Architecture Model for a Service Delivery Platform supporting mobile distributed services in interoperability networks shown by the example of mixed reality applications

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Abstract

"Anytime and anywhere interoperability" generates very high requirements on hard- and software architectures in core backend systems because mobility services and applications must be accessible all the time. (Umar Amjad, 2004) At the technology level, ambient services are routed to different core networks. On the client side, interoperable mobility services distribute applications to different client types. One problem is that the possibility to develop and operate such services is dependent on the type of application fields. Moreover new classes of multimedia applications shown by the example of mixed reality applications raise additional issues with regard to interoperability. Such applications combine the real environment and virtual reality items.

A service architecture model supporting concurrent development and operation of different technologies and platforms is very challenging but a necessary precondition for handling mobility application scenarios regarding everyday things. The aim is to identify the technological requirements for a universal architecture model supporting services and interfaces from different technology platforms with particular regard to both the development and the operation of those services. (Cordier Christophe, 2005)

The objectives focused on in this PhD research are, firstly, the consideration and analysis of the lack of existing architecture models supporting the interoperability of services of different requirement levels and, secondly, the location/definition of new architecture appendages for developing and operating new classes of applications (mixed reality applications) including identified options/other models for combining IT-, fixed and mobile network environments by using the IMS (IP Multimedia Subsystem) technology. A further part of the research covers the identification of enablers for service adaptability (load mixed reality applications, for instance 3D data on demand) to find methods of resolution for the basic problem of distributed data sources in the context of mixed reality applications. And last but not least the identification of new operation business models are also part of the research.

The paper focuses preliminary on problem findings and outlines the research starting from the problem statement and the description of building a conceptual framework to the point of a proposed solution and an architecture prototype definition based on a functional architecture. The selected research methods are based on applied science access using the deductive/inductive process for the development of a theory and prototyping for verification of the theory.

1. Introduction

Interoperability between different types of user devices and core systems are not ubiquitous for the operation and the development of mobility services anytime and anyplace. Mobile and wired/wireless applications and services become everyday things. The challenge is how to help users in making their everyday life easier! (Klemettinen Mika, 2004) One aspect for those applications named “Everyday’s life applications” using for instance location based services for searching and showing the next ATM in the nearly environment of the asking user are located yet. Ambient networks and services support these applications with the power to link different types of core networks. (for example a ADSL to a GPRS network) At the moment there are no systems to support and connect different types of mobile user services to the right backend system and to offer operations and development together. This research focuses on the gap to be filled between ambient networks and “Mobilife” applications. The following figure supports the understanding of this problem.

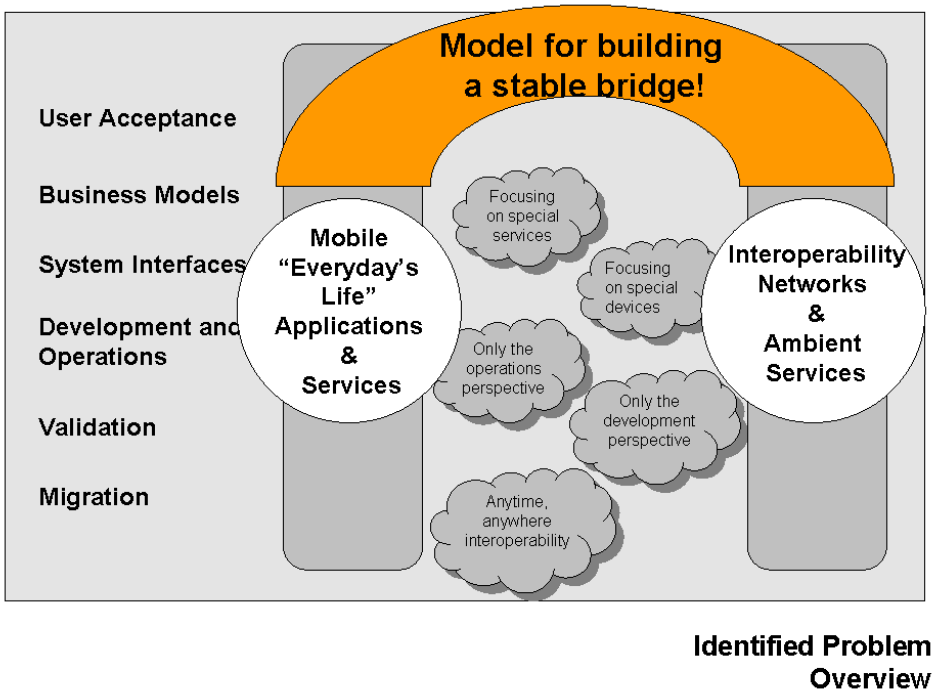


Figure 1. The present consisting problem anytime, anyplace interoperability
(Source: Bergaus Martin, 2006)

The aim of this research work is to identify an architecture model which are the basis for defining and developing a “Mobilty Service Delivery Platform” to connect Mobilife applications and services to interoperability networks and ambient service focusing on an common approach to handle many kinds of applications and services on different device types, platforms and core networks. (Cordier, Christophe, 2005; Martin Bergaus, 2006) The anytime/anywhere approach and operations as well as development of those services is a must of this new architecture model.

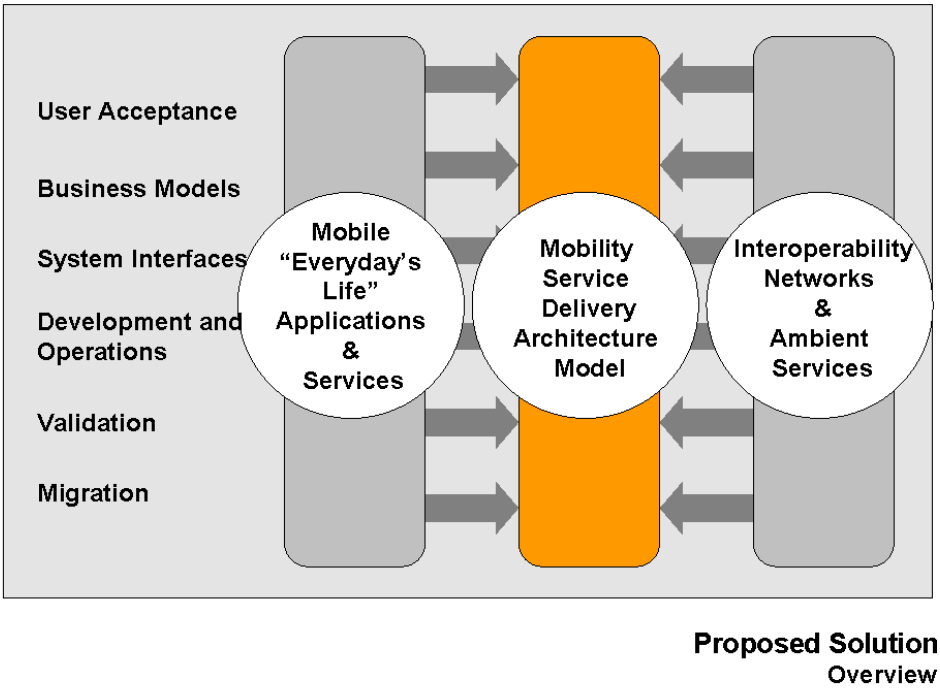


Figure 2. The proposed solution – develop and build a Mobility Service Delivery Platform (Source: Bergaus Martin, 2006)

The output of the my research work will be an architecture model using in the Mobility Service Delivery Platform regarding aspects like user acceptance, different operator business models, system interfaces, development and operations, validation and migration. On very interested point here is the analyzing and building of models for Service Mobility regarding intelligent mobile applications and ambient networks to discuss aspects of a service architecture for the development and operation of interoperable services. The research identified that IMS (IP Multimedia Subsystem) is the basis technology for defining and building this architecture model. IMS is the enabler to combine services and applications in mobile cellular phone networks and IT networks. (Miikka Poikselkä; Georg Mayer; Hisham Khartabil; Aki Niemi, 2004) Moreover to focus on a new class of distributed applications (mixed reality applications) the model will focus on model specific options regarding the support of those kind of applications. In this context the research identified three very important aspects for working with mixed reality applications: (Balcisoy, S., Kallmann, M., Fua, P., Thalmann, D., 2000)

- Tracking and elaborateness of tracking methods regarding the usage of a new class of distributed applications. (mixed reality applications)
- Collaboration and exchange of user data regarding the usage of mixed reality applications.
- And last but not least the very important question about the distribution and storing of 3D data regarding mixed reality applications.

2. The Concept of the Model Architecture

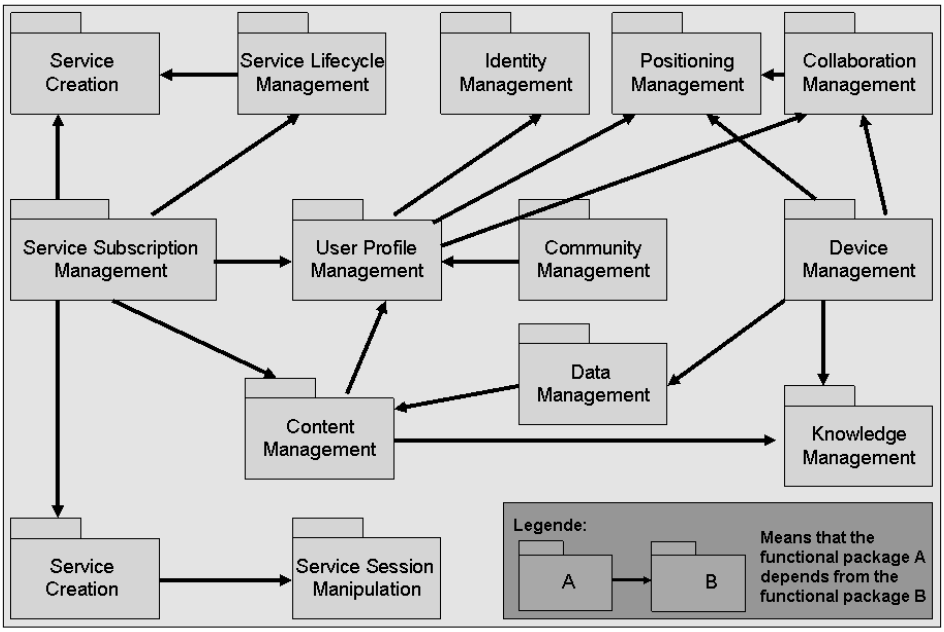
The global vision of a Service Delivery Platform is to design, develop, evaluate, prototype an extendable overlay architecture and framework that

- supports an easy and quick service creation of intelligent and ambient aware services, cooperation of multiple heterogeneous execution environment, seamless delivery of services across operators domains, networks and terminals
- provides ambient service enablers and investigate seamless services delivery aspects of the service platform level
- assists easy and seamless access electronic services and applications
- facilitates end-to-end communication based on an open architecture supporting fast service and content control boosting end user acceptance and trust

The research focuses on creating such architecture model in consideration to the analysis of using a new class of distributed applications (mixed reality services and applications) and different kinds of new business models.

The high level objects of the Mobility Service Delivery Platform are

- enabling new business models and redefining the role of telecommunication operators from access to service providers and blurring the roles
- taking benefit of existing variety of services, networks and devices and make services more intelligent and easier to use (assist users and developers)
- supporting inter domain aspects like service provisioning and inter working for example
- providing services timely: accelerate creation and delivery of services in terms of fast service creation and reduce “time-to-market” for new services
- opening platform capabilities to 3rd parties and support multi-vendor and multi technology middleware platforms
- providing a unified and seamless way to deliver services over heterogeneous execution platforms, network and terminals
- enriching the service landscape, through an overlay structure offering a personalized user experience anytime and anyplace
- creating a trusted and open platform that can simplify the use of services and devices through personalization and customization (open-up to new business models and value chains)
- promoting the uptake of innovative IT software technologies in a telecommunications grade service platform environment



Functional Packages of the Service Delivery Platform & their Relations

Figure 3. The proposed packages for the solution – develop and build a Mobility Service Delivery Platform (Source: Cabanillas Silvia, 2006; Bergaus Martin, 2006)

The above mentioned functions and data are grouped into functional packages. These packages are represented and described as followed:

Functional Package Name	Functions	Information
Service Creation	• SLA agreement • Service publishing • Service composition • Mock-up service composition • 3rd party service discovery • Service repository browser • Service testing	• SLA
Service Lifecycle Management	• SLA enforcement • Service deployment	• SLA
Service Subscription Management	• Service advertisement • Service roaming • Service matching • User service discovery	• User subscribed services

Identity Management	• User authentication • 3rd party service provider authentication	• User account
User Profile Management	• User profile creation • User profile personalization • User profile providing • User profile rating	• User profile
Community Management	• User profile matching	• User contact list
Content Management	• Content push messaging • Content adaptation • Content publishing	
Knowledge Management	• User Knowledge discovery • User knowledge providing	• User knowledge
Device Management	• Device configuration • Choice of access network	
Service Control	• Service invocation • Service monitoring • Service pause/restart • Application data sharing	• Service logs
Service Session Manipulation	• Service session transfer • Change service session	

Table 1. The description of the functional packages of the model architecture
(Source: Cabanillas Silvia, 2006; Bergaus Martin, 2006)

3. The Mobility Service Delivery Platform and their Objectives

The Mobility Service Delivery Platform is defined regarding in consideration of the following approaches:

- Platform centric approach
- Semantic enhanced middleware
- New service eco-system building
- Open and controlled access to service providing capabilities
- Multi terminal and multi access distributed communication sphere

A Scenario-driven approach illustrates three different scenarios which are the basis for defining the application features in three different kind of state of the art and future oriented application scenarios:

- Intelligent Portal: In this scenario, users are assisted by an “intelligent portal” that proposes services adequate to the location, the context and user preferences. It mainly focuses on service roaming, seamless delivery, security and content adaptation (Cabanillas Silvia, 2006)
- Emergency: This scenario, patients suffer from cardiovascular diseases and elderly people use an innovative technology solution to monitor and process in real time, through a limited set of devices connected to their phone within a body area network. Their critical biometric parameters, such as electrocardiogram, heartbeat, body temperature, blood pressure, physical activity, body position, etc. are controlled (Cabanillas Silvia, 2006)
- E-Tourism: The E-tourism combined scenario integrates the intelligent service enablers, user assistance and service creation, with different tourism scenarios (travel, event, at a hotel, going to the cinema) has to be defined. (Cabanillas Silvia, 2006)

The technical objectives of the new architecture model and service delivery platform focus on the following aspects

1. Business models/scenarios and architecture
    - Business and technical requirements for telecommunication service providers
    - Viable mobile eco-system, where telecommunication service providers play a central role
    - Mobility Service Platform architecture definition
2. Platform middleware and enablers
    - Generic service enabler components and cross-domain component access
    - Infrastructure for discovery and deployment of components
    - Inter service platform roaming mechanism
    - Service exposure layer and charging enabler
3. Distributed Communication Sphere (DCS) Management
    - Building and maintaining users in the DCS
    - Framework for transparent remote DCS configuration
    - Dynamic desktop and communication decision engine
4. Increasing service intelligence
    - Personal information management framework
    - Intelligent context awareness functionality and intelligent knowledge provisioning
    - Pro-active triggering of mobile services
5. Service creation and life-cycle management
    - Multiplatform service execution engine
    - Integrated service creation environment allowing fast service deployment
    - Advanced service description language
    - Tools for automatic/dynamic service composition

6. Service access control and trust management
   - Federated policy-based access control methods, dynamic SLA enforcement, and policy management
   - Secure mediation function to share information between stakeholders (identity management, privacy management)
7. Information and content delivery
   - Multimedia content description
   - Protected distribution of content between devices
   - Content sharing in a user-friendly and secured way
   - Scalable decision mechanism that control the delivery of content to several devices and networks

4. The Functional Architecture of the Service Delivery Platform

The functional components and internal interfaces are described below and just aim all main functionalities on one picture in a consistent way. The idea is to define in the architecture of each component block in detail and emphasis the relation that exists with other components of other functional block of the whole architecture. Data flows and dependencies is described as well.

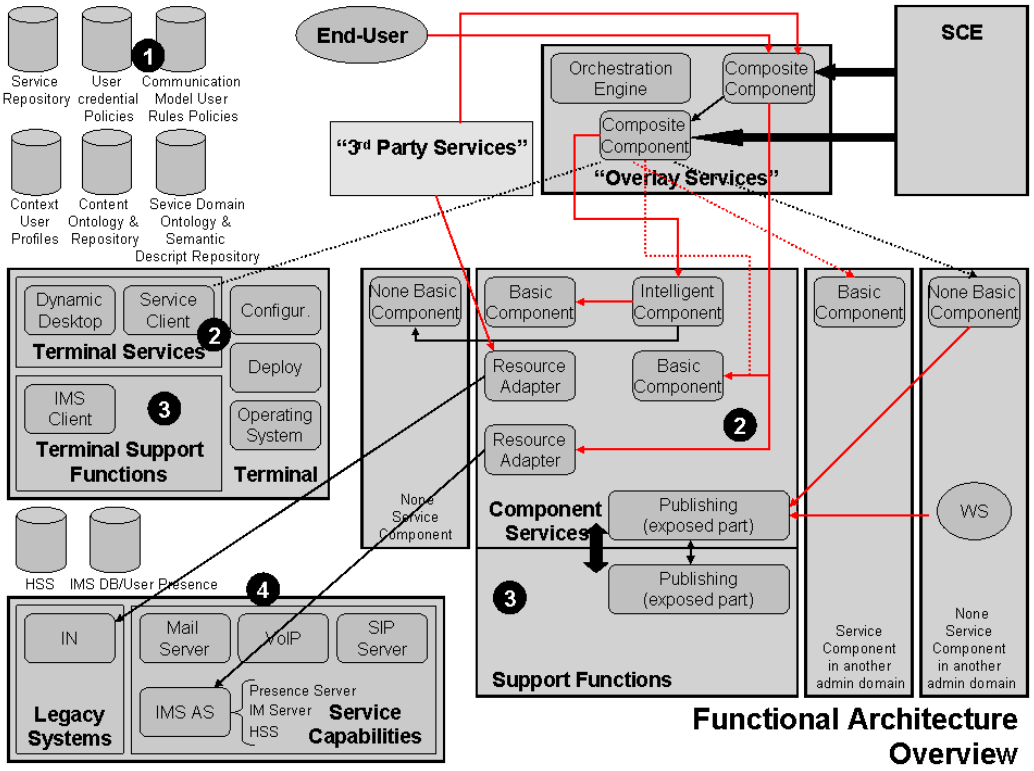


Figure 4. Draft definition of the functional architecture without mixed reality components (Source: Cabanillas Silvia, 2006)

The previous picture shows the component categories: (Cabanillas Silvia, 2006)

1. Refers to the data bases and repositories that are managed either by the basic components, intelligent components or support function.
2. Refers to the category of components that are exposed to the outside world through the so-called “exposure layer”. These components can be used and combined by the SCE to create composite services. (Resource adapters acts are “exposed” proxies to the category components. They are not intended to bring real added value to the components they are pointing towards.
3. Refers to the category of support functions. They are fully dedicated to supporting the components that are in the service delivery model. They are not exposed to the outside world. But it is still possible to implement a basic component that exposes some of the aspects of the supporting function.
4. Refers to existing service sub-systems and legacy systems
5. Refers to component deployed within the terminal

5. Conclusion and Perspective

The presented work (definition of a service delivery platform including new classes of distributed applications like mixed reality applications and services) outlined in paper here builds the methodology process for setting a standard for a new service delivery architecture providing ambient services on the core network side and “MobiLife” applications on the application layer. It defines a common system to operate and develop mobility services which can be used anytime and anyplace by different kind of core network systems.

A standardized architecture based on this model using IMS as technological implementations concept will bring a very big benefit for the development of mobile services and applications as well as special kind of services like mixed reality applications for the future, because the specified model includes many aspects based on use cases and scenarios for those kind of applications. The development of such a model implicates the rethinking regarding new possibilities of business models, which can be a big benefit for used by operators and service distributors.

The next steps are to define the architecture in detail and come up with the requirements based on the 3 use case scenarios including and identifying the mixed reality relevant aspects and rethinking about new business models.

6. Acknowledgments

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7. References

Umar, Amjad (2004) *Mobile Computing and Wireless Communications – Applications, Networks, Platforms, Architectures, and Security*, NGE Solutions, Inc.

Cordier, Christophe (2005) *Service Platform perspective: Overview of the Service Platform for Innovative Communication Environment proposal*, WWI Workshop, Mobile IST Forum 2005, Dresden

Klemettinen, Mika (2004) *MobiLife – Overview,* Mobile IST Forum 2004

Bergaus, Martin (2006) *PhD Research Proposal (Pre-R1)*, PhD Research Programme Danube University/Leeds Metropolitan University

Cabanillas, Silvia (2006) *Service Platform for Innovative Communication Environment – Functional Architecture*, FP6 Integrated Project

Poikselkä, Miikka; Mayer, Georg; Khartabil, Hisham; Niemi, Aki (2004) *The IMS – IP Multimedia Concepts and Services in the Mobile Domain,* John Wiley & Sons, Ldt, West Sussex

Balcisoy, S., Kallmann, M., Fua, P., Thalmann, D. (2000) *A framework for rapid evaluation of prototypes with Augmented Reality* http://ligwww.epfl.ch/~thalmann/papers.dir/balcisoyvrst2000.pdf

Burkhardt, Jochen; Henn, Horst; Hepper, Stefan; Rinkdorff, Klaus; Schaeck, Thomas (2001) *Pervasive Computing*, Addison Weseley

Messerschmitt, David G. (1999) *Networked Applications*, Morgan Kaufmann, San Francisco

Mueller, Stephen M. (2002) *APIs and Protocols for Convergent Network Services*, McGraw-Hill