



# WIRELESS WORLD

## RESEARCH FORUM

### Service architecture enabling advanced mobile applications from business model perspective

Ulla Killström, Bernd Mrohs, Luca Galli, Dario Melpignano, Olli Immonen, Björn Kijl, Christian Räck, Stephan Steglich, Heli Virola

**Abstract—** MobiLife Integrated Project [1], part of the Wireless World Initiative (WWI), in IST-FP6 is to bring advances in mobile applications and services within the reach of users in their everyday life. The emergence of technologies enables the introduction of new services. However, this is not enough for success in the future marketplace. In the dynamic and converging market new business models are emerging. They include new roles providing value-added services. A key enabling component in this evolution is the specified service architecture. It meets the challenges of the complex future structures.

**Index Terms—**Business models, roles, enabling architecture

#### Introduction

The IST project MobiLife aim to understand how the innovative mobile applications and services can be defined from business model perspective. In particular, the project specifies a service architecture enabling advanced mobile services supporting multimodality, context awareness, personalisation and group awareness while maintaining privacy of users. For this, we study business models in relation to the architecture, to analyse topics as stakeholders in the systems

In MobiLife we study the different components needed in modelling the business at application and service level. The emerging networks of actors - value nets -

are more dynamic and complex than the state-of-the art way of doing business. These value nets have more as well as new actors. Each market actor has one or more roles to perform and may participate in more than one value net. A role represents a set of functions that enables to make a mobile service and to deliver it to the environment. The roles define the business architecture in providing the services to the user. However, all this depends on how well the other architectural levels with several questions are settled.

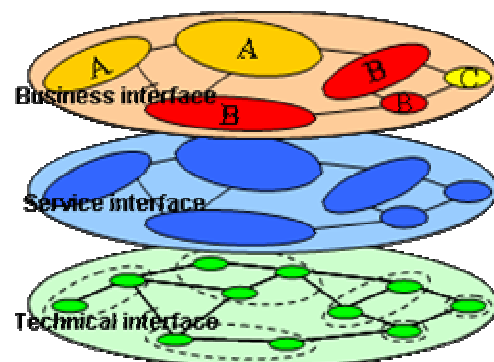


Figure 1: Different architectures as interfaces

Analysis from business modelling point of view is still ongoing and thus the discussions will contribute to the insights into the challenges in this area. This paper introduces the iterative process and methods used in defining the components and exploring the meaning of modelling the business for mobile applications and services. It describes the business architecture as a framework for modelling the business. Additionally, it introduces insights into the architectural questions and the need for “new” roles and

gives an overview on the resulting architectural specification and service lifecycle aspects.

## Research Process and Methods

The business modelling research is based on literature and public data survey. It has followed a constructive approach in analysis of business model frameworks. The research process has been iterative, considering the modelling topics at a high level, analysing the details for modelling, comparing the findings with general topics. The hermeneutic approach of the research has provided interpretations.

The *marketplace dynamics description* codified the state-of-the art academic, market research and media material from a series of different perspectives, covering the key facts and trends from diverse angles or point of views. We described the user perspective, society perspective, applications and services perspective, technology perspective, industry perspective and regulative perspective. The resulting picture is truly multidisciplinary and as rich as possible.

In order to focus on the most important topics (prioritizing) in the further research the main drivers and hurdles that shape the marketplace have been identified under each perspective. Their interaction will have a major impact on the future success and failure of new mobile applications and services.

The foundation of a *business model* has been seen as a set of basic assumptions about the components describing the theoretical framework for a business model. However, the aim in MobiLife is not to go through a complete set of approaches to determine the components of a business model but to understand the framework to be used in investigating the business models for future mobile applications and services.

Mapping the marketplace dynamics perspectives and business model components together we defined the opportunities and threats for future mobile business models.

MobiLife project investigates applications and services based on user scenarios. It has developed 11 different mock-ups of varying levels of fidelity which have been tested in a series of user studies. These mock-ups provided us examples to be studied further in *with-in case and cross-case analysis* in order to define the business model components.

The cases have enabled multiple levels of analysis within the project. By using these case descriptions we gathered qualitative evidence of the characteristics of different business model components in the future mobile based services. That provided us descriptions of each case. We used also cross-case analysis and compared the findings in order to specify those topics necessary for a business model and ended up to proposals. In this paper we describe the main findings in each of the component defining the business model. In particular we describe the roles, especially the new roles necessary but not sufficient components of the future business models.

## Business Models and Components

Business models have become a trendy concept. The background and also the reasons behind the sudden interest are in the Internet business.

Several authors have analyzed and defined the business model [2][3][4]. The definition have been made from value creation, industry, need for change, company strategy definition, managerial or just the modelling point of view. A good business model remains is essential for every company. It includes company specific definitions and brings clarity to the performance of the business. In MobiLife we have followed component based approach in our work.

The main motivation for choosing a component based approach comes from the strategy literature. All components included in a business model are also used in the strategy definition of a company. The components are: user/customer, products and services, earnings logic, resources, suppliers, organization and processes. All these business model components are necessary for the business definitions also in case they are provided by a network of companies.

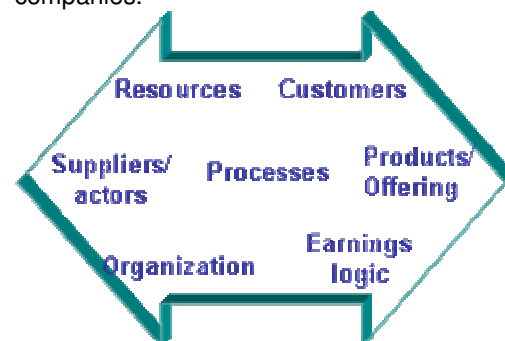


Figure 2: Business Model Framework

## **Users / customers**

A key question in building a business model is what type of customer benefit a firm should seek to provide, deliver utility to customers and earning a profit from that activity. Customer needs and expectations are always service or application specific and they vary depending on the customer segment. Customer perspective is important for the company also in differentiating itself from other service providers with a unique and valuable proposal.

The characteristics of value creation are useful in determining the business model. As common characteristics usefulness and convenience have demonstrated to be taken in the highest regards by the users, both in the mobile business and in the Internet world. On the other hand, emotional and irrational needs are important drivers as well. The balance of these factors should be searched. Trust and privacy issues are important from user's point of view and have to be included in all future services.

A company's relationship with a customer is an access channel to the customer's ongoing value-creating activities [5]. Companies have to collect information through various means, including market research and information gathered from the field in order to fully understand people's needs. The process can be costly and time-consuming because people's needs and expectations are often complex and subtle. In business modelling the demographics (e.g. age, educations, incomes) are not sufficient definitions. The use of services or products, things like lifestyle, values and past usage experiences seem to affect strongly the adoption and usage of products and services. Customization is used to create services modified according to the users needs. In the future the importance of user research further increases from business modelling point of view because the customer priorities have a natural tendency to change: business models tend to stay fixed.

Innovations in the mobile business have quite often been dampened by the predominance of technology-led approaches. MobiLife project is trying to avoid this mistake by clearly identifying the expected user's benefit for each designed application and services concept, testing it in user research cycles that complement social acceptance and business viability analysis in a newly integrated fashion.

The management of the customer relationship portfolio is identified as one of the most crucial aspects in the management of a company's business model. Customer relationship management processes, are key tasks that address all aspects that identify customers, create customer knowledge, build customer relationships and shape their perceptions of the organisation and its offerings [6].

## **Products and services**

The product and service component is the one in which customer value creation has to be reflected. Accordingly, to develop products that ascertain optimal customer value creation is the firm activity main objective. The creation of value for buyers can be either in the form of differentiated product or one produced with lower costs [7].

Value proposition includes a description of all relevant value elements and drivers identified as important for the future mobile business models. This business model concept should work as a guideline for the entire product development process. In this context the product development can be seen as one value creating process [8].

This has also a direct impact on architectural issues as it points out the need for an infrastructure designed in a way that fully supports the mobile products and services management process, from initial prototyping to progressive deployment and subsequent iterations, including contributions from relevant third parties (e.g. external content providers, context information provider and so on).

More in general, the company has to meet also the same challenge as all technology-enabled businesses - the value proposition is dependent on the technology adoption life cycle [9]. Technology-based products pass through multiple phases of adaptation during which the market i.e. customers behave in different ways, that are specific to each phase. The company needs to be aware of the user acceptance as well as of the overall market situation. If end-users are already familiar with the substitute products in private life or in the work sphere there is for instance a better probability to achieve a successful match.

Moreover, product and service managers in different companies have to cope with the

challenges of an increasingly networked world. Interdependent players will not switch to new products unless they believe other players will [10].

Applications are an essential element of the services offered to customers in advanced mobile and wireless environments. As the telecommunications market shifts from voice-centered offers to differentiated usage situations it is important to clarify what it is distinctive of services in principle and what is related to service management processes.

Regarding the service concept, four special service characteristics should be highlighted: intangibility, inseparability, variability and perishability. But the key factor for making a difference in the dynamic marketplace is providing a customized experience.

Modularity is a key concept in challenging the demand for customised products and services [11][12]. When managed strategically, modular product, process, and knowledge architectures enable firms to create greater product variety, introduce technologically improved or new products more rapidly and lower costs of product creation and realisation [13]. Modular architectures also affect the processes inside the company as well as between different companies in value net.

Intelligence through continuous information exchange with users/consumers allows companies to create products and processes using the best possible modules. The MobiLife process of iterative development cycles demonstrated that active user involvement in enabling technology evaluation (with application and services testing) is a way to align the technological architecture and components development with user expectations. E.g. the need of a visually rich and clearly understandable user interface for group management features prompts the development of a group management common component with an efficient and appealing interface metaphor; this common element can be applied to the specific applications that better match some specific user need.

More importantly, the dynamic customisation of products and services requires an organisation that is fundamentally committed to operating in this new way. Product or service modularity requires the partitioning of a task into independent modules that function as a whole within an overall system as well as business architecture. The main aim for the company is to provide greater customer

satisfaction and in some cases also lower costs.

The Internet impact has to be also taken into account. Web service and interfaces have accelerated and redefined the possibilities of a remote product or service experience. Now that every company has to assess how its products and services can be experienced in the new marketing infrastructure a number of interactive channels have to be made available.

The question is how best to use the Web's power to create superior linkages with customers [14]. This is firstly a strategic issue but one that put some important requirements on business and technology infrastructure, as customers access products and service from a range of interactive and personal devices.

Then the Internet catalysed the process of digitisation that now has transformed every media. This process challenges current device and channel specific approaches, pushing towards a truly seamless multiple devices and multiple channels user experience.

### **Earnings logic**

The earnings logic component of the business model spells out how organizations create revenues. When services are offered by a group of organizations in a value network, also attention needs to be paid to how costs and revenues are shared within the value network [15]. Therefore, organisations have to balance different interests and earnings logics to create a 'win-win' situation, in which each player has incentives to co-operate. Important concepts within the earnings logic component of the business model are the following:

- (1) Costs,
- (2) Revenue model and pricing,
- (3) Investments,
- (4) Division of costs and revenues.

The earnings logic component defines the financial arrangements between actors in the value network by describing how the profits, investments, costs, risks and revenues are shared among actors. Different standard forms of revenue models can be distinguished, like advertisement, subscription or usage based models. Bundling a new service with existing products or services may be interesting as well.

Typically the arrangements are not static but change over time. So the concepts mentioned before are dynamic variables that may respond to changes in other variables, either in the earnings logic component, in other business model components, or in the external environment.

The development of a new service goes through phases, which leads to changes in the financial arrangements within each phase. In the technology phase and implementation/roll-out phase, research institutes, entrepreneurs, and venture capitalists may play an important role [16]. Mostly, small companies take more risks and are, unlike established companies, not dependable on existing businesses. In the market offering phase big companies like telecom operators may become more important. They have marketing power, a big existing customer base, and can profit from economies of scale. All these players have different earnings logics. So, over the life cycle of a new service, different financial arrangements are needed. Scenarios for investments, costs and revenues may be used to capture future uncertainty.

In order to be able to share revenues in value networks (especially in the market offering phase), a service architecture is needed that is able to accurately monitor the actual usage of services and that has an advanced billing system for collecting, reporting, and sharing the revenues. Also performance measurement may be important in this context.

If the earnings logic is not clear, there is no viable business model. Therefore, earnings logic is one of the most crucial business model components.

#### **Resources** (technology, capabilities)

Allocation of human, technological and financial resources - that are either owned or controlled by the firm - are all important in creating a business model for the firm and defining concrete plans to implement it. Resources can be divided to tangible ones like people, equipment, technologies, and cash; less tangible ones like product designs, information, brands and relationships with suppliers, distributors, and customers.

Capabilities refer to the firm's ability to exploit resources in order to accomplish its targets. Capabilities are related to internal operations (production, delivery and product innovation) and managing inter-organisational relationships (cross-firm management, SCM

& CRM capability, partnering and network orchestration). A set of capabilities is generally required to produce any type of value.

The technology resources and capabilities required in MobiLife type of applications include advanced terminal software, powerful and compact computing platform, fast and flexible network connectivity, sensor integration, and hardware and software elements for the user interface. The server technology includes advanced personalisation logic for handling large amounts of information.

A large information base of personalization data covering users from different groups and locations, is required having a critical mass for personalized applications. International presence and the capability to local partnering are necessary for successful deployment. A good brand image helps creating trust.

A capability related to specifically mobile applications and services is developing intuitive user interfaces with minimal interaction by maximal utilization of context and personalization.

#### **Suppliers/actors**

The development, implementation and exploitation of new mobile services mean that different type of actors is needed. A business model describes in this case how these actors co-operate in creating and capturing value from new innovative services and products as a network of organisations. The importance of the actors varies according to the development phase of the services. Research institutes as well as entrepreneurs may play an important role. In the market offering phase, players like telecom operators become more important.

In essence, the service concepts to be developed are mostly global applicable. However, because a lot of future mobile services are context dependent, also local organizations (like museums, restaurants, public transport companies, etc.) may become increasingly important actors of future mobile service value networks (at least as information providers for or as providers of products or services related to context dependent mobile services being used by end users).

Also new roles like context information or personalisation providers are expected to emerge. It has to be noticed that the roles can be performed by existing companies like telecom operators, IT and other Internet companies or we will see an entry of new types of actors who create their business around though new roles.

#### **Organization** (architecture, orchestration)

The amount of relationships between organisations in mobile service value networks is growing and increasingly complex. In this environment organisations can only capitalize a technology if they define a viable business model that pays attention to the service architecture, information, knowledge and money flows between all needed business actors, what their roles are, and what the potential benefits for the various actors are.

The orchestration of the co-operation between different actors is necessary and has to be clearly defined. In co-operation between a selected, persistent, and structured set of autonomous firms, governance processes and governance mechanisms are included in business level architecture definitions. These organizational arrangements are dynamic and related with lifecycle phases of a service. In the end, scalability in service provisioning is necessary for success in the marketplace.

In future, more services will be provided using dynamic organisational arrangements. However, interorganisational ties still need agreements between different actors regarding their roles, agreements of provided service levels, revenue and investment sharing and other kinds of compensations. The confidentiality of the user and service information as well as authentication decisions of different actors/roles are also part of these agreements. Key questions are who is responsible of what in service provisioning. The strategies of different actors have an impact on their desire to manage a role. The capabilities and resources they provide for the value network define the power they have in defining the governance systems and the rules and discipline mechanisms in the network.

#### **Processes (service provisioning)**

For provisioning the new services the needed processes should be concretely described in a business model. Processes are very much dependent on what the services developed will be and what are the roles of different

actors. Processes between different actors are slow to change and it is very important to start analysing them at early stages of applications and services development in order to be able to take into account all needed aspects. The new applications have to be connected to the existing processes of different companies in the definition of a business model. The common way to structure the processes (e.g. like eTOM in telecom industry) is needed in doing business in an open value creation system and open market. Different kinds of processes are developed and utilised (e.g. user centric design) throughout the MobiLife project and they can be utilised when describing processes for the business models.

The traditional thinking about supply chain management is moving from suppliers to thinking about partners, relationships management, and networks. Bovet [17] defines value net as a business design that uses digital supply chain concepts to achieve both superior customer satisfaction and company profitability. According to Bovet a value net is not just about supply but about creating value for customers, the company, and its suppliers. Nor is it a sequential chain, instead it is a dynamic, network of customer/supplier partnerships and information flows. This change has an impact on the business model definitions.

The traditional supply chain manufactures products and pushes them through distribution channels, in contrast value net begins with customers, allows them to self-design products, and builds to satisfy actual demand [17]. Difference to concepts of traditional supply chain processes and management is in description to highlight dynamic, collaborative, and agile nature of the new markets. In the markets that are enabled by digitalisation and ubiquity of communication networks where the ability to strategically reconfigure supply chain if needed is crucial.

### **New roles and architectural challenges**

In the future mobile service provisioning the traditional roles still exists and they will meet minor changes in value drivers and earnings logic. However, the new possible roles - personalisation provider, identity and trust provider, and context information provider- are necessary in future business models.

### **Changes in traditional roles**

There are traditional business roles (e.g. network provider, application developer, device manufacturer, content provider, advertiser etc.) that are still needed in new mobile service provisioning. However, changes are needed to be able to respond to the new challenges in the business environment and to collaborate in a new way with existing and new players in the value net.

For the user the new mobile services offer more possibilities to influence or to directly participate to the product or service design or delivery. This can lead changes not only in the user role but also e.g. in service provider role when closer communication with users is needed. As virtual organizing becomes more widespread, companies must recognize communities as part of the value delivery system and respond appropriately in their strategies. Previously, in the industrial economy, consumers could not be effectively linked together across time and space. The emerging global, digital economy allows for establishing and leveraging a two-way information link between a company and its customer [14].

Also the existing roles can be taken by new actors. An example can be taken from payment processing. Beside network operators, which traditionally have had the only billing relationship with the customer, other parties such as banks, specialised billing companies and mobile commerce platform vendors have the opportunity to get involved in this activity.

### **New roles**

The research based on MobiLife cases (applications and services) points out the new roles; context provider, personalization provider and group awareness provider. The definition of these roles depends of the actor who is going to provide them. There are a lot of uncertainties on the marketplace and there are no evidences that the existing actors are interesting in covering it. The new roles are included in the business architecture together with the already existing ones.

#### **The context information provider role**

Context information refers to a very broad range of data and descriptions; it can be related to time, location, network connections, applications, sensors, remote sources as well as higher levels like being

with a group of friends or family members [18].

The impact of this potentially sheer amount of granular information and data flows seems quite evident from the point of view of processes, systems, storage and transactions operations, including billing.

On the other hand it is questionable that this is going to create favourable conditions for a new player to step in and build a distinctive positioning in the value network. It may be that context information just increase the complexity that existing players e.g. operators have to tackle with.

In terms of user benefits, context-awareness and automatic reasoning allow to make information and services distinctively convenient and adapt to the specific conditions of a given situation. These context and reasoning capabilities are mainly expressed through representation of single user and/or group whereabouts as well as identification of services (offline and online) relevant in a certain location (e.g. ticketing system at a bus stop station). Proactive service discovery mechanisms thus make these applications radically different from existing Internet services (even if used in a mobile setting), prompting a shift from the user having to search browser pages to the user being proposed information and services when they are really needed.

From an organizational and technological point of view, this means generating, managing and updating a very big amount of context-information. To make the related services flow requires a wide range of players to collaborate in a very efficient way.

As the sources of revenues may be differentiated, ranging from company-funded customer support to premium services or advertising, technological architecture should allow the organizations operating in the value network to track down the related money flow, enabling revenue sharing and appropriate redistribution mechanisms.

It is then evident that the context provider role is new and of crucial importance. This role has to interface many others and requires an increased ability to manage inter-organizational process and business agreements. Considering the current market structure, operators seem to be the most likely actors for this role and this could greatly reinforce their central stance in the mobile and wireless value network – and adding at

the same time a relevant workload to their daily operations.

Let us consider an hypothetical application that would allow an user to benefit from swift changes in her conditions (leaving a certain location to catch a bus, waiting for it at the station, having a ride on it etc.); for each of it a set of services is pre-selected and pro-actively offered exactly because they matches opportunities and constraints of that specific condition. In a similar scenario a transportation company may act a simple intermediary of information collected e.g. by an operator from a various service providers; but the integration of them with e.g. a service related to the situation (e.g. the ticketing system) still requires that every system involved has proper interfaces and customizable characteristics at the application (including the user interface).

Let then us imagine an application that address a better usage of leisure time for groups and individual users; it could rely on the availability of context information from a vast array of differentiated sources, including the users as creators of content, events and social initiatives. The broad heterogeneous nature of these sources will have to be supported by the technological architecture, allowing inputs in various formats and managing identities at the individual and group level with several privacy and trust policies.

#### **Personalisation provider role**

Personalisation i.e. adaptation based on profiles and preferences is especially important for mobile information and entertainment services because of usage environment: need to present the data of personal interest with minimal interaction.

Personalization can be seen as a competitive factor of a service or an intelligent user terminal. But it can also be seen as a business role: personalization provider. In this role, a company has the capability to create personalization information, e.g. using automation (learning), and owns or controls a collection of personalization information that covers a wide audience and is applicable to a wide set of services oriented to a particular content. The company needs to manage all technical, organizational, regulatory and social aspects involved.

Personalization means intimate knowledge of the customer and the ability to offer a suitable service for the individual at appropriate time

and place. That is why personalization is linked to trust: it requires trust to let a business party to manage user's personal data. Again, a party handling the personal data well can gain trust. Such link can be relevant in the architecture.

Advertising is seen one possible source of earning for future mobile services. Efficient advertising needs to be targeted to a certain audience which means a link to personalization.

As an example taken from MobiLife application mock-ups the users with some specific needs and in a specific situation, like parents with babies visiting a non-familiar city or area and wishing to find places suitable for visiting with a baby e.g. a place for warming up baby food, receive relevant information based on their personal needs at a certain place, time and activity (personalization and context awareness). Targeted advertisements, e.g. related to events nearby and bargains well suited for the particular consumer group, are part of the received information. A potential service provider would need to collect a sufficiently large user base with personalization data (preferably using automation and learning) in order to have a target for automated information push and advertising. Personalisation is the central part of the complete service and it may be justified to consider that as a separate role while other functions such as collecting local tourist information and creating local advertising network would be distinct from that.

From mobile services architecture point of view, the possibility view personalization as a business role, requires that enough flexibility to have the architectural components related to the personalization and function either part of the user terminal, the (content) service, content aggregation service or separate.

#### **Group awareness**

Just like personalisation and context awareness, group awareness can be seen as one of the main building blocks for future mobile services. Group awareness is a specific form of context awareness: a service is group aware when it is based on context information for and about groups. The buddy list in popular instant messaging clients like MSN Messenger can be seen as a group awareness service. Group awareness services will be an increasingly important element of online community and

communication services, in a fixed as well as mobile context because they support people in choosing between different types of interpersonal communication (voice, instant messaging, SMS, mail, etc.) as well as help them to stay in touch and maintain peripheral awareness of each other's whereabouts and activities.

The real time registration and distribution of group awareness information is a complex and highly interconnected task from organizational as well as technical point of view. A generic group awareness service (e.g. in the form of a buddy list) can be seen as a central service on which other group based services can be built. It is also a complex one: the group awareness provider needs to have interfaces to a lot of different other players (e.g. different communication service providers). Therefore, managing inter-organizational processes is becoming an increasingly important aspect.

The group awareness role can be part of telecom operators' service because they already have a lot of basic context information (e.g. location information, online/offline information, segmented customer data). The registration of group awareness information generates traffic and could therefore be strategically important for operators also from a financial perspective. Companies like Microsoft, AOL, and Yahoo! may also become increasingly interested in offering group awareness services in a mobile context because of their already strong positions in 'fixed' group awareness services in the form of presence & instant messaging services on personal computers. Of course, also organizations that already offer online community services may be seen as important actors in this context.

Revenue sources for group awareness information providers may differ from subscription fees from customers, selling group awareness information to other service providers, and advertising, possibly based on revenue sharing mechanisms.

As an example we could consider a new group awareness service that supports light-hearted, effortless context-aware interpersonal communication and helps people to stay in touch and maintain peripheral awareness of each other's whereabouts and activities over extended periods of time. This service capitalizes on trends like being always in touch with your friends, continuous communication between friends and technical trends like the

emergence of presence awareness technologies. We expect such a service makes use of asynchronous (IP-based) digital communication (for the distribution of presence information) and may trigger synchronous communication traffic as well (as a form of conversational content). In order to offer such a service, a flexible technical infrastructure is needed that can manage and distribute real time status information via different networks and devices. Identity management as well as trust and privacy management play an important role here as well.

### **Architectural overview**

The initial specification of the MobiLife architecture is described in [20][22]. The specification process is still ongoing. This document described the MobiLife Reference Model that includes the following functions:

- Privacy and Trust Function (PTF)
- Personalisation Function (PF)
- Context Awareness Function (CAF)
- Group Awareness Function (GAF)
- User Interface Adaptation Function (UIAF)
- Service Usage Function (SUF)
- Service Provisioning Function (SPF)
- Operational Management Function (OMF)

It covers the technical interface layer of Figure 1.

The detailed description of these components can be found in [20]. Here is a short overview of some important fact for this document.

Future mobile services and applications deal with data related to the user which raises the issue of trust and privacy of the personal user data. Therefore, the PTF has been introduced to the MobiLife Reference Model, ensuring privacy and trust through specifying a trust engine and defining privacy policies.

The PF provides profiles and preferences of users and groups to the service, applications and MobiLife components, and supports learning of user and group interests as well as user and group preferences.

The CAF takes care of raw, interpreted and aggregated context data. This function handles context data related to individual

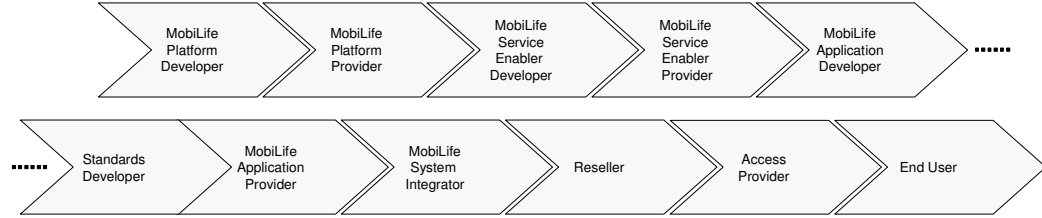


Figure 3: MobiLife Value Chain Stakeholders

users and to groups of users. It supports the service developer by providing users' and groups' current context information through well-defined interfaces. New context information and changed context information can be notified to interested components and application services, and context information can be requested from the CAF. The Context Provider (CP) specification defined in CAF enables developers to create own context provider.

Various Context Providers are already available. They form high-level MobiLife framework services available for service developers to create MobiLife services: Location CP (delivers location data), Preference CP (provides preference data), Weather CP, Wellness CP and Presence CP.

The GAF supports applications and services dedicated to groups by managing groups and managing group preferences and information.

Today, a great variety of mobile terminal devices exist that users can employ to access services. The devices are heterogeneous with respect to their capabilities to handle input, present user interfaces or the media they support. Additionally, network capabilities are also changing when using mobile devices to access a service. In consequence, the UIAF is needed to properly handle these discrepancies and provide the best user experience. The UIAF provides functionalities to allow service developers to make services available through multiple devices using multiple modalities.

The SUF covers all aspects related to the service usage; in particular it covers every step in the 'timeframe' between service discovery and service offering. SPF holds a repository of services known to the system, their descriptions and properties and offers

functionalities for service discovery, proactive service provisioning and service composition.

The OMF supports the management of the whole lifecycle of services.

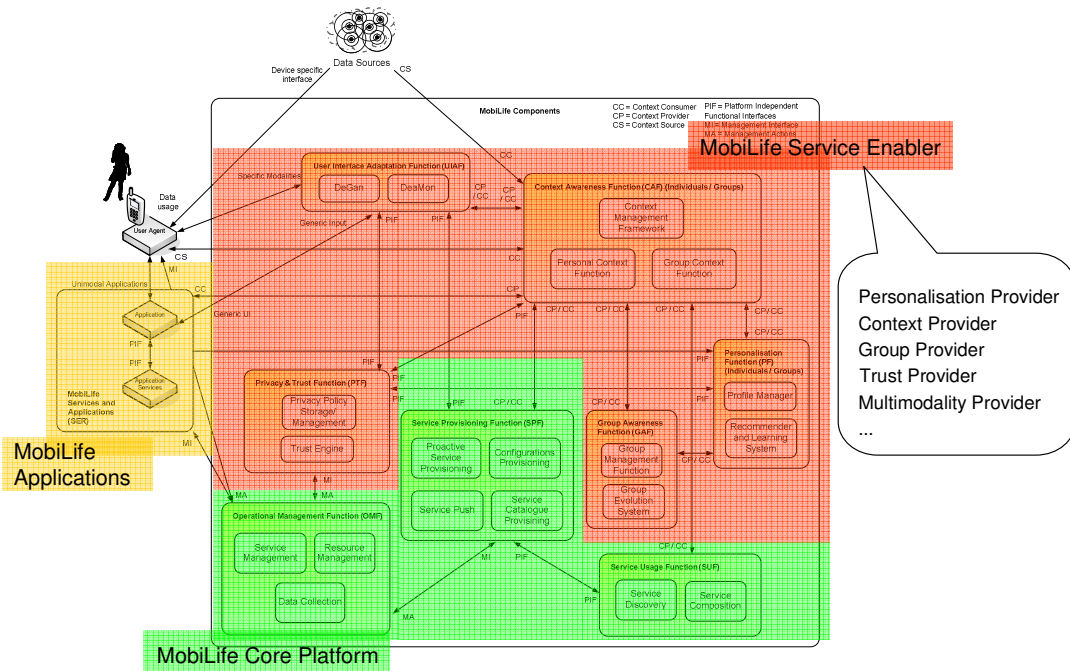
## Impact and architectural Overview

### The MobiLife value chain

The provisioning of mobile applications and services will be done in a value network in co-operation between different actors and roles. The identified new roles will have a significant impact on the traditional e-commerce and mobile service value chains [19]. However, from architectural point of view the provisioning can always be described as value chain. The MobiLife value chain, shown in Figure 3, describes a series of roles and functions that needs to be addressed in order to offer and manage MobiLife services and applications.

The MobiLife value chain has the following stakeholders:

- *MobiLife Platform Developer:* Implements (creates, develops) the MobiLife core platform following the reference architecture.
- *MobiLife Platform Provider:* Runs the implemented MobiLife core platform. The platform does not include the service enablers nor the actual applications.
- *MobiLife Service Enabler Developer:* Implements MobiLife service enablers based on the core platform. Service enablers are low and high-level framework services that provide services with personalization,



**Figure 4: Potential Stakeholders and the MobiLife Reference Model**

context, privacy support and group support.

- **MobiLife Service Enabler Provider:** Runs and maintains MobiLife service enablers.
- **MobiLife Application Developer:** Develops MobiLife applications, based on the MobiLife specifications.
- **Standards Developer:** Develops standards based on platform, service enabler and application work.
- **MobiLife Application Provider:** Runs MobiLife applications.
- **MobiLife System Integrator:** Integrates core platform, service enablers and services into a running system.
- **Reseller:** Creates service bundles (based on different applications and service enablers) and sells them to the end user.
- **Access Provider:** Provides general access to MobiLife system; e.g.; telecommunication service provider, Internet service provider, etc. It is not specific to the MobiLife value chain.
- **End-User:** Uses MobiLife service and applications.

MobiLife Service Enabler Developers and Provider are a direct result of the identified new roles. They can offer services related to personalisation, context management, privacy management and group support. They represent most probably the biggest variation of the traditional mobile service provider stakeholders [19]. These new roles extend the today's common mobile service value chain significantly adding important new players.

The introduced MobiLife value chain enables a number of various approaches to modelling the business.

**Architectural approaches to business models**

There are several possible possibilities to combine the different architectural role and functions definitions in order to develop reasonable and functional business models for future mobile applications and services. However, all these approaches to modelling the business will most probably summarise three different domains on the technical interface layer (Figure 1), based on identification of potential stakeholders and the functional separation of the MobiLife architecture's components:

- The **MobiLife Application** domain,
- The **MobiLife Service Enabler** domain, and
- The **MobiLife Core Platform** domain.

With regard to the separation and distribution of the MobiLife system components, basically, every reasonable business model can be regarded in two dimensions:

- An **open** model features several companies playing the roles of *MobiLife Application Providers*, as well as for *MobiLife Service Enabler Providers*. This means that those functional components can be operated by different companies and that therefore common reference points / interfaces between the different domains are needed in order to specify their interworking.
- In contrast, a **closed** model features one company operating and providing all MobiLife applications and MobiLife service enablers. The development of those components might be still done outside this company.

Of course, there also combinations of these options possible. So, the actual degree of openness can be between the two extreme views, described above.

One possible approach to business modelling might feature a stakeholder that combines the roles of *MobiLife Platform Provider and Reseller*. The stakeholder hosts all components from the three domains (either exclusively or not depending on the aspect of openness, as described above). In this model, the end-user has a direct relation (contract) to this stakeholder in addition to a relation to one or more *Access Providers* of his / her own choice. The *MobiLife Platform Provider* operates the system without any direct access to 3<sup>rd</sup> party (access) provider.

A second approach to business modelling might feature the cooperation of the *MobiLife Platform Provider and Reseller* and the *Access Provider* offering MobiLife applications directly to the end-user. For example, a mobile network provider can provide additionally MobiLife application and services in connection with its actual communication services. So, customers of this mobile network operator can subscribe to these added-value services just by extending their existing contract with the same provider. In this business model an end-user has therefore only one relation to a stakeholder since he / she gets all needed services from one source.

Another thinkable approach might feature a combined *Access Provider and Reseller* as one stakeholder in addition to a separated (3<sup>rd</sup> party) *MobiLife Platform Provider*. Here, an end-user has a relation to the *Access Provider and Reseller*, whereas this stakeholder in turn has a relation to (a contract with) the *MobiLife Platform Provider*.

It is possible to think about a fourth approach to business modelling that is more or less similar to the first business model with the exception that the *MobiLife Platform Provider* has a direct relation to some *Access Provider* in order to extend and improve the provided MobiLife services and applications by additional functionalities offered by the access provider. So, the end-users subscribe MobiLife services and applications directly with *MobiLife Platform Provider*, which contracts some services from *Access Providers*.

The fifth possible approach to business modelling assumes a completely open system, in which the end-user directly subscribes all needed services. So, there is no single reseller offering the MobiLife applications to an end-user. In this model, there are different (and any number of) *MobiLife Application Providers*, *MobiLife Service Enabler Providers*, and *MobiLife Platform Providers*. This loosely coupled approach makes it necessary that an end-user has several relations (contracts). At least, one relation to each stakeholder that offers a service that is relevant to an end-user is needed. The challenge in this model is obviously to enable and to ensure the cooperation of the different parties and deal with the complicatedness maintaining the different relationships a customer has.

### **Impact to the MobiLife architecture**

Supporting the new roles needed for future service provisioning and the potential business models has a strong impact on the specification of the MobiLife architecture [20]. Some impacts were already reflected in the requirements analysis of the MobiLife service infrastructure [21]. Additionally, the roles and business models influence the ongoing specification process, i.e. they impose a further refinement and update of the MobiLife architecture specification.

The described approaches to modelling the business all assume three architectural domains on the technical interfaces layer: *MobiLife Applications*, *MobiLife Core Platform* and *MobiLife Service Enabler*. They can be recognised in the *MobiLife Reference*

Model [20][22] through a clustering of the functionality, see Figure 4. The MobiLife Application domain consists of MobiLife Applications and Application Services. The MobiLife Core Platform is defined through the functionality of OMF, SUF, and SPF. The remaining functions belong to the MobiLife Service Enabler.

The functions specifying the low-level MobiLife Framework Service UIAF, GAF, PF and CAF are one part of the MobiLife Service Enabler. More Service Enablers are defined through the High-level MobiLife Framework Services. These are specified following the Context Provider specification [20]. Some examples of resulting MobiLife Service Enablers are:

- Personalisation Provider
- Context Provider
- Group Provider
- Trust Provider
- Multimodality Provider

Service Enablers have to follow the Context Provider / Context Consumer specifications. As developers can create further Service Enablers using this specification, the above list introduces only some examples of available Service Enablers. The broad heterogeneous nature of context sources is covered in the MobiLife architecture through specifying interfaces and data formats for hard- and software encapsulation Context Providers.

New roles and business models have also influence to other parts of the MobiLife architecture specification that are described in the following.

As the three architectural domains and their components inside respectively can be developed and provided independently from each other, the MobiLife architecture specification should follow the service oriented architecture approach (SOA). The loosely-coupled principle is used for defining all MobiLife components. The components will have a clearly defined interface and no unnecessary coupling. The MobiLife architecture specification following the SOA approach will inherently support openness and scalability. Modular approaches are indispensable for today's demand for customised products and services [12] and the processes inside of and between companies as described above. The particular components run stand-alone. Only

functional relationships that are really needed should be incorporated.

Because all components in the three architectural domains can be developed and provided independently of each other, they have to offer component deployment descriptions and interfaces for lifecycle management (starting, stopping, etc.), accounting, etc. These interfaces must be clearly defined in the MobiLife service infrastructure specification. This is also an important step to deal with the challenges of the increasingly networked world that product and service managers face today.

Facing the revenue sharing described above, the MobiLife architecture has to support operational management functions beyond the lifecycle management, including accounting features. To be able to share revenues in value networks, system and application monitoring is needed to support billing systems for collecting, reporting, and sharing the revenues. Accounting features have also to be offered for the MobiLife service enablers, so that attaching billing systems is also possible here.

The interoperability of the MobiLife system components of the different architectural domains (within each domain, but even more important among the different domains) has to be enabled through a careful architectural specification. According trust relationship and security mechanisms are needed to facilitate a cross-domain interworking,

### **Conclusions and next steps**

In the MobiLife project the business modelling process will provide us as a result an understanding of how the process can be executed at the same time of the technology development process based on user centric design. It further provides propositions of the key issues that have to be taken into account in modelling the business at application and service level.

The research process is gradual and still continues. In order to have a good picture of the modelling topics and the key issues having impact on the success of new business models the following challenges still have to be tackled:

- Earning logic is one of the critical topics in business models. It is still unclear which revenue model are the most appropriate for exploiting MobiLife kind of services.

- Mobile service value networks are getting increasingly dynamic and complex with new as well as more players. The topics enabling or hindering that development are still undefined.
- There are new roles needed for the future mobile business. These roles have strategic importance for many already existing actors. However, some scenarios of the future socio-economic development are needed in order to describe under which kind of environmental development the new business models based on mobile applications and services will reach market success.

Taking the architectural impacts into account when specifying the MobiLife service infrastructure will lead to following achievements:

- This specification enables a rapid development and deployment of new and innovative services and applications, because developers can create and contribute service enabler and applications independently of each other.
- It opens service and application creation to Third Parties while protecting the Service Provider assets.
- It has the chance to significantly broadening the developer pool.
- The specification will lead to a development of an evolution path for an integrated and unified service enabler environment.

The impact that the new roles and business models have to the MobiLife architecture will be taken into account in the further specification work. The interaction process between business model development and architectural relation is ongoing throughout the whole project.

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