

MOBILE MARKETING USING A LOCATION BASED SERVICE

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ABSTRACT

Considering the recent convergence of computing and telecommunications technologies with the tremendous success of the Internet, the World Wide Web, and Mobile Communications, the next step is expected to be the Mobile Web. The main promise of the Mobile Web is to satisfy user needs for anywhere, anytime access to information and services, including Location Based Services (LBS). This paper presents an innovative LBS service applicable to the Mobile Marketing industry sector. We describe the architecture of the information system supporting the proposed service and a software prototype we implemented using a simulation environment for providing location information. The technologies adopted for this design are based on open standards and have successfully met the requirements of scalability and autonomy. Then, we propose and describe a business model for this service. Emphasis is given on the participating entities, their roles and the interactions among them.

Keywords: Mobile Advertising, Location Based Services, Business Model, System Implementation

1. INTRODUCTION

Advances in wireless communications and information technology have made the Mobile Web a reality. The Mobile Web is the response to the need for anytime, anywhere access to information and services. Many wireless applications have already been deployed and are available to customers via their mobile phones and wirelessly connected PDAs. However, it seems that everyone is still looking for the “killer” wireless application. One such direction points to Location Based Services, which we discuss below.

The remainder of this paper is organised as follows. In the second section we provide basic definitions associated with Location Based Services (LBS), we describe the evolution path of such services and provide a brief market analysis. In the third section we present our motivation for examining such services and we give an overview of our proposed service for the mobile marketing sector. In the fourth section the technical aspects of the system which supports the proposed service are presented in detail. In the fifth section a possible business model is proposed. Finally, in the sixth section we provide our conclusions and directions for future work.

2. BASIC DEFINITIONS & MARKET ANALYSIS

Location Based Services are services, which are enhanced with and depend on information about a mobile station’s position. This kind of information has no meaning if it is presented as is. It has to be

correlated with some types of services. Location Based Services take up the role to supply the user of these services with customised information according to his/her position.

In 2000 Gravitare Inc. has published a white paper which (correctly to our opinion) identifies three evolution steps for Location Based Services [3]. The first generation refers to services where the subscriber has to manually give his position information to the system. The second generation (existing services) refers to location services where the position of the subscriber is automatically discovered but with little accuracy. Finally, the third generation refers to services where the position of the subscriber is automatically discovered with accuracy and which have the intelligence to inform or warn the subscriber about events depending on his position (the subscriber doesn't have to initiate the service, the initiation depends on triggers according to his/her preferences).

2.1 Categories of Location Based Services

The GSM Alliance Services Working Group [11] has defined the following types of Location Based Services:

- Emergency Services
- Emergency Alert Services
- Home-Zone Billing
- Fleet Management
- Asset Management
- Person Tracking
- Pet Tracking
- Traffic Congestion Reporting
- Routing to Nearest Commercial Enterprise
- Roadside Assistance
- Navigation
- City Sightseeing
- Localised Advertising
- Mobile Yellow Pages
- Network Planning
- Dynamic Network Control

2.2 Driving Forces for LBS

Market Forces

Recent market researches (e.g. [12]) showed that consumers in Europe are ready and willing to pay for Location Based Services. Some indicative findings say that mobile subscribers would consider even changing mobile phone operator in order to gain access to location based services and pay up to 16 Euros as a monthly fee for these services. In the U.S mobile subscribers would pay as much as 50 Dollars to have GPS or other location technology built into a cellular phone, according to similar market research [9]. Some critical success factors for the adoption of LBS, as identified by these researches, seem to be the following:

- Protection of mobile user privacy
- Easiness of usage
- Non-intrusive way of LBS operation

Competition forces

Having established large customer bases, Cellular Service Provider will seek new ways to ensure customer loyalty by offering new types of services. Location Based Services are the most promising type of these services, also called value added services. Some of the advantages for the Cellular Service Provider who offers Location Based Services are:

- Innovative service provision attracts new customers and enhances existing customer's loyalty to the provider.
- Revenue increase due to traffic generated by the use of such services.

- Capability to introduce new revenue streams through deals with third party companies (which specialise in LBS implementation and/or provision), in order to sell to these companies user location information.

Technology forces

The first location based services are expected or are already offered to mobile phone users via WAP or SMS. Every GSM mobile phone supports the SMS feature and there are many that also support WAP. The cost for a WAP enabled phone is under \$80. This means that many customers can instantly make use of the location services provided. In addition the evolution from GSM to GPRS, which means a significant increase in the available bandwidth for data communication over mobile phones (from 9.6Kbps to 115Kbps) will also assist the provision of location based services that in many cases can be bandwidth demanding. Finally new type of phones such as media phones and communicators are slowly entering the market giving greater capabilities for displaying information (e.g. user interfaces enhanced with photos, buttons and not only text).

Regulatory forces

In USA the Federal Communications Commission has issued a directive requiring the identification of the geographical origin of an emergency call made by a mobile phone user. According to this directive, operators should be able to provide location information for every mobile subscriber, who makes an emergency call, with accuracy of 125 meters for 67% of the time [8]. The European Union is expected to produce a similar directive by the end of 2002.

3. MOTIVATION AND SERVICE OVERVIEW

3.1 Mobile Advertising

The proposed service belongs to the mobile advertising category. This category of LBS involves the provision of location aware advertising messages to cellular subscribers. Mobile advertising can be considered as a part of mobile commerce. It is an integral part of mobile marketing.

Mobile marketing can be described as all the activities required to communicate with the customer through the use of mobile devices in order to promote the selling of products or services and the provision of information about these products and services [10]. There are many optimistic predictions about what we can expect in the future from mobile marketing. Some of these predictions are the following [10]:

- From 2003 to 2005, analysts predict that mobile marketing as an industry sector will grow from 4 billion dollars to 16 billion dollars, serving over 500 million users world-wide (Chart 1, Source: Ovum Research Ltd.).
- Location aware advertising messages are expected to create 5 to 10 times higher click-through rates compared to Internet advertising messages. (Source: BWCS Consulting and Communications Services Inc.)
- By 2005 the 33% of a Cellular Service Provider's revenue will be coming from advertising and from payments and commissions from mobile commerce activities.(Source: BWCS Consulting and Communications Services Inc.)

Considering all these predictions as well as the history of advertising in other mediums like television and Internet, it would be quite realistic to say that advertising is going to play a significant role in the mobile web too. With the help of Location Based Services advertising companies can now provide truly location aware messages to the customer. This fact gives for the first time the opportunity to reach consumers with highly customised promotions and advertisements, which depend on the location of the consumer.

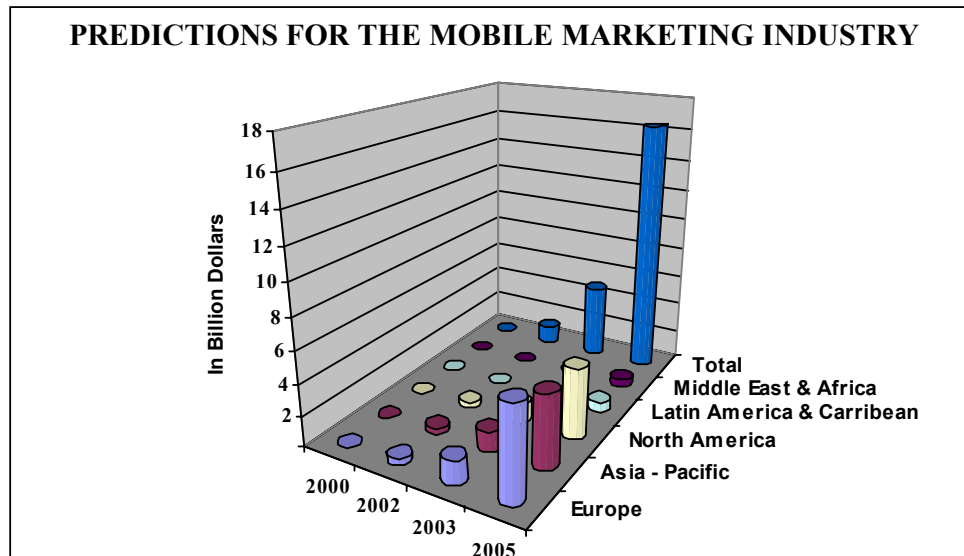


Chart 1: Worldwide Mobile Marketing Industry Predictions

3.2 The Proposed Service

The proposed LBS belongs to the category of Information Services and is about providing users with advertising messages. Mobile Advertising is an integral part of Mobile Commerce and, to be more accurate, of Mobile Marketing. The service operates in a way similar to directory services. To be more precise, there is a distributed information base storing data about product promotions offered by every supermarket in a given area where the service is provided. A user can search for promotions selecting the product categories he is interested in. The service returns all the available promotions offered by nearby supermarkets. The information system supporting the service described above has the following characteristics:

- The service is accessible through the WAP protocol. This means that the complexity and intelligence of the service is managed by a web server and not by a stand-alone application on the user's device.
- Users are located by the system at the level of a sector of a telecommunication's cell by using the CGI (Cell Global Identity) method. It is the simplest positioning method but can support efficiently the above service given the small size of the cells in urban areas.
- The information about available supermarkets and product promotions is stored in a Directory Information Tree, which is accessed through the Lightweight Directory Access Protocol (LDAP) . The information model used is hierarchical and is mainly used for search/read purposes than write purposes. The LDAP protocol is used for high-speed access to this kind of information. It also has valuable distribution capabilities (different servers store different parts of information), thus offering scalability to the system. The availability is also increased as there is no single point where the information is stored, the failure of which would mean the failure of the whole service.

The above system has been implemented in simulation environment but can also be tested against real-world conditions using available telecommunication network's infrastructure (telecommunications network with positioning capabilities) because it is based on well defined industry standards.

4. SYSTEM ARCHITECTURE

4.1 The System

During the design of information systems that support Location Based Services, emphasis is given to scalability, distribution and interoperability through the use of well-documented flexible ontologies and broadly accepted information access protocols [2][5]. Scalability and distribution refers to the capability of a system to expand providing support for more users and also to the capability of autonomous management of separate parts of the available information. The information access protocols, when standardised, give the opportunity to the system designer to use already well-defined interfaces. The ontologies used to describe the available information should be based on standards, which allow the easy expansion and management of the information (e.g. XML-like ontologies). Our approach for the architectural design of the proposed system is based on the above principles.

We will now thoroughly describe the operation of the proposed system (shown in figure 1). The user communicates with a Web Server over the WAP protocol through a WAP Gateway. The information which is sent to the Web Server upon service initiation is the user's id, password and telephone number (MSDN). All this information is used by the system for authentication purposes.

In order for the Web Server to grant user access, the information is sent to the Location Server. If the user is in the access lists of the Location Server then access is granted and the user's current position is recorded and sent back to the Web Server. The Web Server informs the user for successful sign in and allows the user to select the product categories in which he is interested. Upon user selection the Web Server communicates with the LDAP Server in order to create a list with all the available super markets located near the user. If there is no supermarket located at the cell-sector in which the user is located then the two adjacent sectors are searched. If no supermarket is found there either, then the system returns an appropriate message to the user. But if supermarkets (at least one) are found then the Web Server returns their credentials and addresses. The user by selecting a supermarket can be informed for available promotions for products (belonging to the categories he has already chosen) offered by that certain supermarket.

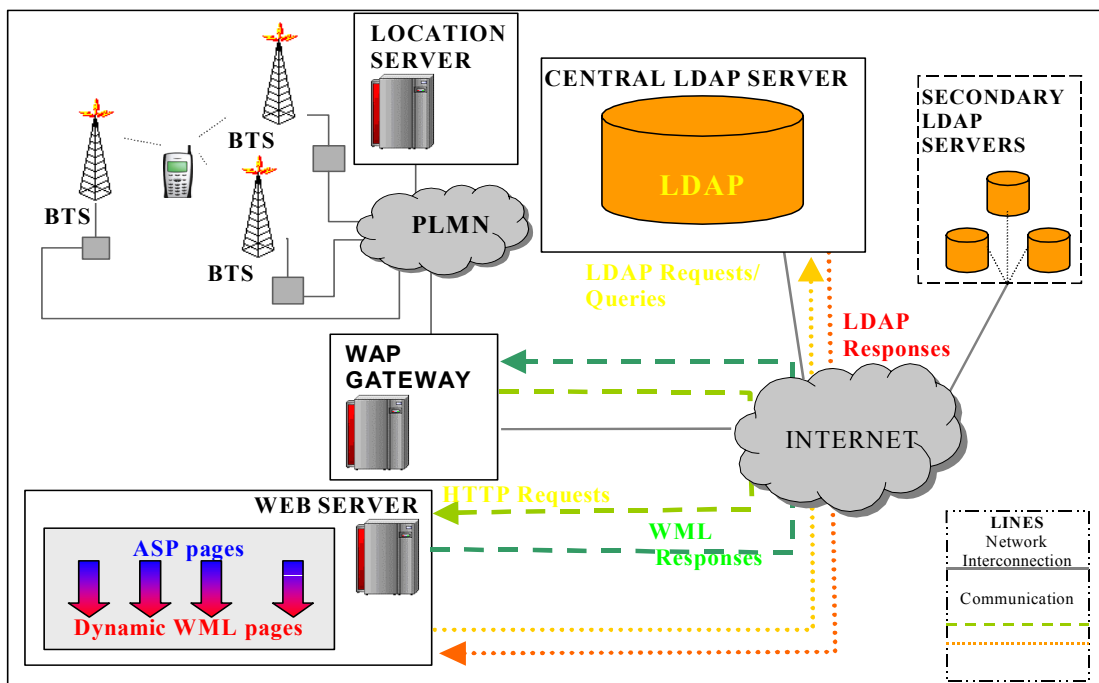


Figure 1: System Architecture

From the above it is made clear that the main building blocks for the proposed system are:

- Web Server
- Location Server
- LDAP Server

In the following paragraphs we study each one of them and analyse the technologies they utilise and their roles in the system.

Web Server

The Web Server acts as a central management unit being responsible for the following:

1. User Interface: The Web Server hosts static WML pages as well as dynamic ASP pages which generate new WML pages. The distinction between static and dynamic pages exists because only a part of the user interface remains the same (e.g. user authentication) while the rest contains pages, whose content is dependent on the user's location, the choices he has made and the contents of the product-promotions information base.

2. Communication with the Location Server: The Web Server constructs positioning requests, forwards them to the Location Server and then accepts the positioning replies from the Location Server. The requests and replies are constructed as XML documents following the Mobile Positioning Protocol (MPP) and the Web Server has the ability to compose and decompose these documents in order to encapsulate or derive information respectively. The MPP protocol is a kind of implementation of the official prototype MLP (Mobile Location Protocol), which is being developed by LIF (Location Interoperability Forum) and which describes the communication between an application and a Location Server. The MPP protocol is based on XML and it supports the CGI and CGI-TA positioning methods. In order for the positioning requests to be transferred to the Location Server the HTTP protocol is used and particularly HTTP POST requests.

3. Communication with the LDAP Server: The LDAP Server waits for LDAP requests, which correspond to search queries on its content. After processing the request the LDAP server returns an LDAP response. Using the user's location information and the choices the user has made, the Web Server forms appropriate LDAP requests (following the LDAP v3 protocol specifications) and forwards them to the LDAP Server. Then, based on the LDAP responses received, the Web Server dynamically creates new WML pages containing the results and offers them to the user.

Location Server

The Location Server performs two tasks. The first one is to authenticate user access to the system and the second one is to provide user location information.

During access control the Location Server checks user credentials (id, password, telephone number). If any of these credentials doesn't match to the records of an access list kept on the Location Server then an appropriate message is returned to the Web Server. User credentials are transferred from the Web Server to the Location Server with the help of the MPP protocol.

Upon successful authentication, the Web Server constructs a positioning request (in XML) for the particular user and forwards it through an HTTP POST request to the Location Server. The Location Server communicates with various network elements and initiates the appropriate positioning methods. When the user's location information arrives to the Location Server, the Location Server constructs (in XML) a positioning reply containing this information and returns it to the Web Server. If the user couldn't be located by the system, the Location Server returns a positioning reply containing a failure notification.

LDAP Server

The LDAP Server holds all the information about products, promotions and supermarkets. To be more precise this information is about product promotions, available categories from which a user can choose, details about the supermarkets which offer the promotions and last but not least identifiers and other details concerning the cell sectors in which the supermarkets are located. We should note here that the

requests are sent to a central LDAP Server. If the requests cannot be satisfied by the central server then they are propagated to secondary LDAP servers connected to that central server. This allows for information to be distributed across many different servers, which are responsible for information about certain supermarkets and/or certain geographic regions.

The LDAP requests are constructed at the Web Server as we have already mentioned. The first request sent searches for the available generic product categories (food, drinks, household). The second one searches for the available subcategories (e.g. for the food category some subcategories are meat, oils, fish etc.). The third request sent searches the information base for the cell sector in which the user is located according to the reply from the Location Server. When the sector is found then the product promotions for each supermarket located in that sector, are returned to the Web Server. Then the Web server dynamically constructs the user interface pages that will host all this information.

The main reason for using the LDAP protocol is because the information model is rather hierarchical than relational and is based in key-value pairs, matching perfectly the LDAP protocol's philosophy. The LDAP protocol is a broadly accepted standard for accessing such information and is mainly used in Internet applications, in Intelligent Networks and in modern multimedia communication networks [4]. Other reasons for using LDAP in the proposed system are:

- Even if a hierarchical model of information is «translated» to a relational one using normalised relational tables, there will be a need for recursive SELECT queries in order to retrieve knowledge that could be retrieved only through an LDAP query. This fact leads to lower response speeds of such a system.
- The X.500 type of services (The LDAP protocol enables access to such services) are used for storing and accessing mobility management data in public and private telecommunication networks (e.g. in 3G networks using UMTS) [1].

4.2 LDAP Directory Information Tree structure description

The first object in the DIT (Directory Information Tree) is the root (see Figure A in the Appendix). The first hierarchical level under the root contains objects of type CELL, which contain information about the cell global identity (CGI) identifier (CellID) and the cell's base station's geographic coordinates (longitude, latitude). One object of type cell is created for every cell in the coverage area of the service. For each one of these objects, three objects of type SECTOR are created at the next hierarchical level of the DIT. These objects store information about the sector identifier (SectorID) and the start and stop angle, which define the shape of the sector. Going one level further down the hierarchy we find objects of type SUPERMARKET for each supermarket located in the sector's covering area. These objects store information about the supermarket's identifier (SMBrand), their full name (Smname) and their geographic coordinates (smlong, smlat). These coordinates are not used by the application developed but are stored in order to make possible a transition to a system where better positioning accuracy can be achieved (e.g., accurate user location coordinates using the A-GPS positioning method). Three product categories can be found in every supermarket (food, drinks and household stuff), so under every object of type SUPERMARKET three objects of type PRODUCT_CATEGORY are created. If a certain supermarket offers promotions for any of the above categories a corresponding object is created one more level down the hierarchy. For example if a supermarket offers promotions on food products, then an object of type FOOD_CATEGORY will be created and its identifier (foodcat) will store the value/name of a specific food product-subcategory for which promotions exist (e.g., meat, pasta, dairy products etc.). Finally the objects which appear as leafs in the DIT are objects of type PRODUCT storing information about their brand and the promotion-message.

The flexibility provided by structuring the DIT in the above way is justified in the following:

- Between the root and the objects of type CELL new objects can be added in order to group the cells in greater geographic regions. This allows the use of relatively less complex positioning methods (e.g. location by postal code which the user enters to the system) when advanced positioning methods are not available or for pilot-applications.

- New categories and subcategories can be easily added as long as the appropriate objects are defined. Moreover new supermarkets that participate to the service can be easily added and/or existing ones can be removed.
- Every part of the DIT that corresponds to a specific supermarket can be stored to a separate server due to the tree structure. So the DIT can easily expand to serve any number of supermarkets. As a direct consequence, the availability of the entire system is strengthened, as there are many places where the information is stored and not a single one, the failure of which would mean the failure of the whole service. In addition using the replication process, which the LDAP protocol easily supports, the system can be strengthened furthermore against failures.

5. BUSINESS MODEL

5.1 Participating entities

There are three business entities involved in the business model, which will support the proposed service. In the next paragraphs we give short descriptions about the role of each entity and analyse the interaction between them.

The first entity of the business model is the customer (not a business entity). We define as customer the user of the service. The first business entity is the Cellular Service Provider, to whom the mobile network belongs and who is responsible for its operation and maintenance. The second business entity is the Provider of the advertising service (advertising Service Provider), who is responsible for the advertising service operation. Finally the third business entity is the company which owns supermarket stores (Supermarket Company). As Supermarket Company we define any company which owns supermarket stores in the geographic region where the advertising service is offered and wills to provide promotions for products through the proposed service. Next we describe the interaction between the entities of the business model.

5.2 Interactions

The interactions between the business model entities, as described in the following paragraphs below, are presented as arrows in figure 2.

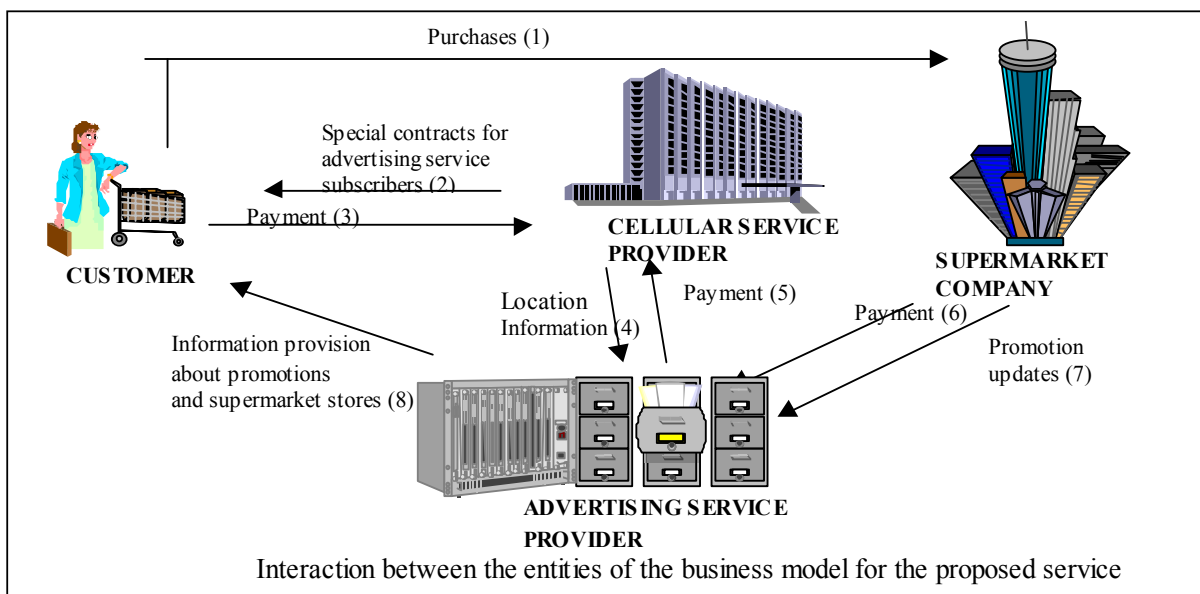


Figure 2: The Business Model

Customer

The customer is also a mobile subscriber for the Cellular Service Provider. Through the mobile network the consumer has access to the advertising service. The customer pays (arrow 3) the Cellular Service Provider according to the contract between them and also makes purchases (arrow 1) exploiting the promotions he receives about products he is interested in.

Cellular Service Provider

The Cellular Service Provider provides special contracts for users who want to use the advertising service (arrow 2) giving them extra incentives to do so. The Cellular Service Provider also sells the location information of the subscribers who use the advertising service to the advertising Service Provider (arrow 4).

Advertising Service Provider

The advertising Service Provider provides the means (infrastructure, communication) to the Supermarket Companies to be able to update information about the promotions that they offer. The advertising Service Provider is paid by the Supermarket Companies (arrow 6) and pays the Cellular Service Provider (arrow 5) for getting subscriber location information through his network.

Supermarket Company

The Supermarket Company frequently updates its product-promotions information (arrow 7), which are being available to the customer through the advertising service. The Supermarket Company also pays the advertising Service Provider a fee for participating to the service (arrow 6).

5.3 Service Viability

The advertising Service Provider's revenues come from companies which are interested to communicate their product promotions to mobile subscribers. These revenues should cover the operational cost of the service (e.g. maintaining records in the information base, payments to the Cellular Service Provider for providing subscriber location information). However the advertising Service Provider can create another revenue channel exploiting the information he possesses about consumer trends by maintaining a database with information about product categories for which consumers seek promotions, organised by location and time. The advertising Service Provider could sell access to this database to third party companies, which would be interested in mining consumer trends. Having already established the infrastructure for the advertising service, the Service Provider could also exploit the same infrastructure to expand to other sectors of retail commerce e.g. hosting promotions for clothes, shoes etc.

In the following paragraphs we analyse the strategic goals and benefits for each one of the other business model entities interacting with the advertising Service Provider.

- **Supermarket Companies**

The Supermarket Companies use the proposed service to promote their products and to increase their sales by providing highly personalised promotions to each individual consumer. According to experts, this type of marketing (one to one marketing) has the greatest possibility to result into a sale. The proposed service creates a new marketing channel through which a company can communicate with each one of its customers separately [5]. The customer is given the ability to customise the advertising messages he receives (by choosing the product categories-subcategories he is interested in), to receive these messages when he needs them (before or during shopping) and finally to get extra information, which will help him to reach the store that offers the promotions (store address). Finally, through this new marketing channel the supermarket companies are given the ability to respond to market trends immediately with low cost, in contrast to traditional marketing channels where costly marketing campaigns were requested every time a company wanted to revise its marketing strategy. We should mention here that this new channel will not cannibalise existing marketing channels but it will coexist providing the sense of personalised communication between company and customer that current marketing channels lack.

- **Customer**

Every mobile subscriber generally wants immediate and timely information tailored to his/her needs and interests, information that adds value. The information, which adds value in our case, is information that minimises the time a consumer dedicates in finding the best money-for-value promotions when shopping. A subscriber also wants to freely choose when to get all this information. Last a user-friendly interface for the service is required in order to facilitate the browsing of promotions.

The location based advertising service proposed achieves all this expectations by offering subscribers information about products they are interested in, at the right time and place (the subscriber chooses when to initiate the service and selects which products are of interest to him). In addition the subscriber is informed by the service about the whereabouts of the nearest supermarket stores in which he can find the desired products. Finally the interface implemented is very user friendly, as it is based on easy-to-browse menus only. The user doesn't have to write down words but he can browse through product categories and make selections by just a few clicks.

- **Cellular Service Provider**

The three strategic goals for Cellular Service Providers are:

- To attract new subscribers
- To keep current subscribers loyal
- To increase their revenues

In order to accomplish the above goals a Cellular Service Provider should support and push the provision of pioneer services of high utility and value to the mobile subscriber. Location Based Services have already been identified as such. Especially for the service proposed here, its added value has already been described in the above paragraphs. When such services are deployed the loyalty and satisfaction of existing subscribers grows while new subscribers are added to the provider's subscriber base in order to use these services too. Last but not least the Cellular Service Provider establishes a new revenue channel by selling location information to the advertising Service Provider.

6. CONCLUSIONS AND FUTURE WORK

We implemented an information system supported by a Location Based Service for the mobile marketing sector and proposed a suitable business model to support this service. We defined an "open" distributed architecture to promote service reliability and fault tolerance. Our implementation was based on broadly accepted, standards-based technologies. We elected to put the complexity on the network-side rather than the client device, where we opted for a simple and easy to use user-interface.

For our future work we are considering the development of an intelligent agent, which on behalf of the user, would select automatically the most appropriate Super Market located near the user, based on criteria like distance, total purchase cost, user cost or distance aversion, etc. Further work should also be done towards improved business models for deploying location based services for advertising.

REFERENCES

1. E. Buitenwerf, G. Colombo, H. Mitts and P. Wright, "UMTS: Fixed network issues and design options," *IEEE Personal Communications* 2(1) (1995) 30-37.

2. K. Cousins, U. Varshney, "A Product Location Framework for Mobile Commerce Environment" in the Proceedings of the *ACM Mobile Commerce Workshop*, Rome, Italy, July 2001.
3. I. Koeppel, "What are Location Services? - From a GIS Perspective," Available at: [http://www.jlocationsservices.com/company/esri/What are Location Services.html](http://www.jlocationsservices.com/company/esri/What%20are%20Location%20Services.html)
4. H. Maass, "Location-aware mobile applications based on directory services," in the Proceedings of the Third *Annual ACM/IEEE Conference on Mobile Computing and Networking*, September 1997.
5. O. Ratsimore, V. Korolev, A. Joshi and T. Finin, "Agents2Go: an Infrastructure for location-Dependent Service Discovery in the mobile electronic commerce environment," *First ACM Mobile Commerce Workshop*, Rome, Italy, July 2001.
6. G. Swedberg, "Ericsson's Mobile Location Solution," *Ericsson Review*, No. 4 (1999).
7. B. Waqar "Location Tracking Techniques (E-911) especially in a CDMA Environment," Masters research paper. Available at: <http://www.personal.psu.edu/users/b/x/bxw175/newres.htm>
8. Location Based Services, Service Requirements Document. Revision 1.0.0. GSM-NA Services Working Group, GSM Association Services Expert Rapporteur Group, January 2000.
9. "Nationwide Study on Consumer Interest in Location-Based Services", Driscoll-Wolfe Releases 2002. Driscoll-Wolfe private market research study. Overview available at: [http://www.driscoll-wolfe.com/2002 WLBS PR.htm](http://www.driscoll-wolfe.com/2002_WLBS_PR.htm)
10. Siemens mobile, "Siemens Location Services (LCS), Mobile Phone with a sense of place, Added value through location services" White Paper. Available at: http://www.siemens.mobile.de/mobilebusiness/CDA/external/press/en/Whitepaper_Location_Based_Services_e.doc
11. The GSM Alliance Services Working Group. <http://www.gsmworld.com/about/structure/serg.shtml>
12. "Top Line Trends In Consumers' Attitudes Towards Location-Based Services In Great Britain, France and Germany". Research commissioned by AirFlash, Inc in January 31, 2001. Available at: http://www.webraska.com/news/pres_rele/saratoga/pr_1_31_01.html

APPENDIX

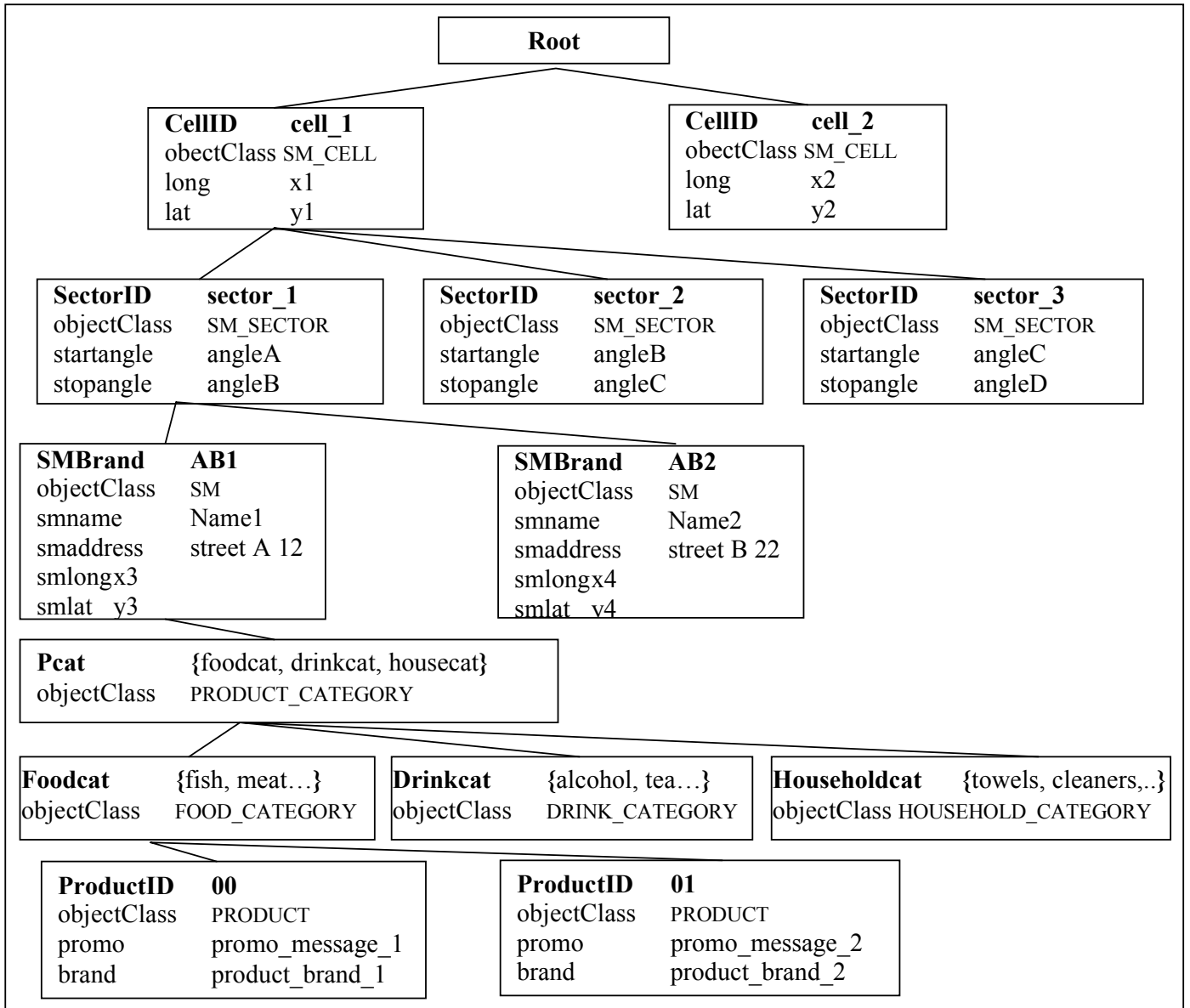


Figure A: The Directory Information Tree