present location can be transmitted by an Enabling Service. This preliminary service enables the development of location based services.

The platform based marketing of service modules has the advantage for telecommunication network operators to foster innovation in ICT service development on a wide basis. Through the opening of the access to formerly proprietary systems, they can potentially profit from the innovative power of a multitude of developers. Through profit sharing business models, platform providers have the option to directly participate in the success of service providers. As a side effect, the core business of network operators, the network transport, is stimulated: an increase of ICT service usage has a direct relationship to higher infrastructure capacity usage.

This aspect becomes obvious in Apple's iPhone SDK business model : For the iPhone, Apple offers a development platform with a multitude of programming interfaces, the iPhone Software Development Kit (SDK). Already after a short amount of time after its launch, a lot of applications have been developed on this platform. The marketing of these applications is carried out through the App Store, which is controlled by Apple. 30% of the profit is retained by Apple. Through the offering of a great variety of applications, Apple's core product, the iPhone, is enhanced.

## SPECIFYING ENABLING SERVICES – A STRUCTURED APPROACH

Service engineering concepts for the development and management of general services have been adapted to the specific context of ICT services (Boehmann et al., 2003). But the specifics of the development of Enabling Services have, up to the present, poorly been addressed by researchers. As presented above, a primary objective of service engineering is the design of a resource model for a given service. Being preliminary services of ICT services, Enabling Services are a subject of design in such resource models. For this reason, Enabling Service design is a subtask in service engineering. Many methods in service engineering suggest a customer oriented design of services, which is based on the descriptive model for services. Service concept and production processes are designed based on customer requirements (top-down approach). The given infrastructure is only taken into account and matched to modules at the lowest layer, during the design of resources (bottom-up approach). The definition of Enabling Services, presented in the previous section, suggests a structured approach to the specification of Enabling Services, which is oriented at the methods of service engineering: Enabling Services implement

ICT service modules, which support an end customer service production process. The specification can therefore be carried out in three steps (Figure 2):

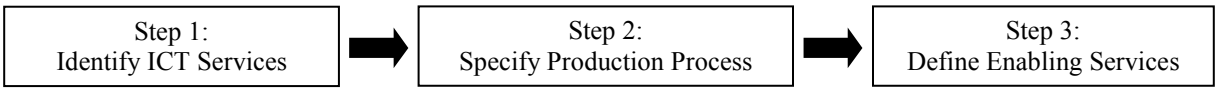


**Figure 2. Steps for the Specification of Enabling Services**

In the first step, ICT services, which are to be supported by a platform, are identified based on customer requirements. Trend analysis and customer surveys evaluate the service demand. Thereafter, customer requirements are defined, which are addressed by a service offering. Finally, feasibility studies can be carried out and the profitability of a service can be assessed.

In a second step, activities are specified, which are required for the production of ICT services. A functional decomposition of the selected ICT services is carried out. The identified activities form the starting point to the functional design of Enabling Services in the next step. These activities are structured in a business process for the production of an ICT service. For process modelling, well known modelling from Business Engineering can be employed (Scheer, 2000; Oesterle, 1995).

In the third step, Enabling Services are identified to support process functions. Function modules are defined, which completely or partially support a function as an application with a software interface. Modules are functional units of a manageable size, which are independent from their application context and have well defined interfaces (Boehmann et al., 2003). Each identified module is further specified in an Enabling Service definition. Such a definition contains interface and functionality descriptions and serves as a basis for Enabling Service implementation.

Regarding the scope of functionalities, which are provided by Enabling Services, there is no agreement reached in applied and academic research. A standardization effort, the Open Service Access (OSA, Unmehopa, Vemuri, Bennett, 2006), identifies few basic SDP modules, which can be regarded as the least common denominator. Table 1 gives an overview on selected module concepts from applied and academic research. Mostly, only functionalities have been taken into account, which can be implemented in Next-Generation-Networks (Knightson et al., 2005).

A comprehensive portfolio of Enabling Services needs to be developed in order to reach the objective of SDPs and Enabling Service development: to efficiently support ICT service providers during service development. Ideally, the main value proposition of service development is the aggregation of preconfigured Enabling Services and not any more the independent development of custom-tailored individual solutions.

| **Name** | **Author** | **Function Scope of Modules** |
|---|---|---|
| OSA/Parlay API (Unmehopa et al. 2006) | Parlay Group | Call Control, User Interaction, Mobility, Terminal Capabilities, Data Session Control, Generic Messaging, Connectivity Manager, Account Management, Charging, Policy Management, Presence and Availability Management, Multi-Media Messaging, Service Broker |
| OMA Service Environment (OSE) (OMA 2005) | Open Mobile Alliance | Broadcasting, Content Delivery, Device Management, Digital Rights Management, Game Service, Location, Messaging, Charging, Presence & Availability, Push to talk, Security |
| Sprint Business Mobility Framework | Sprint | Location, Presence and Messaging |
| Web21C SDK | British Telecom | Authentication, Call Flow, Conference Call, Inbound SMS, Messaging Voice Call |

**Table 1. Function Scope of SDP Modules**

## CASE STUDY

In the following, a case study is presented, which was carried out at a European telecommunications company in 2007. It was the objective to create a company wide shared understanding of Enabling Services. Based on this understanding, fields of action for the creation of an Enabling Service portfolio were identified.

In the first step, a trend analysis for the ICT service market was carried out, in order to make predictions about the future demand for ICT services (Table 2).

| **ICT Service Segment** | **Trends** | **ICT Services** | |
|---|---|---|---|
| Information Services | Self promotion and participation<br>Information reduction<br>Automated Processing<br>Data Usability | Mobile Search<br>Location Aware Services / Navigation | User generated content<br>Videocasting and Podcasting |
| Communication Services | Convergence<br>Communication as a Service<br>Ubiquity | VoIP<br>IP Telephony<br>Single Phone<br>Unified Communications | Unified Messaging<br>Video Conferencing<br>Web Conferencing |
| Transaction Services | User Empowerment<br>Personalization | Web Self Services<br>Community Marketing<br>E-Marketing | Preference Management<br>Mobile Marketing and Advertising<br>E-Payment |
| Enterprise Services | Flexibility | Utility Computing<br>Network Outsourcing | Software as a Service |
| Entertainment Services | Fast Accessibility<br>Mobility<br>Terminal Convergence | IPTV<br>Mobile TV Broadcasting<br>Mobile TV Streaming<br>Video Streaming | Video on Demand<br>Pay-per-View<br>Digital Music / Video Distribution<br>Gaming and Online Gaming |

**Table 2. Trend Analysis for ICT Services**

In the course of this trend analysis, various market surveys were analyzed (BITKOM, 2007; GARTNER, 2006; Pohler, Beckert, Schefczyk, 2006; Wirtz, Burda, Raizner, 2006) and trends were extracted, which have a sustainable impact on an ICT service segment. Based on these findings, ICT services were selected, which are to be supported by Enabling Services. For example, in the segment communication services, the trend convergence has been considered important: in this context, it refers to the substitution of traditional circuit-switched telephony by IP-based packet-switched telephony. Video conferencing is an ICT service, which is directly effected by this trend. IP-based technology offers manifold opportunities to implement innovative video conferencing services in the future. Such implementations can be supported by Enabling Service offerings.

In the second step, a general value chain for the production of the previously identified ICT services was created (Figure 3). The value chain is subdivided into four segments: Content, Application, Infrastructure, and Delivery and Management. The linear design of the value chain does not necessarily imply that all segments and activities have to be processed consecutively. The intention is to provide an overview of all required activities. Activities in all four segments are a necessary prerequisite to provide a complete end customer service over a telecommunication network.

The *Content* segment consists of the activities content creation, content aggregation, and packaging. The term 'content' does not only refer to information and entertainment content, which is paid for by consumers, but also to user generated content and advertising. Content creation covers all tasks that are needed to produce content such as research, script writing and editing. Content aggregation, as the second activity, includes the gathering of content from heterogeneous sources and the digital rights management. Packaging is the last activity in this segment and encompasses the bundling of content according to customer needs.

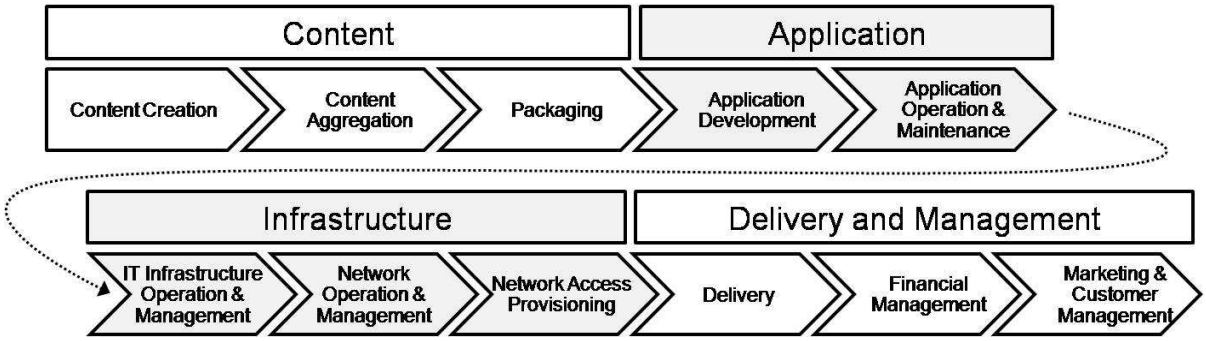


**Figure 3. Value Chain for the Production of ICT Services**

The *Application* segment comprises all tasks for the creation of software, which supports the production of end customer services. Application operation and maintenance is a prerequisite for the provisioning of applications, e.g. in Application Service Provisioning (ASP) solutions. The *Infrastructure* segment is subdivided into IT infrastructure operation and management, network operation and management, and network access provisioning. The IT infrastructure operation and management activity focuses on acquiring and managing hardware resources to run applications. Network operation and management consists of providing data transportation services and network management. Network access provisioning includes the provisioning, management and sales of network access. The *Delivery and Management* segment of the value chain comprises all ICT service specific activities which require a direct end customer relationship. Delivery covers all tasks that are related to providing terminals and software for the access of end customer services and to the management of the content appearance on the terminal devices. Financial management tasks include the accounting of end customer services as well as of all preliminary services that are used in the production process. Tasks in the last activity in the value chain focus on the management of marketing, CRM and customer support.

| **Enabling Services for Packaging** | |
|---|---|
| **Enabling Service** | **Function Description** |
| License Issuing | Check terminal data, Control user identity, Retrieve product ID, Create licence, Save license |
| Usage Authorization Control | Check terminal data, Control user identity, Control product ID, Retrieve license, Analyse license, Submit control information |
| Location Information Transmission | Control user ID, Retrieve and transmit location information |
| Transmission of Status Information | Control user ID, Retrieve and transmit status information |
| User Profile Transmission | Control user ID, Retrieve and transmit user profile |
| Customer Terminal Equipment Information Transmission | Control user ID, Check status, Retrieve terminal ID, Transmit terminal information |

**Table 3. Enabling Services for Packaging**

For all of these value chain activities, functional modules are defined in the last step, which support these activities. For these functional modules, interface and function descriptions are created, which jointly define an Enabling Service. Table 3 lists functional modules for the activity packaging, in which content is adapted to specific end customer requirements. E.g., the transmission of status information of end users is a functional module, which is potentially used during packaging. With such information, content can be edited according to a customer's requirements, e.g., by creating and sending a text message either as an email or as an SMS.

This way, a multitude of Enabling Services were specified. Not all of them are implemented by the telecommunications network operator. The issue, which Enabling Services can be marketed efficiently, is not analyzed during this specification process. It should be addressed separately by carrying out market surveys. Thereafter, the selected Enabling Services need to be implemented, the required production environment needs to be installed and the Enabling Services need to be integrated in a SDP.

## CONCLUSION AND OUTLOOK

Due to the emergence of complex service systems in telecommunications, formerly vertically integrated telecommunication network operators are increasingly under pressure to redesign their business models (Li and Whalley, 2002). Whereas 'over the top' service providers, which are new to the market, partially realize high profit margins, the data transport, which is the core business of telecommunication network operators, has been degraded to pure commodity (Nystroem and Hacklin, 2005). New technologies offer the opportunity to telecommunication network operators to market new products. For product development, they can make use of established methods from IS research: This paper establishes a conceptualization of platform based function modules, so called Enabling Services, based on concepts of Service Science. Such a conceptualization is a prerequisite for the introduction of modular service platforms in telecommunications. Present implementations reveal that the introduction of modular service architectures in telecommunications is in an early stage. In contrast, in the IT sector, service oriented architectures are already popular. The presented case study demonstrates that there are more opportunities for the marketing of Enabling Services than just the modularization of existing telecommunication systems und functionalities. Comprehensive module offerings are required to enable an efficient service development.

Additional research efforts are required regarding economical as well as technological issues: It is necessary to technologically realize the concepts of Enabling Services and SDPs presented in this work. The question must be answered, whether it is possible to satisfy customer requirements in modular service architectures, e.g., regarding security and response times. Economically, it must be analyzed, which Enabling Services are required as a foundation for future ICT service implementations and which role will be played by telecommunication network operators. In addition to the development of Enabling Services, it is also possible to integrate third party service modules into one's platform. This raises the question, how platform concepts can support the distributed production of ICT services. In the telecommunications ecosystem, which is growing due to convergence (Li and Whalley, 2002), modular ICT concepts can be employed for the customer oriented allocation of production tasks (Hoogeweegen, Teunissen, Vervet, Wagenaar, 1999). In order to analyze such consequences of the introduction of modular platforms in telecommunications from the micro- and the macroeconomical perspective, additional research activities are required.

As described in (Maglio et al., 2006), technology is not the only resource, which must be engineered and managed in service systems. People, knowledge and organizations are equally important resources. Hence, the installation of SDPs will not be sufficient to enable efficient, effective and sustainable ICT service provisioning in telecommunications service systems. Resulting research issues address the management of such resources to optimally enable cooperation within service systems, e.g. by providing shared informational resources or by setting cooperation incentives (Spohrer et al., 2007).

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