IMPROVING CROATIAN TOURIST INFORMATION VIA LOCATION-BASED PUBLIC SERVICE THROUGH MOBILE PHONES

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Abstract – The paper analyses the reasons for the development and the possibilities of implementing the applications for mobile terminal devices in order to improve the tourist information in the Republic of Croatia. The application has been developed in J2ME environment at the Faculty of Transport and Traffic Sciences. The results of experimental application have justified this research. The basic idea is to prove the justification of implementing the services based on the user's location in improving the process of informing the traffic system users, mainly regarding the provision of new classes of services in the field of tourism.

The paper presents the conceptual, logical and physical operation model of the application intended for real-time informing of the traffic system users interested in the tourist offer of their current location. The paper also presents the analysis of the necessary information and communication technologies which are used to achieve real-time and location-based information. The research is based on the fact that tourism in the Republic of Croatia is the fundamental development orientation. What has been noticed is the currently relatively poor information level based on the principles that are lagging behind technologically and that offer out-of-date and poor quality information. The result of the application developed through implementation is a better level of information provided to the potential users of tourist services in Croatia.

1. – Introduction

Today we are witnessing the ever faster development of information and communication technologies, led by mobile communications with increasingly innovative new services. It is becoming more and more difficult to meet the users' desires. Every day new services are emerging with the aim of attracting new and keeping old users.

A large share in the new users paradigm belongs to the Location-based Services (LBS). The term LBS is most often linked by applications that integrate the geographical position with other pieces of information. The development of new classes of services, based on LBS, including those applicable in the field of transport and tourism according to the forecasts in various studies (e.g. Gartner Inc.), technically and conceptually, represents a new field for the formation of economic subjects (service providers) who will provide information and consequently realise economic profit.

Based on the application of the existing technologies and by forecasting new technologies and the possibilities of their exploitation, a conceptual application model has been developed for mobile terminal devices in GSM/UMTS networks in the function of applying LBS services with the aim of improving tourist information services. The primary task is to make it easier for the users to access the real-time information regarding the tourist information for the near vicinity and to improve their quality and credibility (information on

the possibilities of leasing and selling certain real estates together with the details about them), providing and increasing the mobility and level of information of the potential known and unknown users.

2. – Location-based Services

The primary role of the location-based services is the integration of the location or the position of the mobile terminal device (which includes the user) with a maximum of other available pieces of information (in this case, the tourist offer of a certain region) which eventually results in providing the users with new Value Added Services (VAS). It should be emphasised that this insures the precondition for economically based work of the new subjects for information management about the tourist offer. With fast development, wide spread and the convergence of the information and telecommunication technologies integrated into mobile terminal devices, determining of the location of mobile users has become possible by the application of several different technologies. The technologies include the Geographical Information System (GIS), the satellite positioning system, radio frequency identification and various other positioning technologies of higher or lower accuracy, coverage or costs of installation and maintenance, depending on whether these are related to indoor or outdoor premises, the necessary level of positioning accuracy of the user's device and the objective of the application (Figure 1).

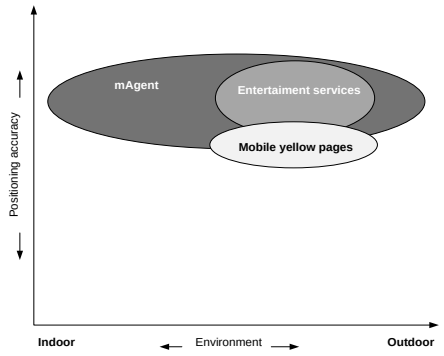


Figure 1: Levels of positioning accuracy depending on spatial characteristics

2.1 – LBS implementation domain

For the moment the location-based services are mainly related to three areas: in military and state branches, emergency services and commercial sector services. The application considered in this paper would require minimal adaptation of the system, primarily at mobile telecom operators, their position on the market, technical and technological conditions and relations established towards the end user. Another option is the provision of information about the users' location obtained by using telecommunication network resources to the third party, i.e. certain interested service provider, who would add new value to the generated information (e.g. information about tourist facilities).

Starting from the previously mentioned conditions and their implementation for undisturbed functioning of LBS services, i.e. one's own developed *mAgent* application, with the previously selected business model, the target group of *mAgent* application are the persons with the attribution of tourists in Croatia. Such a group of users is interested in the information of certain characteristics such as lease or purchase of certain real estates, information about catering facilities or cultural objects, etc., but their method and habits of

living do not allow them detailed and good static search (searching the advertisements in written or web forms). The *mAgent* application provides the possibility to do this regardless of the locations of the users and the time via mobile terminal devices, compatible with the J2ME development environment.

2.2 – Framework model

For the location-based applications to function, it is necessary to overcome several challenges of technical and technological nature. Technologically, the LBS realisation can be described as a triple-layered communication model (Figure 2) which includes the following layers: positioning layer, middleware layer and application layer.

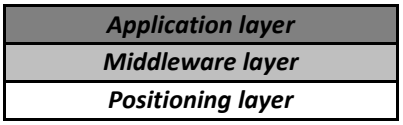


Figure 2: Three-layered communication model of LBS

The Positioning layer is responsible for locating the mobile device i.e. the user. This is done by means of the Position Determination Equipment (PDE) and geospatial data stored in GIS. While PDE determines the position of the device regarding network, GIS enables conversion of the network into geographic information (longitude and latitude). The end output is the forwarding of the obtained results by means of a Gateway directly to the application layer or the middleware layer.

The Middleware layer: necessary to insure a simple way of linking the operator's network infrastructure with the GIS data (vector and raster maps, aero photos, geocoding and reverse geocoding) and LBS application layer, and provides the functions of protecting privacy and anonymity of the user in determining their position.

The Application layer allows the application logic for all the services that use the information on the user's location, processes and displays information about the location.

3. – Application deployment

The main characteristic of the entire system is high-quality and up-to-date information that is being handled, such as the advertisements about the real estates – flats, apartments, houses, land, etc., which are available to the user in the form of graphical-visual display on a map using mobile terminal devices, available to the supporting advanced communication technologies (GSM, WCDMA/UMTS, LTE) in real time. Depending on the current position, the mobile user is provided the possibility of getting information on the location and detailed information about the requested real estate as well as the existence of the objects of equal or similar attributes, in their immediate vicinity (within a variable radius of 1-8km from the user's position, Figure 3). Everything is adjusted for the graphical presentation on the mobile device, with the user's current position marked on the map, including the available real estates in the vicinity, for the sake of faster orientation and more precise information.

It is very important to note that the *mAgent* application provides the user with the search results not only related to the user's position, but also similar ones, i.e. with the approximate search results of advertisements based on the given criteria, applying the so-called fuzzy logic. These results need not necessarily be related to the immediate vicinity of the user. The user can see what else with similar characteristics, is being offered at other locations by implementing an algorithm, testing the given search criteria, and thus obtaining positive results – either exact or approximate to a certain level.

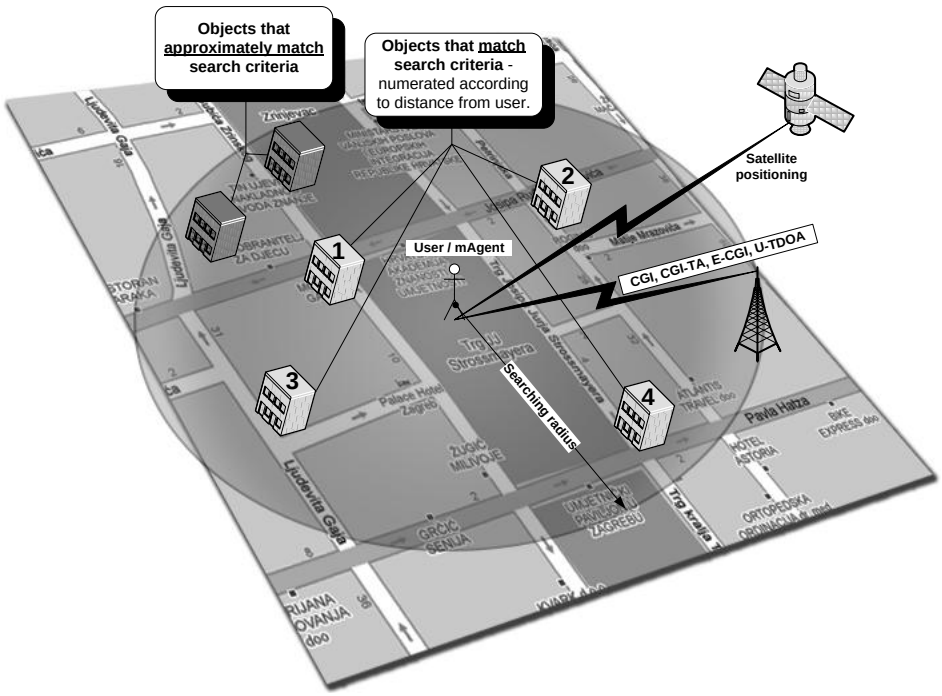


Figure 3: Visual presentation of providing information to a potential user

3.1 – System entities interpendence

The entities of the entire system (Figure 4), the relations between individual parties are complex and partially do have conflicting goals. This makes smooth cooperation among the entities more difficult and this is one of the reasons, generally speaking, for a slower advance of LBS on the market.

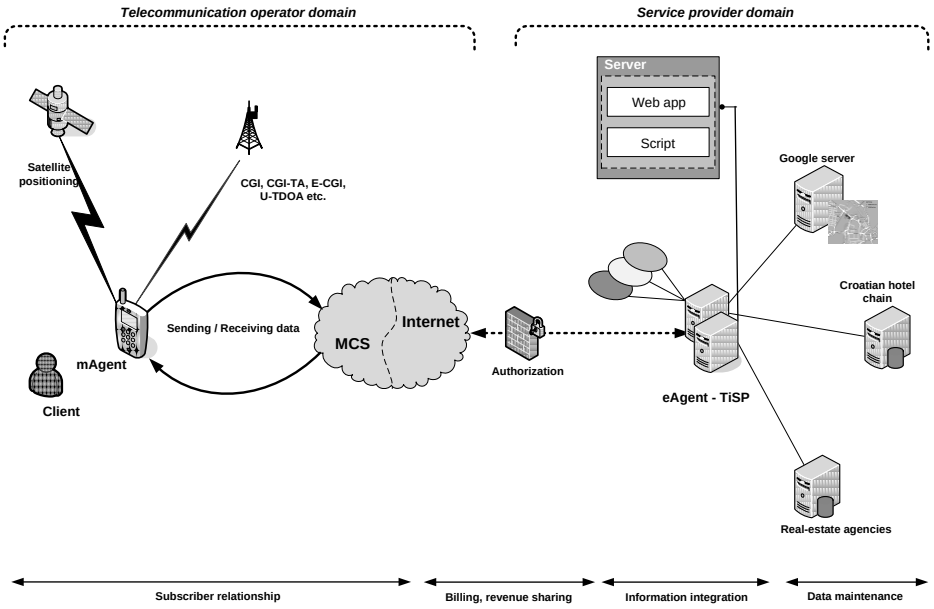


Figure 4: LBS value chain

The user is the applicant and the "customer" of location-based services, who uses the *mAgent* application on their mobile terminal device. Apart from determining the location via satellite navigation, the user can use the equipment and the technology for positioning CGI-*Cell Global Identity*, CGI-TA – *Cell Global Identity with Time Advance*, E-CGI – *Enhanced Cell Global Identity*, U-TDOA - *Uplink Time Difference of Arrival* provided by the telecom operator.

The data are sent by means of MCS - Mobile Communication System, to the tourist information providers - *Tourist information Service Provider* (TiSP) [6], based on self-developed application *eAgent* which has been developed for tourist information service provider web business, for integration of data, location-based information and their harmonisation, maintenance and updating – from geographic maps, detailed city maps, data on facilities, providing services to the Croatian chain of hotels and real estate agencies in order to assist in sales/lease of apartments, real estates, etc. After having performed data integration by TiSP according to the user's request, these are sent back and displayed on the user's mobile terminal device.

The Telecom operator and the users have a subscription relation. This means that the users are the main source of operator's revenues and therefore they are very careful in their efforts not to lose a single user. To the other side, the telecom operator is in a very fragile correlation with TiSP, i.e. *eAgent*. They are connected only by the charging and sharing of revenues based on the provided services. On the other hand, *eAgent* is interested in collecting data on the users' habits and profiles, which can attract interest of the other party. It is necessary first of all to determine the quality of service and to sign the *Service Level Agreement* (SLA).

3.2 – Information quality level

The introduction of new classes of services into mobile communication systems enables their application as the basis for implementing the principles of mobile public services in the information system of the interested service provider. However, feasibility, availability and the possibilities of relatively affordable prices of implementing the new services are not a sufficient incentive for the development. A threat to the introduction of services regarding tourist information is also the quality of information, responsibility for their distribution and the possibility of value adding, i.e. the charging of the target users. The quality of information depends directly on their updatedness by the information provider.

When one analyses the characteristics of information, placing them on a timeline, it may be concluded that the most adequate ones and those with greatest usability are those pieces of information that change several times a day and within a time interval of 1 hour to 1 day. The group of information of such characteristics includes also data on real estates, various facilities, etc., that may be described by a stochastic model of the traffic system. Potential interest, as well as the optimisation of resources and operation costs may be restricted on the bases of LBS-based services for numerous potential users.

Feasibility, availability, usability and technological solutions are not sufficient for the success of the commercial LBS service. Like various other technologies, LBS has several competitors with similar value propositions. LBS has to provide a convincing proof to the user of its superiority over other services. The most important item of high-quality LBS service is the level of information quality (Figure 5).

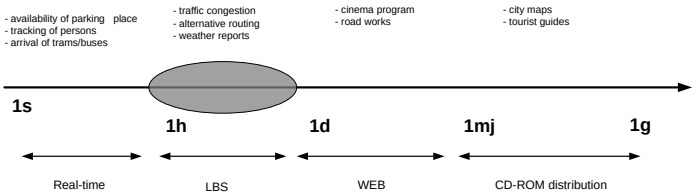


Figure 5: Change of information on the timeline

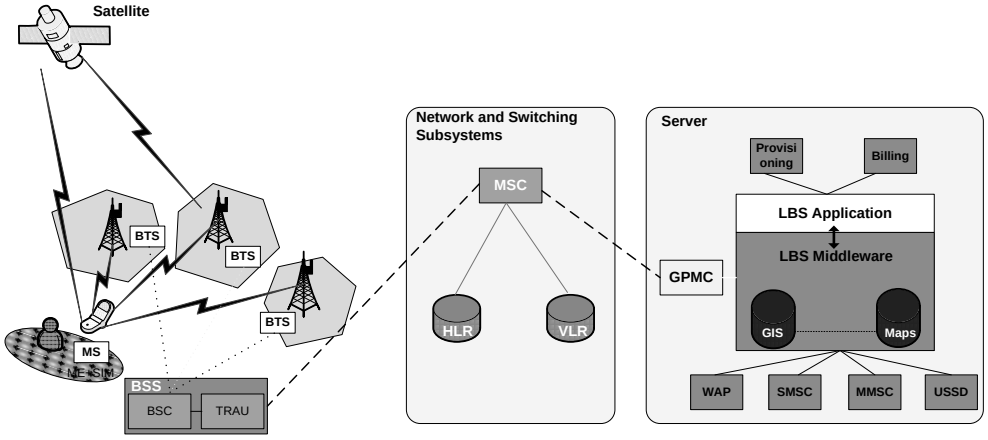
Looking at the timeline, it may be noted that the location-related services are most usable in an environment in which the information changes more than once a day, but remains valid over a certain period of time, usually for as long as it is necessary for the user to reach the desired destination, i.e. target. For instance, the application which assists in finding a free parking place is not an appropriate LBS application, since the information about a free parking place changes very often in urban areas and these time intervals of changes are shorter than the time necessary for the user to reach the available parking place.

On the other hand, the operation method of *mAgent* application is based on updated and good informing of the users. The diagram in Figure 5 [11], leads to the conclusion that *real-time experience* is the most adequate medium for *mAgent* operation with the aim of improving the tourist information in Croatia, with the information contents changing in a time interval ranging from 1 hour to 1 day.

Other pieces of information that remains static even for several days are more suitable for web pages (information on various events, cinema programs, shop opening hours, etc.) rather than LBS.

3.3 – Architecture design

The system architecture consists of several sub-systems that form together a functional whole (Figure 6).



Abbreviations	
BSC	Base Station Controller
BSS	Base Station Subsystem
BTS	Base Transceiver Station
GIS	Geographical Information System
GPMC	Gateway Mobile Positioning Centre
HLR	Home Location Register
ME	Mobile Equipment
MMSC	Multimedia Messaging Service Center
MS	Mobile Station
MSC	Mobile Switching Center
SMSC	Short Message Service Centre
TRAU	Transcoding and Rate Adaption Unit
USSD	Unstructured Supplementary Service Data
VLR	Visitor Location Register
WAP	Wireless Application Protocol

Figure 6: System architecture

- *Client.* Represents the user, i.e. mobile terminal device, which serves as the so-called intermediary between the user and the rest of the system – in this case *mAgent* application. It serves for visual communication with the user already regarding the fact that the obtained data are graphically displayed on a map on the mobile terminal device display.

- *Network and Switching Subsystem(s).* Infrastructure of a supporting network and all the accompanying equipment and technology necessary for the communication and data transfer on the relation client, user – provider and vice versa.

- *eAgent.* Server computer of the tourist information provider described in more detail in Section 3.1.

- *LBS application.* Used for integration of advertisements together with the related attributes and their connection with the geographic data. It is found on the server computers in the form of a web interface.

- *GIS database.* Contains detailed and content-based geographic information about streets, cities, districts, counties, and integrates these data with other data (e.g. data on certain facilities, providing thus added value). The types of data related to advertisements (objects) are mostly in correlation with location. The problem is how to correlate a certain advertisement with a certain geographic location and how to connect certain attributes only with those advertisements they relate to. For instance, the data on the number of rooms for a certain flat is meaningless and invalid when referring to a storehouse. For all this a good database model is required, which is dynamic, flexible and scaleable in the function of regular updating and efficient search of the database records (Figure 7) [8].

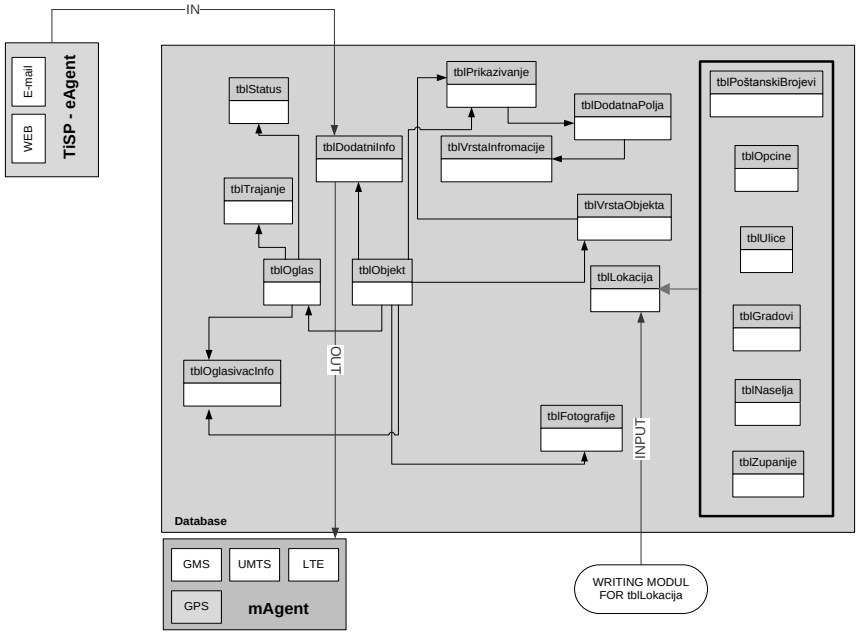


Figure 7: System data flow logic model

- *Maps.* At the time of displaying a requested real estate in their immediate vicinity on the display of the mobile terminal device, these are presented together with the background map.

3.4 – Use-case scenarios of the *mAgent* application

For *mAgent* application several possible use-case scenarios can be defined. The user wants to find a certain facility, e.g. an apartment which is for lease. The required facility may be, but needn't be available. In case there is a certain facility that satisfies their affinities, the user sends a request for the closest approximate location of the searched object. The found objects with the respective locations are displayed in the graphical form on the map on the user mobile terminal device display, depending on its known position.

In case there are several users, i.e. requests for certain objects, the serving discipline in that case is *First-come-First-served* (FCFS), i.e. every user is assigned respectively the so-called *mVoucher* which obligates the user and provides the possibility to be first to make contact, i.e. to fulfil their purpose – to lease the apartment in this case. Optionally, the user may request a route display, display of routes to the object or they may call the flat owner, i.e. agency.

Another possible scenario is when the user wants to be informed about the requested object when it is available. The moment the object that satisfies the criteria set by the user appears, the user is informed by means of a message. In this case also, equal discipline of serving is valid, i.e. the *mVoucher* principle.

And thirdly, the user wants to be informed when they are in the immediate vicinity of the object they are looking for. This is a characteristic case of the previous scenario. Apart from wanting to be informed about the requested object in case it becomes available, the user also requests to be informed when the object is in their immediate vicinity.

3.5 – *mAgent* application interface

The operation of the *mAgent* application is based on a simple and intuitive usage. The objective was to make it possible for the user to obtain the desired results in as few steps as possible. Immediately upon starting the application, the user is offered the main menu (Figure 8-a) where the user selects the type of real estate that they are interested in. The second step is the input of the search criteria (Figure 8-b), depending on the selected type in the search interface, into which only one of the several requested parameters is input – this may be the planned user budget, desired flat area (quadrature), number of rooms, land price, etc. This is followed by determining the user's location by means of GPS. When the location has been determined, the coordinates are sent together with the search criteria to the server for further processing [7].

(a) Main menu. (b) Search interface (c) Map object display (d) Choosing info

(e) Available objects (f) Additional info (g) Additional info (h) Object's photos

Figure 8: Actual operation of *mAgent* application on SonyEricsson K800i

Based on the received data, the software script on the server performs necessary activities (adaptation, aggregation of information) and returns the data and information as search results to the user mobile terminal device. This information is related to the advertisements (real estates) which are located in the vicinity of the user based on the determined position, i.e. read GPS coordinates.

On their mobile devices the users obtain displayed search results on the map (Figure 8-c). For each of the presented announcements, additional information can be viewed as well (Figure 8-f, Figure 8-g) such as the level of equipment (type of heating, availability of Internet, geographical orientations, etc.), the closeness of public urban transport, public and educational institutions (schools, kindergartens) and entertaining, cultural and catering facilities, etc. Each advertisement is numbered regarding the level of distance from the user's location, from *1* to *n*, respectively.

An interesting option is providing the user with the possibility of viewing the photos for a certain real estate (Figure 8-h) and the user can immediately contact the advertisement submitter and look at the desired real estate.

The display of time specification of performing the operation and the interaction of the process among the system entities for the needs of the operation of the self-developed *mAgent* application is presented by a diagram in Figure 9.

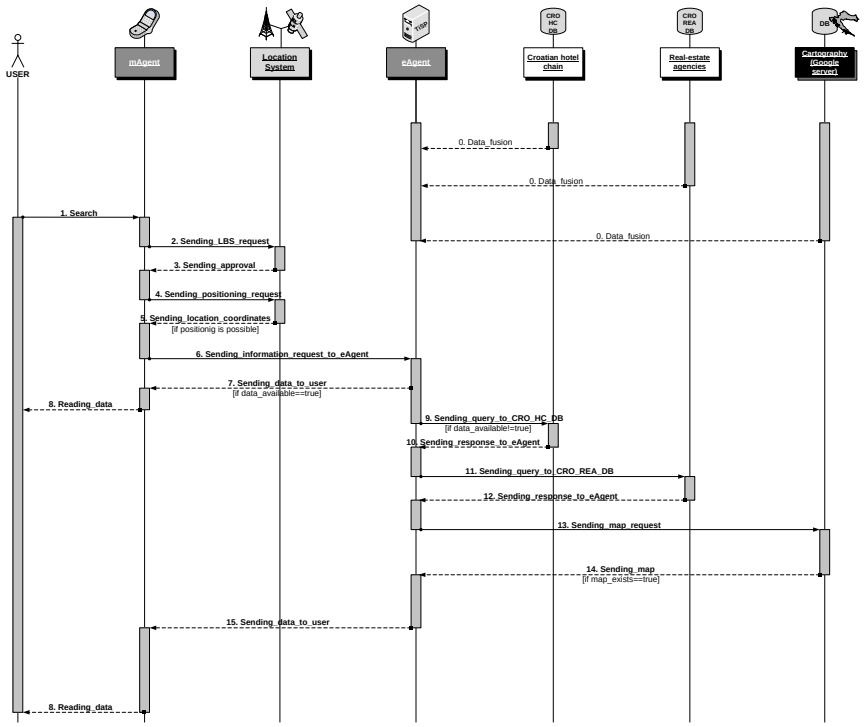


Figure 9: UML sequential diagram of *mAgent* application operation

4. – Conclusion

The objective of developing the described application was to study the possibility of implementing the LBS service in order to raise the level of tourist information in the Republic of Croatia. The field of LBS services in Croatia is still in its infancy and just starting to develop. In the western countries the degree of distribution and usage of LBS applications is at a higher level, which is contributed also by the mobile operators with low prices of the data traffic. The development of information and communication market in Croatia and the formation of greater competition will result in lower service prices, and thus also greater usage of LBS applications by the users.

Although at the present level of development the application operates quite satisfactorily and well, there are possibilities of further improvements and upgrading of the very application by new possibilities and functionalities. The price of application, according to current tariff packages of the telecom operators in Croatia, is acceptable, except when it refers to the roaming users, but this is solved at a higher level of negotiations and recommendations of the European Commission of telecom operators in EU.

Since during the past development the application used to be based only on search and display of the searched real estates on a map on the mobile terminal device display, the application development methodology allows simple adaptation and implementation with necessary improvement of the distribution methods through cooperation with operators of mobile communication systems. The additional functionality, namely, for better information of the users regarding tourist resources, is the provision of information to the users about other objects and activities as well, and complete personalisation of the service based on the users' habits.

The user, i.e. the tourist in Croatia can obtain information about the required tourist resources that are in the immediate vicinity of the very user shortening thus the way through the traffic network and time that they would otherwise use to arrive to the concrete object without using *mAgent* application.

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