# LOCATION BASED SERVICES IN REVITALIZATION

*The Use of Commonly Available Techniques for a Client-Participation Model*

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**Abstract***:* This research concentrates on the combination of remote sensing devices, georeferenced data, web-based optimization techniques and Location Based Services in revitalization. Its aim is to enhance the delivery of information about the development potentialities of existing buildings. The present and idle stock of buildings is extensive. Nonetheless, significant data and information about existing buildings is hardly available. The real estate owners are usually not known by prospective clients and they can be elicited only with substantial effort. But even if data about a building is available it is difficult to valuate it precisely, because of missing standard classification techniques. The question whether or not a building is suitable for a certain subsequent use is therefore hard to answer. It involves an extensive expenditure of time and manpower. Recent publications however, demonstrate that requests for the re-use of buildings can be solved through the use of combinatorial optimization techniques (Loemker 2006a, 2006b, 2007). Within these approaches researchers mainly concentrate on the architect dealing with inquiries from clients. These inquiries typically address the question if specific buildings are suitable for particular future uses. With the aid of optimization engines the architect can solve these requests through a description of the existing buildings and the corresponding enquiries in terms of specific criteria such as number and size of rooms or adjacency between rooms. According to an unambiguous syntax these approaches can be applied to any building type. The building data is stored in databases which can be inquired through optimization engines which thereupon calculate suitable solutions to the demands made by the client. But even if these approaches demonstrate high potential, their bottleneck lies in the exclusive use through the architect. Neither can they be addressed to buildings that are not listed in the architects own inventory listings nor can they be used by the clients themselves. Furthermore, no reliable statement about a prospective reuse of a building can be made directly on site by prospective clients, i.e. buyers or renters. In our research we examined if ad-hoc analyses of existing buildings can be accomplished through the clients themselves with the aid of Location Based Services that can be accessed by common remote sensing devices. The aim is to give prospective clients the possibility to visit a building and run in-situ usability simulations. To accomplish this, building data will be transferred between the building and the client through the use of ordinary communication devices. These devices automatically connect to server-based applications, which compare the requirements of the client with the existing building and run remote simulations on concrete further utilization. The newly generated information will then be passed back to the client's device. In the paper we address a scenario of a prospective client who visits a city where he hits on an unused building he might be interest in. The client wishes to gain immediate and accurate information if the building is able to meet his demands regarding the space needed for his company. Different techniques investigated, their assets and drawbacks will be described that could accomplish suchlike tasks.

## 1. The dilemma of revitalization

The size of the existing building stock is enormous. In Germany and in many other European countries a massive amount of buildings exists that is not used anymore. From an ecological point of view this development is crucial and has to be handled with great care. The most essential aspect of this development refers to the fact that existing buildings consumed a lot of energy during their erection and during the first phase of their life-cycle. As long as they remain untouched there would be no more energy consumption to be denoted. But unfortunately at the same time new buildings arise which in turn consume energy and often the erection of these new buildings involve the demolition of existing ones (which again consumes energy). Instead of questioning this process, it seems that no-one really has an interest to propagate the necessity of a continued use of old buildings. There is a great variety of reasons for this dilemma. On the one hand architects have a superior interest in new buildings, whereas on the other hand the revitalization of old buildings involves many unstable and unpredictable factors. But there are other reasons for this situation as well.

Firstly, there is no general repository about the building stock, which means even if a client is interested in using an old building it is hard for him to find appropriate information about buildings that fulfill his specific needs.

Secondly, information about buildings that are listed in inventories is not publicly available and even if, it is not standardized. Thus, different inventories from diverse owners or caretakers are difficult or impossible to be compared.

Thirdly, it is difficult to gather information about a building someone incidentally faces. Often the request to rent a building is not only made on stringent conditions. An interest could arise frequently by just passing by an appealing building or a pleasing neighborhood.

*Figure 1.* A typical revitalization object.

Whereas it is difficult to foster the architect’s interest in revitalization or to reduce the difficulties of unstable revitalization conditions, it is possible to find answers in terms of technology utilization to some of the other aspects brought forward, i.e. in-situ analyses.

## 2. Access to Building information

Let us consider a scenario of a prospective client who visits a city where he incidentally faces an unused building he might be interest in. The client has no idea if the building is able to meet his demands regarding the space needed for his company. To obtain more information about the building he should either contact the real owner or an estate agent. Both are unknown to him and difficult to find without substantial effort. To get reliable information about potential future uses he might as well involve an architect which would entail to invest money. In any case the client has to gain access to any kind of inventory listing that specifies the building data needed. Most problematic in this context is the question which data is stored in these listings, i.e. for what aim they were compiled and how they are organized. Generally spoken the content of inventory listings might be extremely diverse and closely related to the question of who is using them primarily.

In our scenario it would be sufficient to use listings that first and foremost specify basic data about the buildings dimensions, organization, classification and prior utilization. The whole purpose here is to make use of the existing building stock due to ecological reasons, i.e. the dissipation of energy through the erection of new buildings. Therefore we prefer a quantitative approach which lists many buildings with fundamental properties instead of a smaller amount of buildings which are precisely specified in every nut, bolt and screw.

More specific the aim of these inventory listings merely is to publicize the existence of buildings that might be suitable for new uses with the goal to sell or rent them. Through the use of these listings in conjunction with Location Based Services a first stone can be laid for further thorough discussion of the subject. Once a request to the LBS is successful many other parties have to be involved, i.e. real owners, estate agents, architects, town planners, municipalities, planning offices.

### 2.1 DATA STORAGE, COMPILATION AND ACCESS

Apart from buyers all parties mentioned above store information about unused buildings some way. Unfortunately the type of storage is not standardized. Thus, different data types exist (text, drawings, photos, etc.), classification schemas, if any, are oriented towards the specific owner of the data and data formats represent the variety of software deployed. It is unnecessary to mention that this status quo is apparently not going to change shortly. Therefore it is reasonable to find the lowest common denominator all parties could comply to. In our approach it would be suitable to use ASCII-files to be imported into our databases. These files have to apply to an extensible classification schema, which currently lists the fundamental properties mentioned above. Due to our attempt to spread the system widely and make it accessible for many different devices we try to refer to Open-Source-Software under licenses such as GPL. In this case a MySQL-database can be used to merge data from different parties.

Most software products commonly used in the building sector are able to generate ASCII-files according to the classification schema of a MySQL-database. Within many applications programming interfaces exist that could aid this process. The majority of CAD-software also supports the Industry Foundation Classes (IFC), through which the data needed can be generated automatically. But as long as inventory listings are only available to those who have compiled them, the idea of revitalization would not spread out widely. It is therefore indispensable to find a medium that provides public access to the lists. Not only to share the data but to generate information as an answer to the users specific request. In our approach we refer to the utilization of remote sensing information technology, the Internet and Location Based Services to accomplish this demand.

## 3. Client-Participation and Location Based Services (LBS)

To gather more information about the building the client could search for information on the Internet. With the aid of search engines like Google™ he would type keywords such as the name of the street and the city (i.e. the position) or he would try to find phone numbers of real estate agents and ask them if they now about the building. In any case the only valuable information the client can provide is the location of the building. Location Based Services can employ this position automatically by using mobile devices. LBS can be described as follows:


*Figure 2.* Cellular phone with LBS-request.

“LBS are information services accessible with mobile devices through the mobile network and utilizing the ability to make use of the location of the mobile device.” (Virrantaus et al. 2001) referred to by (Steiniger et al. 2006).

It is important to notice that the client cannot gather information about the building in-situ without asking someone passing by or without using technology he usually does not have at hand. The idea of LBS is that through the use of commonly available mobile communication devices and with the aid of data relating to the position, time and individual user, information or services could be made available by a service provider.

## 3.1 COMPONENTS OF LOCATION BASED SERVICES

### *3.1.1 Mobile devices*

These devices assure communication between the client and the provider of Location Based Services. Mobile devices can be cellular phones, smartphones, PDA's, PNA's or notebooks. It is important that they have the capability to communicate via any kind of communication network. Communication can be established through various techniques, among which GSM, GPRS and UMTS prove to be most successful.

### *3.1.2 Communication networks*

The mobile network transfers data from the users' mobile device to the provider of the Location Based Service. This communication is bi-directional so that interaction between the parties is possible. The simplest possibility to set up a communication network would be a Wireless LAN, due to the fact that access to this service is more or less area-wide available. It is however wise to consider Wide Area Networks due to their better tracking mechanisms and wider range of devices to be supported.

### *3.1.3 Positioning component*

To deliver a service to a client's mobile device, its position has to be determined. This is either possible through the use of the devices' own mobile communication network or by the use of the Global Positioning System (GPS). In the later case the mobile device has to have a GPS component attached to or build into it (e.g. PNA's). Generally spoken a position of a target device can be determined by the target device itself (GPS) or by a Position Finder which could be the provider of the phone service. This provider detects the position of the mobile device according to information from his base stations tracking the position of mobile devices in radio cells. These tracking positions usually need to be converted (by a Location Finder) into a format that can be used by the Service and Application Provider. It is also possible to determine the position through Wireless Local Area Networks (WLAN).

### *3.1.4 Service and Application Provider (LBS Provider)*

This provider makes use of the position data generated by the position finder and integrates them into his applications, i.e. the service requested by the client. Communication between the Service User (Customer) and the Service Provider is displayed on the customers device using WAP or i-mode technology.

*3.1.5 Data and Content Provider*

Sometimes the LBS Provider does not maintain specific data that is needed to provide a service (e.g. maps for route finding). In this case Data and Content Providers deliver missing data.

*3.1.6 Service User (LBS User)*

The LBS User makes a request to the LBS Provider and calls for a specific service. These services can be distinguished into two different kinds: Pull Services (reactive services) and Push Services (proactive services).

Reactive services are directly inquired by the user, whereas proactive services are either indirectly or not inquired by the user. They can be activated trough specific events. An indirectly inquired service could be a subscription to a service which would only be activated if a pre-defined condition arises (i.e. the user is situated at a specific location). Not inquired services can be advertisement massages, which are as well activated by entering a specific location.

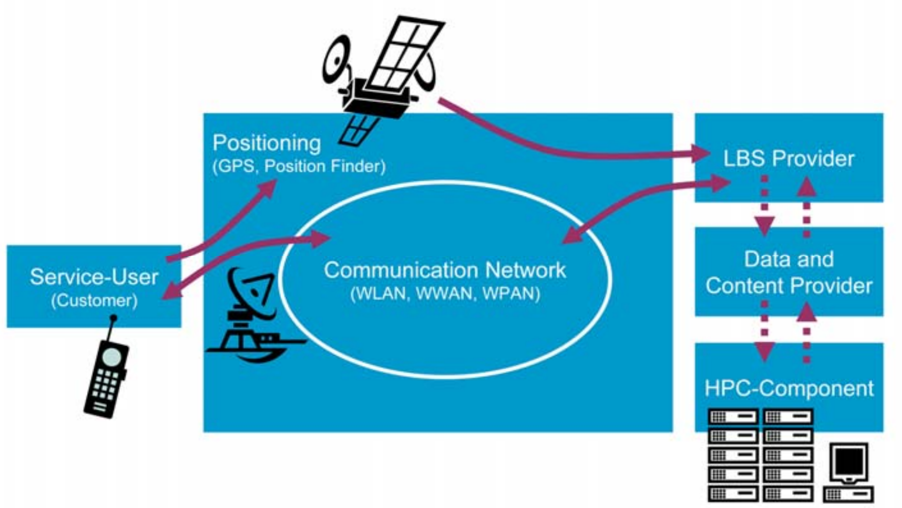


*Figure 3.* Prototypical LBS communication.

## 4. Techniques

The basic idea underlying the approach presented herein is to use an optimization engine to execute a client request. The engine itself is not available on the clients own device. This is due to the fact that no mobile device would be capable to provide enough compute power to solve complex requests. In addition the client has no information about the buildings structure, i.e. inventory listings of the building do not exist on his device. Hence, the idea is to provide access to all necessary components via the use of communication devices, whereas the focus lies on the condition that the least demands have to be made to the clients' devices.

### 4.1 OPTIMIZATION ENGINE

In our approach we used an optimization engine that is build into ILOG OPL Dev Studio. This powerful optimization package runs under several operating systems such as Windows and Linux. Accessing the engine can be accomplished using a sophisticated programming language (OPL – Optimization Programming Language) as well as several script-languages such as OPL-script or JavaScript. The code developed can be integrated into stand-alone applications by the use of one of the many API´s (e.g. C++, Java) that are delivered with the full package. OPL code can as well access databases such as MySQL to import data from inventory listings.

### 4.2 WLAN (WIRELESS LOCAL AREA NETWORKS)

The easiest and cheapest possibility to setup LBS in revitalization would be through the use of an open WLAN. In this case charges for the service do not necessarily have to accrue for the client. It entails however that the client has a wireless mobile device such as a PDA or a notebook at his disposal. It also entails that the WLAN access-point is fixed to the building and that the client is within the reach covered by the network. If the WLAN would be accessed it would re-direct the client to a website where he could retrieve information about the building. Through this website he could also access a web-based front-end to enter data about his specific needs. This data would be passed by the web server to a high-performance computing center where a simulation of the request is processed with the aid of optimization engines. The results would be retransferred to the web server and displayed on the website, i.e. on the clients' notebook or PDA. There are several bottlenecks in this approach referring to the WLAN, the mobiles devices and security. In the first instance it cannot be guaranteed that each and every building can be equipped with a WLAN. It is also questionable how to deal with a situation where different buildings from different owners are situated at almost the same location. Furthermore, not every prospective client keeps a notebook or a PDA with him all the time. Regarding security an open WLAN might also be accessed by others and potentially be damaged. Maintenance for such a system would be costly and maybe not effective enough. WLANs could cover ranges between 10m and 100m, depending on the technology used (Ultra-Wideband / 10m, IEEE 802.11a / 50m, IEEE 802.11b / 100m). They achieve data transfer rates of up to 54 Mbit/s (IEEE 802.11g).

Recapitulating these facts it can be said that an LBS based on WLAN-technology might be one of the cheapest, yet simplest possibilities to gain information about a buildings revitalization capabilities. It would be easy to set up but would have some shortcomings. Most laborious is the necessity to fix access-points to every building.

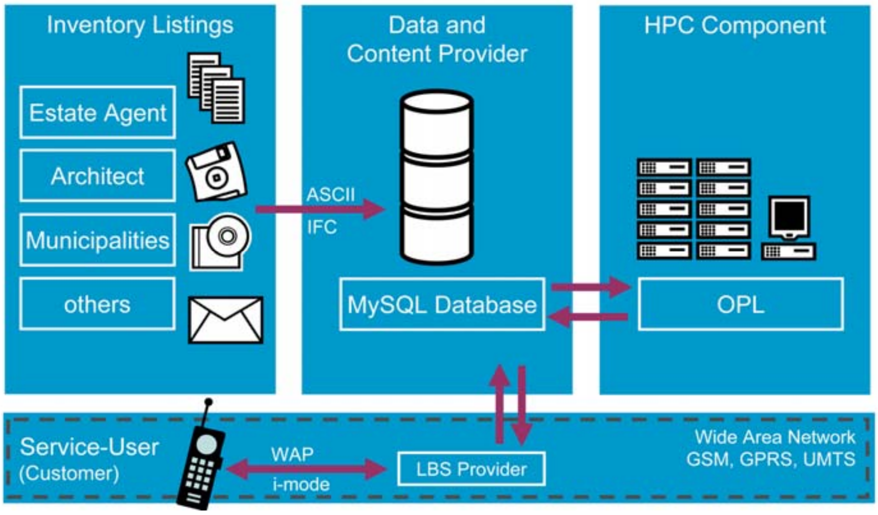


*Figure 4.* Data transfer and communication.

### 4.3 WWAN (WIRELESS WIDE AREA NETWORKS)

The most common WWAN communication technologies are GSM (Global System for Mobile Communications) and GPRS (General Packet Radio Service). Both Services belong to the second generation of mobile communication standards. Due to the fact that both services originate from voice communication requests, their data transfer rates are quite low and not sufficient for extensive multimedia applications. Other than these two services the roots of the third generation UMTS (Universal Mobile Telecommunications System) lies in multimedia communication. Thus, it provides much higher data transfer rates but is due to its high costs still not widely-used. WWANs cover ranges between 100m and 35km, which means that the distance of the mobile device, which is usually a cellular phone, from the base station is within that range. While communication through a WLAN entails that the position of the client and the building is known through the fixed position of the access-point, communication over WWANs comprises two kinds of position tracking. On the one hand the client could call upon specific services that would track his position. This could be achieved with the aid of a position finder who would make use of the clients' devices own mobile communication network within which his position is known. On the other hand the client could make use of GPS data received from his GPS-compliant phone. In either case the biggest advantage of WWAN-technology is that it is not necessary to affix any devices to the buildings themselves. This is an invaluable factor to foster the willingness of building owners to participate in Location Based Services. Communication through WWANs is definitely more complicated to set up and requires higher technological effort. Their data transfer rates reach only 14,4 Kbit/s (GSM), 20 Kbit/s (GPRS) or 3,6 Mbit/s (UMTS, HSDPA-Category 6). However, the advantages of device-independent position tracking outweigh the disadvantages. Since 2000 the accuracy of position finding using GPS averages 15m, whereas GSM positioning is less accurate and more complex to determine.

### 4.4 WPAN (WIRELESS PERSONAL AREA NETWORKS)

These networks cover ranges between 0,2m and 50m. Their data transfer rate reaches up to 2,1 Mbit/s (Buetooth 2.0) and 16 Mbit/s (IrDA (Infrared Data Association)). Most disadvantages that apply to a WLAN apply to a WPAN as well.

## 5. Summary

Even though Wireless Wide Area Networks provide the lowest data transfer rate and are more cost-intensive than other technologies we recommend their use in Location Based Services for Revitalization. The essential reason is that services can be provided device-independent. Thus the building owners do not need to install any hardware within the building. The only need is to make data about the building available to the Service- or Content Provider. The client however needs only a common portable device such as a cellular phone or a smartphone. If he traces an interesting building the service could be inquired directly by him (Pull Service). Position finding would then be conducted automatically and the ascertained position data would be transferred to the Service Provider to query the database in terms of the building which is closest to the clients' position. Alternatively the service could be inquired through a subscription that activates it once the client passes through an area within which buildings are located that match his predefined needs (Push Service).

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