Wireless Internet service development

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Abstract. The new wireless technologies for telecommunications networks and devices will enable new kinds of mobile services [7] and create enormous business opportunities [2]. Effective use of these business opportunities requires cooperation with other companies and using applications developed by third parties. The teleoperators today have a dominant position across all markets, and third parties can only provide applications. The third party service development is limited today both by technical and business constraints that make the effective use of third party applications difficult. This paper handles the development of wireless service and proposed use of open standards (like OMA and OSA) and interfaces as one solution to more effective use of third party applications. The wireless Internet service development is illustrated with the aid of a wireless pilot service that is under development for the third generation wireless networks.

1 Introduction

The success of the Internet has had a dramatic impact on software development as it enables interaction of applications over the network [8]. The revenue derived from wireless content and content-related services is expected to increase significantly in the future for all actors of the wireless business. According to the forecast of the Universal Mobile Telecommunications System (UMTS) Forum, [12] the providers of Third Generation (3G) services will achieve revenues of $322 billion by 2010, which means an increase of over $ 300 billion compared to the current situation. The new wireless technologies for telecommunications networks and devices will enable new kinds of mobile services and challenge the traditional value chains [7]. The emergence of 3G technologies will also create enormous business opportunities [2.

The Japanese I-Mode has won the wireless service market thanks to the wide range of service offered and its successful business model based on third party service development. The success of I-Mode has also been due to the adopted billing strategy, in which the users do not pay for the time they are connected to a website or service, but they are charged only

according to the volume of data transmitted. The business idea of I-Mode may still have difficulties succeeding in other parts of the world, as the circumstances are different.

In this paper, third party means an application developer- a company that offers consulting, planning and implementation of wireless Internet services to other companies to solve their need. In order too manage in the wireless business, the companies should provide end-users with services that are useful and work in multi-operational environments.

Enablers mean enabling technologies like MMS (Multimedia Messaging Services), Java and WAP (Wireless Application Protocol) 2.0/XHTML (eXtensible HTML) browsing in mobile terminal. Some other technologies needed for driving the mobile services market include service enablers such as Digital Rights Management (DRM), authentication, location and presence identification and device management. [10

The target of this paper is to identify and find feasible solutions for the problems that most hinder the development of wireless Internet services. Development of a wireless service is illustrated by designing a business model, development process and architecture for a pilot service that is under development for the third generation networks. As the presented model is based on the experience and views of various real 3G-participants: Network Operator, technology provider, application and service providers, we believe that it serves as a good basis for the development of wireless services.

1.1 Related Research

The IST-project MB-Net [9] has researched the mobile business research challenges. MB-Net has indicated the following research challenges for mobile business: emerging applications and services, emerging m-Business models, consumer, content delivery, network infrastructure, device capabilities, security and privacy, pricing, billing and payment, service roaming & interoperability and regulatory and policy issues.

Houssos et al. [6] has developed the MOBIVAS-framework, which is a distributed flexible platform for dynamic service provisioning of applications. The MOBIVAS-framework comprises several components that are vertically placed within administrative domains. The central component of the platform is VASM (Value Added Service Management).

Hayes [5] has described the process for turning business requirements into solution requirements. His approach is to use the answers to the Why, Who, What, When, and Where questions to provide a framework for winnowing the wireless decisions down to a manageable number. He has explained how to develop specific requirements for devices, applications, data, and wireless networks and how, by comparing these requirements to the tables and other component-specific information, it is possible quickly identify the wireless options that best apply to your needs and then develop them.

2 Current service development environment

Telecom operators dominate the current development environment of wireless Internet services by adapting the best practices of the wired Internet without considering the complexity in terms of technology innovation, end user terminal restrictions and end user experi-

ence. The dominant position of the mobile operators has been clear across all markets for three reasons: 1) they have direct access and billing relationship to the end users, 2) they charge for the data traffic and 3) they have the ability to manage all aspects of the system and business.

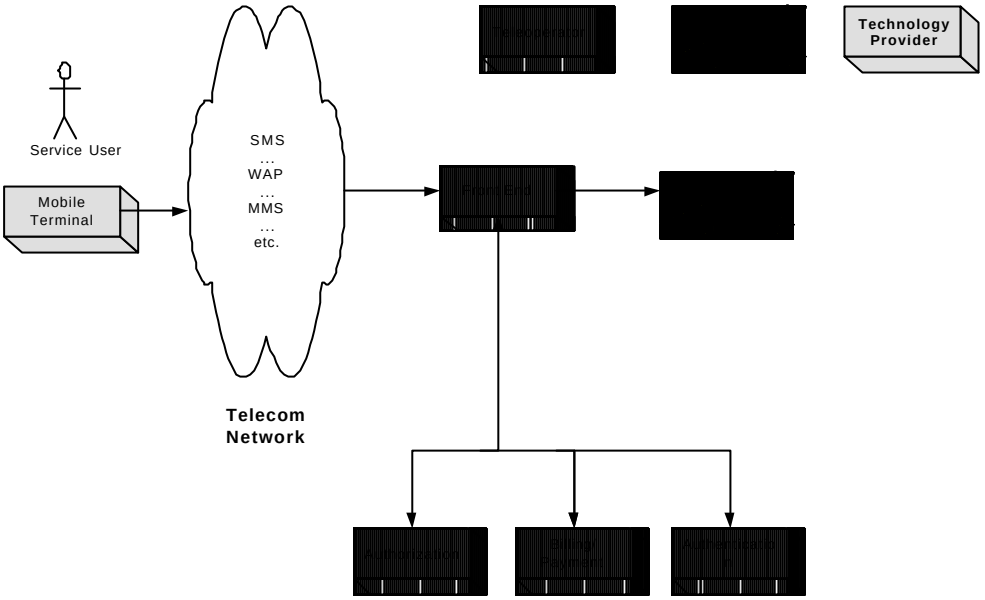

Fig. 1: Current environment of wireless Internet service development

Figure 1 presents the current situation of the wireless Internet service operations. The end user owns different wireless Internet enabling terminals. On the network side the teleoperators own and manage practically everything, including all enablers like user authentication, service provisioning and billing. The 3rd parties can only provide applications.

The current environment of service development emphasizes the need for stronger cooperation between content providers, network operators and equipment manufacturers. The enablers of stronger cooperation between different partners are [10] uniform standards, clear focus on the requirements for specifications that match market needs in timing and in quality, a common industry view on an architectural framework and interoperable terminal offering and service platform.

Figure 2 presents a future scenario in which a company builds its own wireless access for the employee and can offer their own application and Operating Systems (OSs) to boost the business.

Although in Figure 2 service providers offer the enablers, telecom operators can also provide them as in the current scenario (Figure 1). It also seems be evident that several parties will provide the same enablers i.e. authentication, payment/billing or the application provider has been driven to manage interfaces for several service providers.

To enable interoperability between different vendors, there have been initiatives like OMA (Open Mobile Architecture/Alliance) and OSA (Open Service Access) by 3GPP (Third Generation partnership Project) to develop open standards and application interfaces that would enable seamless interoperability between services in multi-vendor development. Participation in industry standard forums dedicated to interoperability among different systems is becoming mandatory for telecom manufacturers, service providers, application providers and telecom operators. This will ensure standard services like roaming and communication among users of two different telecom providers.

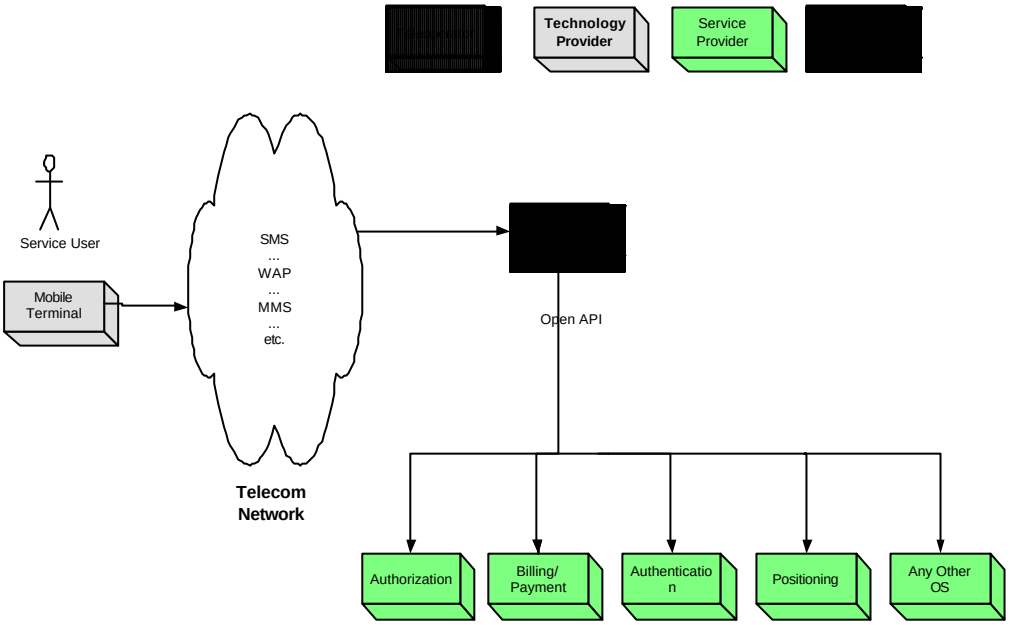

Fig. 2: Future scenario 2: A company builds its own wireless access for an employee and can offer their own application and OSs to boost their business

The goal of OMA is to ”enable mobile subscribers to use interoperable mobile services across markets, operators and mobile terminals" [10]. The target of OSA is to enable applications to make use of the network functionality through an open standardized interface [1]. With the aid of OSA the applications that implement services are independent of the underlying network functionality. This means that third party application developers will not make any agreement with a specific operator to access the enabling network. They can finally launch their services on a multi-operator environment. The network functionality offered to applications is defined in terms of Service Capability Features (SCFs), which are accessible via the OSA interface.

3 Stages of wireless service development

Although wireless Internet services offer flexibility for mobile users, they also pose big challenges for developers. Wireless Internet services should be reliable, scalable, and secure and they are still limited by unexpected errors, variable user interactions, traffic volume, uptime and any computational or telecommunication bottlenecks. Guaranteeing correct processing under all anticipated and unexpected scenarios is also a particularly big challenge for wireless services.

Important stages in the development of wireless services are the design of a functional business model, service architecture and service development process that are handled in more detail in the following chapters.

3.1...Business model.

The business model is a model for service and information flows, including a description of the various business actors, their roles, sources of revenues and links, interfaces and interaction between all the actors involved in the multifunctional environment of 3G [11]. In the mobile business, the technological infrastructure is - unlike many other businesses- set up before the business model, and therefore the technical infrastructure limits the effective design of the service business model. In wireless business models one of the main issues is the division of work and money between the actors. Without effective planning of the flows, the total functionality of a service may not offer the expected revenues.

3.2...Service development process

An explicit process model is a key requirement for high productivity and software quality. Since software development projects are unique regarding their combination of specific goals and characteristics, providing 'ideal', and at the same time, universal development processes is no solution for real life. Instead, effective and efficient software development processes custom-tailored to the particularities of the application domain and project constraints are required.

Nowadays, the development time of the services is too long and the developers need to implement the services with their tools. The developed applications should meet the following requirements [3]:

- The application must seamlessly initiate, successfully manage, and terminate user sessions while assuming no cookie support on end-user devices and a sporadically connected wireless network.
- The application must communicate with many different unified messaging resources typically found around a mobile user, using robust messaging interfaces that enable push/pull functionality in a synchronous or asynchronous manner.
- The application must access existing data access and business logic layers, back-end data sources and other software and application server services through uniform interfaces.

Service testing is difficult today since reproducing commercial deployment of the service is not possible in third party labs.

3.3 Service architecture

Today, a lack of open interfaces, standards and common understanding of the architectural design makes design of wireless services difficult. At the moment each operator has its own proprietary interface to their operating service systems (OSS) so there is no multi-operator, -channel and -terminal access to content and services.

In order to respond to the needs of various stakeholders related to service architectures, architecture descriptions have to contain several viewpoints at different levels of abstraction. To achieve this multi-perspective representation, differing modeling notations for both abstract and concrete architecture descriptions are needed. This is to prevent confusion caused by diverse meanings for the same symbol.

4 Development of the pilot service

To illustrate the challenges of wireless service development, in this chapter we present the development of a wireless service by designing a pilot service, a business model, development process and architecture. The pilot service is a multi-player game known as the “Labyrinth Game” that will be developed in the WISE (Wireless Internet Service Engineering)-project. A game was selected as a pilot application, because games and other forms of entertainment are expected to be one of the "killer-applications" of 3G.

The pilot service is an arcade game in which multiple players move in a big labyrinth or dungeon and complete a mission. The client side is implemented using MIDP (Mobile Information Device Profile). MIDP is a set of J2ME (Java 2 Platform, Micro Edition) APIs that define how software applications interface with mobile phones. Applications conforming to this standard are called MIDlets. The terminal connected to the server for data exchange uses a GPRS/UMTS connection. The server side is implemented using J2EE (Java 2, Enterprise Edition). The user can download the game "over the air" directly on the terminal through a serial cable or infrared connection.

Figure 3 presents the network architecture of the pilot service. Clients have access to a GPRS network (UTMS in the future) that is connected to the Internet by means of a GGS Node. Having this access to Internet, clients are able to connect to the Game Server. The Game Server uses Management Services (such as Authentication and authorization) that are provided by a different server running on a node on the same LAN (but it could be remote as well). The system context mainly affects the software architecture as a rationale for structuring of the architecture and defines the nodes used in deployment views.

4.1 Business Model

Figure 4 presents a possible Business Model for the pilot service. Definition of a business model for a developed service helps the involved parties understand the real money flows between the actors and other influencing factors when launching the service.

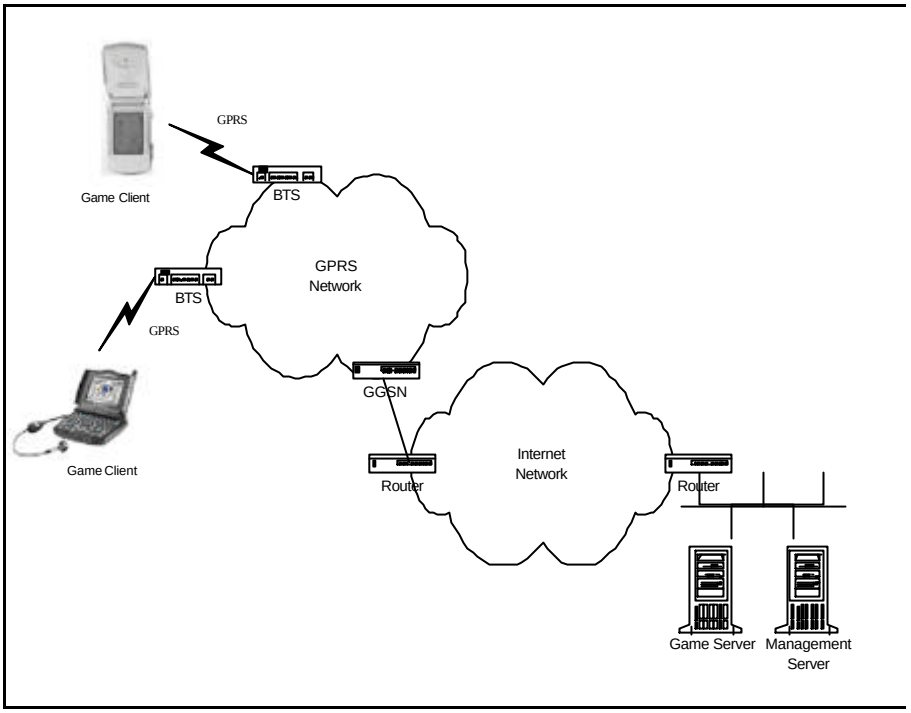

Fig. 3: Network Architecture of the pilot service

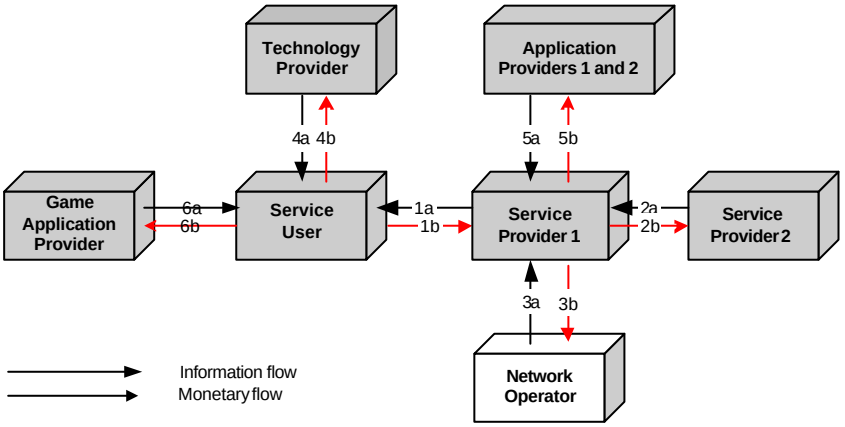

Fig. 4: Business actors and their connections in the pilot service

In the pilot service, the network operator gives the bandwidth and the service delivery is handled by Service Provider 1The user pays for the traffic, plus a "lump sum" every time he wants to play. The Service Provider 2 provides the Service Provider 1 (SP1) with a service management component which enables services like authentica-

tion, billing etc. The application provider provides the game application to the SP1. The technology provider sells the wireless devices needed when using the service to the user. OMA and OSA could be used in the pilot service between all partners to make integration of the different components easier. The flows of Figure 4 are explained more detailed in Table 1.

Table 1: Money and information flows of the Pilot service 2

Flow	Flow from:	Flow to:	Character of the flow:	Based on:
1a	Service provider 1	Service user	Access to the service	
1b	Service user	Service provider 1	Money	
2a	Service provider 2	Service provider 1	Service management component	
2b	Service provider 1	Service provider 2	Money	Fixed sum
3a	Network operator	Service provider 1	Bandwidth	
3b	Service provider 1	Network operator	Money	Number of users
4a	Technology provider	Service user	Terminal	
4b	Service user	Technology provider	Money	Fixed sum
5a	Application providers 1 and 2	Game company	Server side of the Labyrinth game	
5b	Service provider 1	Application providers 1 and 2	Money	Fixed sum
6a	Game application provider	Service user	Client side of the Labyrinth game	
6b	Service user	Game application provider	Free/money	Free of fixed sum/download

4.2 Service development process

Most of the processes that are under definition for the pilot service are extracted from the standard processes of well-known standardization bodies. Applying these processes in the real pilot service will help in adapting the service to wireless world. The aim of the developed process is to achieve better quality of service and reduce costs. This chapter describes the development process model for the pilot service. The information in the model is based mainly on examples of the processes as they have been performed in the respective environments. The phases of the development process are presented in the following sub-chapters.

4.2.1 Phase: Gathering requirements

In this phase the requests from the customer are gathered and analyzed. The requirements document, system requirements specification (SRS) and a requirements traceability matrix (RQTM) is produced.

4.2.2 Phase: Design

In this phase, the system's overall architecture is identified and the application design is specified in a dedicated document (Design Document) for both the client and server side of the application.

4.2.3 Phase: Coding

Java has been chosen for application development because it permits porting of the application on different systems. The client side of the pilot can basically work on any J2ME enabled phone, while the server side strictly follows the "write one run anywhere" myth. The client part of the service, when ported to other phones, needs to be adapted with respect to the specific input/output interfaces and display characteristics available on the mobile. Phone emulators running on desktop PC's are used for application development. Emulators enable debugging of the client application code and testing prior to integration of the application on the target terminal.

4.2.4 Phase: Integration

In this phase all the developed components are integrated and tested. After completion of the integration test, the code is released for the feature test.

4.2.5 Phase: Feature testing

Testing is essential when developing applications for a huge amount of people that generally expect the used handsets to be robust and error-free. Wireless customers require products that do not crash and are always functioning perfectly. In order to guarantee the expected level of quality, testing is carefully planned and designed. The goal of this phase is to identify and fix possible bugs in the pilot service.

4.2.6 Phase: Acceptance testing

In this phase the acceptance test is performed. The acceptance test is the final test jointly executed on the application by the application provider and the customer. It serves as the acceptance phase, after which the final version of the application is delivered to the customer.

4.3 Architecture

This chapter illustrates the designing the software architecture of the pilot service. The architecture of the game is described with four architectural views at two levels of abstraction, as different stakeholders need information at different levels of abstrac-

tion and aggregation. In order to differentiate the viewpoints along those needs, the service architecture description is divided into conceptual software architecture and concrete software architecture. In both of these abstraction levels, hierarchy in descriptions is used to provide the right level of aggregation for a stakeholder.

The two abstraction levels are called conceptual and concrete levels and are defined as follows.

- Conceptual architecture: the first development stage defines the abstract software architecture. Abstract means delaying design decisions. Components at this level are functional blocks with few details. The aim of conceptual design is to find the commonalities shared by all the pilot services, but also identify variabilities. The conceptual architecture provides a so-called plain architectural perspective, decoupled from any technical and technological development choices.
- Concrete architecture: the second development stage defines the concrete (designed) architecture for the pilot. The concrete architecture is compliant with the conceptual architecture; it typically focuses on a proper subset of the latter developed by the pilot, and describes in detail how abstract entities taken from the conceptual architecture are designed and decomposed as concrete components. The concrete architecture reflects technical and technological decisions, too.

The development stages and views described above are necessarily in a strictly temporal sequence: development is an iterative process, during which development stages are defined in collaboration.

In the pilot application, it is assumed that a game server node handles the management of a number of players with mobile devices. The game server handles all synchronization and communication. No P2P communication between mobile terminals is available.

Game Client and Game Server are the objectives of the pilot service and they have to be developed from scratch. Each company develops the part that pertains to its role. Wise Message Transport Service also has to be deployed from scratch, as for now a suitable protocol (that meets the project requirements) for exchanging data between a J2ME client and a J2EE server was not available.

A future task is to define a generic architecture that is common to all pilots, hence stating the overall architectural framework for wireless service architectures.

Table 2: Modeling notation for the architectural viewpoints of the pilot service.

Development stage	**Structural VP**	**Behavioral VP**	**Deployment VP**	**Development VP**
Conceptual architecture	– System Context as a network diagram – Domain information models – Components and logical as-	– Collaboration between conceptual entities	– Deployment diagram of conceptual entitites on top of network	– Business context as instantiated Wise Business model – Classification of component readiness and

	sociations – Responsibilities of entities		nodes	development responsibilities on top of structural VP
Concrete architecture	– Concrete information models – Extended component diagrams – Extended component diagrams – Responsibilities of concrete components	– Sequence diagrams (gross level) – Sequence diagrams (detailed level)	– Deployment diagram of black-box components on top of the network nodes extended with business roles	– Technology platform description as a layer diagram – Development interfaces as a table

5 Conclusions and further work

One of the breakthrough technologies in the wireless world is surely the adoption of Java on the client side and OMA on the server side: both provide open and standard API and can be seen as the beginning of wireless services standardization. The development of wireless services is moving in the direction of open standards and architectures. Several big terminal manufacturers have already shown interest in openness, and we believe that open standards and interfaces will sooner or later make the development of applications easier as common agreement is achieved about the usability of openness.

The current technology limitations makes wireless service development difficult: identification of the right process before starting development could significantly help the parties in application implementation, reducing time to market and increasing the quality of the final product.

In this paper, we have handled the problems of wireless service development. Wireless service development and its solutions were illustrated in this paper with the aid of a wireless pilot service that is under development for the third generation wireless networks. A business model, development process and architecture that could also be used in other wireless services was defined for the pilot service. The presented development model for wireless services is based on the views of several 3G-participants and therefore, we believe that it serves as a good framework for future service development.

The models developed for the pilot service will be defined further in the next months according to the experience gained from the current pilot development.

6 Acknowledgements

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References

1. 3GPP, 2002. TS 22.127 V5.4.0 (2003-06). 3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Service aspects; Stage 1 Service Requirement for the Open Service Access (OSA) (Release 5). 26 p.
2. Afuah, A., Tucci, C.L., 2001. Internet Business Models and Strategies. ISBN 0-07-239724-1. Mc-Graw Hill.358 p.
3. Capone, M., 2001. Extending J2EE for Mobile Application Development. Available online at: http://www.onjava.com/pub/a/onjava/2001/10/17/mobilej2ee.html
4. Durlacher, 2001. Mobile Commerce Report. 75 p.
5. Heyes,I.S., 2002. Just Enough Wireless Computing. Prentice Hall. ISBN: 0130994618. 448 p.
6. Houssos, N., Gazis, E., Panagiotakis, S., Gessler, S., Schuelke, A., Quesnel, *S.*, 2002. Value added service management in 3G networks**.** Network Operations and Management Symposium, 2002. NOMS 2002. IEEE/IFIP, 2002. Pp: 529 -544.
7. Lymysalo, M. ,2000. Evolution of Mobile Electronic Commerce- Opportunities for One-to-one Marketing. VTT Information Technology. Research Report TTE1-2000-31. 88 p.
8. Messerschmitt, D.G., Szyperski,C., 2001. Industrial and Economic Properties of Software: Technology, Processes, and Value. University of California at Berkeley Computer Science Division Technical Report UCB//CSD-01-1130 and Microsoft Corporation Technical Report MSR-TR-2001-11. 50 p.
9. Mobiforum.org, 2002. Draft Roadmap on Mobile Business Research Challenges v. 1.0. 6 p. Available on-line at: http://www.mobiforum.org/cgi-bin/mobi/mobi.cgi?session_id=;user_id=;menusel=;user_id=;action=display_newsgroup;newsgroup_id=4628
10. OMA, 2002. Open Mobile Architecture Initiative- Overview Presentation. 15 p. Available on-line at: http://www.openmobilealliance.org
11. Timmers, P., 1998. Business Models for Electronic Markets. In: Gadient, Yves; Schmid, Beat F.; Selz, Dorian. On-line at: http://www.electronicmarkets.org/netacademy/publications.nsf/all_pk/949/$file/v8n2_timmers.pdf?OpenElement&id=949. 6 p.
12. UMTS, 2001. The UMTS Third Generation Market- Phase II: Structuring the Service Revenue Opportunities. Report No. 13. 100p.