Towards Multi-provider LBS Visual Portals

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Abstract

Location-Based Services (LBS) are more and more commonly accessed through PDA or smart phones. As portals deriving of services delivered by a unique provider are easy to define, the objective of this paper is to address the problem of generating portals allowing the accesses of services provided by several companies. In other words, the goal is to generate automatically a unique visual multi-provider portal in a context of portal interoperability. After the analysis of examples in order to define more clearly spatial concepts such as reference location and scopes of services, various organizations of portals are examined, namely text-based, icon-based, map-based and street-view. We conclude this paper by recommending map-based and street-view systems, together with XML extensions which must supplement LBS metadata in order to generate those visual portals.

Keywords: *Location-Based Services, GUI for PDA, portal interoperability, GIS, Visual portal*

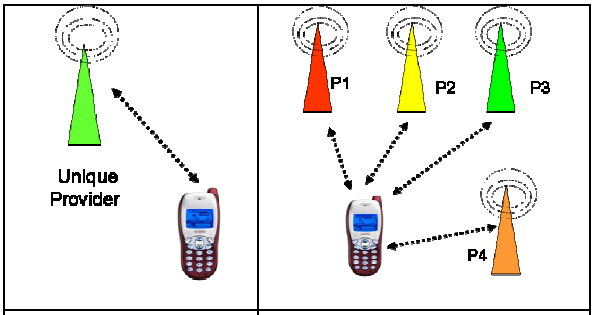
1 – Introduction

The huge majority of studies regarding Location-Based Services (LBS) concern a unique provider of services; however comparing to the evolution of mobile telephones, it is important to begin studies relative to multiple providers; in other words, even if norms and standards will emerge in the nearby future, interoperability of location-based services will be an important theme of research.

One of the problems we have to face is the problem of organizing portals. This problem can be stated as follows (Figure.1): "*Suppose I have a list of p providers, each of them providing s_p LB services, how to organize a portal such as all LB services can be presented in a friendly way*"?

Spiekermann [6] defines LBS "*as services that integrate a mobile device's location or position with other information so as to provide added value to the user*". And later, he distinguishes two categories, namely, person-oriented LBS (such as looking for nearest friend) and device-oriented LBS (such as car tracking). In Wikipedia [7], LBS are defined by a quite similar text as "*information services accessible with mobile devices through the mobile network and utilizing the ability to make use of the location of the mobile device*".

Let us remember that some LB services can be either push, which means that they are offered to the user prior his/her consent, or pull, which means that the service list is the result of a query linked to the profile of the user. In this study, we will overall assume that the user has given his profile, and several services coming from several providers respond to this profile. In addition perhaps emergency push services can also be present, for instance to announce floods or tornadoes when necessary. Moreover, even if SPAM services may exist, they will not be considered in this study.



(a). The present situation: a unique LBS provider

(b). The nearby future: a single PDA is connected to several LBS providers

Figure 1. *From unique to multiple LBS providers.*

Indeed location means several things for any LBS. For instance municipal services are linked to a city, and are no more valid in a neighboring city, whereas a shoe shop does not consider city boundaries since it will attract as many customer as possible. From those basic examples, two concepts are emerging:

- the **reference location** which corresponds to the specific location of the service's provider; for instance the shoe shop itself or the administrative buildings,
- and the **scope**, that is to say the area in which the service is offered, for the city, within the

city boundary, or for the shop its marketing zone.

This paper will address this problem and present some solutions. After having examined a few examples, several portal organizations will be studied, together with some graphic semiology remarks.

An initial remark is if there is no interoperability between portals, a PDA linked to several providers must assign a window per portal as exemplified Figure 2.

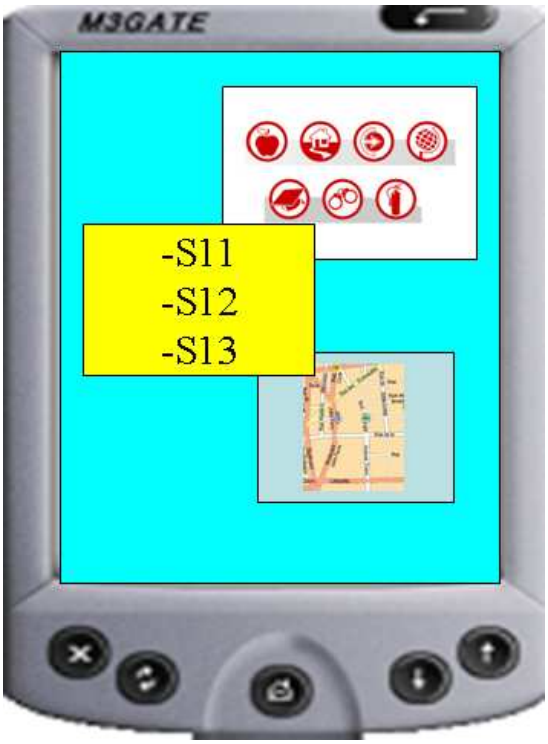


Figure 2. *PDA linked to several service providers assigns one window per provider if no portal interoperability is envisioned.*

2 – Analysis of some examples

Instead of presenting a formal theory about multi-provider LBS, in order to design portals, we will consider a few examples of applications in which services can be requested. In order to illustrate the concerns, we will explain each application in terms of their:

- **Reference location:** specific location of services' providers,
- **Scope:** locations where services must be physically offered,
- **Time:** time in which services are available, and
- **Visualization:** the way in which the user perceives the result.

2.1 – Municipal Administration

We consider a municipal administration which offers different kinds of services to citizens in a city. The city administration may be distributed in many buildings related to several addresses in which different services are provided. The scope of services provided by the Municipal Administration is limited to its jurisdiction; so the user will have services available only in this defined scope. These services in turn will be provided in the hours in which the city hall is opened. The mobile device will show the location of the user, the location of each building belonging to the city hall and the services provided for each of them. In this case we have:

- Reference location: addresses of municipal buildings,
- Scope: the whole city (crisp area),
- Time: opening hours,
- Visualization: one icon per department/per building.

2.2 – Real Estate Agent

This example considers a real estate agent offering services for selling and renting apartments, houses and commercial premises. The scope corresponds to the locations of each apartment, house or premises the agency has to rent or sell. Services are available in the hours in which the agency is opened. Regarding visualization, a map with one icon per apartment, house or premises will be displayed with different representations depending on the nature of the concerned object. For each one of these objects additional information about the particular characteristics or for example, schedules to visit them can be shown.

- Reference location: address of the office,
- Scope: several locations of apartments, etc.
- Time: opening hours,
- Visualization: one icon per object.

2.3 – Meteorology

Meteorological services are very common and offered by different providers in several places. In this case we are interested in the climate around the zone where the user is. Of course, the user may ask for information like temperature, humidity, rains, etc. in any time and even in another place out of his neighborhood; in this case the scope could be considered as the whole Earth. The visualization will show a set of animated icons (like the TV forecast) in a continuous space. In order to bind this space we propose to limit it to 1 km^2 around the user.

- Reference location: meteorological station, or headquarters,
- Scope: the neighborhood of the user,
- Time: any time, present, past or future,
- Visualization: animated icons.

2.4 – Emergency information

In this case we suppose there is a provider who offers services in emergency situations such as natural disasters, catastrophes, etc. These kinds of services are generally "push"; the user receives the information when he/she is entering in the dangerous zone.

The scope will probably be a zone with fuzzy boundaries established according to the type of event; this fact will be also reflected in the visualization. Different labels of security limits could be defined, for example with different colors.

- Reference location: the headquarter of the agency,
- Scope: the epicenter of the zone,
- Time: when necessary,
- Visualization: emergency zone.

2.5 – Public transportation

Services in the context of public transportation are very common and useful not only for local users but also for tourists. Information about bus lines, bus stops, and places where buy tickets are offered by the provider. The scope of services is the locations representing bus lines, stops etc. represented as a set of scattered points and interconnected lines. The time when services are able depends on the schedule of the transport company. The visualization will be a map showing the classical transport network.

- Reference location: the headquarters of the transport company,
- Scope: the various bus lines, bus stops, points of selling tickets,
- Time: when the services are available,
- Visualization: bus stops, line directions (scale).

A variant can be a sightseeing tour in which the scope is the bus circuit that is a closed polyline generally linking the various landmarks of a city.

Surely, some other examples can be studied and analyzed with those criteria, but from those examples, we can state the following:

- The reference location which appears perhaps primarily as the more important aspects, sometimes is not so easy to define (weather forecast) or not important for the user (headquarters of a public transportation company).
- Those reference locations can often be modeled as 2D points.
- The scope can be geometrically defined by several ways, as set of points (real estate), or a network (public transportation, a crisp area (municipality), a fuzzy area (marketing zone, see Example Figure 3) or even a very huge continuous space (meteorology) which must be limited to the user's neighborhood for practical reasons.

Figure 3. *Example of a marketing area of a shop represented as a fuzzy set; the curves represent the various membership degrees at various percentiles, the first one 10 %, the next one 20 %, etc.*

Another aspect is linked to the PDA's screen displaying a spatial window around the user. Depending on the scale this spatial window will represent a territory. Only services the scope of which intersects the spatial window will be considered and laid out. For instance, suppose you are looking for a flat to rent, and there is one at the vicinity (displayed in the spatial window); for this apartment you can easily get information; but when you want to visualize the realtor's address (reference location) the spatial window will be moved accordingly, in order to find the adequate scale showing three locations, user, flat and real estate agency.

After having analyzed those examples, let present some considerations for the designing of a multi-provider portal.

3 – From non-integrated to integrated portals

Designing portals and especially visual portals is a complex task, because we need to decide what kind of metaphor we want to use and how to continue the metaphor without problems of consistency. We will first analyze non integrated portals, and then detail some integrated portals.
In [2], several kinds of portals were examined; among them we can distinguish

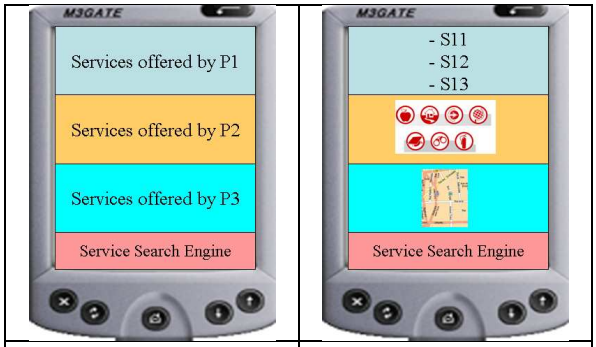
- text-only portals, in which services are given by names,
- icon-based portals, in which services are illustrated by icons or thumbnail images,
- map-based portals, in which all services are located in a single map.

However, the previous portals were designed for a single provider. To study the multi-provider case and to illustrate the concepts, let us take an example of three providers offering each of them several services.

- Provider 1 (generalist):
  - Yellow pages,
  - Nearest restaurant,
  - Nearest ATM.
- Provider 2 (local information):
  - Museum opening hours (HP),
  - Shoe shop sales,
  - Chinese restaurant,
  - Italian Restaurant,
  - Church website
- Provider 3 (municipal information):
  - Local event calendar (Sports, Culture, etc.),
  - Located municipal services,
  - Weather forecast.

3.1 – Without/before integration

Without integration, the PDA's screen is divided into sections, each of them being assigned to a single provider. Figure 4a gives the principles of organization, whereas Figure 3b gives an example illustrating various types of portals which must be integrated into a single portal.



(a). The PDA's screen is split in sections, each of them assigned to a unique provider	(b). Example with different types of portals, text-only, icon-based, map-based

Figure 4. *Example of multi-provider LBS portals without integration.*

3.2 – Integrated portal

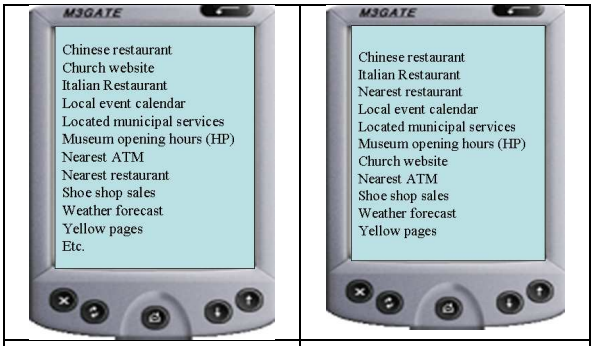
As previously explained, the objective is to design a unique portal integrating the various component portals into a single consistent portal. However if among the list of services, there is one service which is proposed by several providers, it will be presented several times letting the user the choice (maybe with different prices). The key-idea to design such an integrated portal will be based on the Shneidermann's mantra [5] "*Overview, zoom-and-filter, details-on-demands*", in which for our case:

- "**overview**" will correspond to the unique portal allowing the accesses of all services; here, according to this mantra, we need to propose a global organization aiming at connecting to each of all services, whatsoever the provider must be;
- "**zoom-and-filter**" refers both to geographic and semantic zooming and filtering; in other words, the list of provided services must be reduced;
- "**details-on-demand**" refers to additional details when a subset of services is selected; maybe this subset could a reduced to a single service.

Let us now examine various possibilities of portals, textual, iconic, cartographic and street-view.

a/ Text-based

With this presentation all service names are displayed, for instance either by alphabetic order, or ranked according to some preferences as given in the user's profile.



(a) Services ranked by alphabetic order.	(b) Services ranked by user's profile order.

Figure 5. *Examples of text-only multi-provider portals.*

If the same service is proposed by several providers, the name of the provider can be concatenated to the name of the service.

The main advantage of this layout is its completeness and its easiness to be generated. However, the main drawbacks are:

- The length of the list can overpass the size of the screen, essentially if we want to get a readable list,
- There is no indication of the scope of the information,
- Spatial characteristics are not used,
- All scaling aspects are lost, for instance no in- or out-zooms are possible.

Finally, this solution is an easy one to generate, but the main characteristics of LBS are not used.

Moreover, Shneiderman's mantra is not followed because it looks semantically complex to zoom and filter this list.

b/ Icon-based

This solution implies that each service is assigned a very understandable icon. In case when the same service is offered two times, the same icon will be presented twice. To distinguish them, perhaps the logo of the provider can be added.

Figure 6. *Example of services in which reference locations are mapped with icons, shapes corresponding to services and colors to providers.*

Since icons are often difficult to understand, this solution is not recommended. In this paper, we will not continue to study this solution.

c/ Map-based

In this case, a base map is used in which all LB services can be laid out in both senses of reference locations and scopes.

When reference locations exist, we can easily position the service on the map. Whereas mapping a scope implies the description of the zone above the base map.

Here, in- and out-zooming are very easy to perform and the main characteristics of LBS are used.

Figure 6 illustrates an example in which each service is assigned a shape or an icon whereas colors can distinguish providers.

In the next section, other issues concerning this solution will be developed.

d/ Street-view

Figure 7. *Using street-view as a way of presenting services for a pedestrian.*

Another interesting approach is to use street-views as exemplified in Figure 7. This style of presentation is very interesting for pedestrians, especially for those who have difficulties when reading maps. However, only reference locations which exist along the street can be mentioned. A special algorithm must be created taking the perspective of the street-view into account in order to position exactly the services.

One of the main difficulties resides in the exact location of a service. Imagine that the reference location of a small service (for instance an apartment to rent) is located at the fifth storey of a building; do we have to position the service at the fifth storey or at street level? We do recommend in this case positioning all services at street level.

Let us mention that this kind of display is very interesting in picture-aided navigational systems

designed especially for pedestrians as detailed by (Laurini et al, 2008) [3]. Inn this case, the picture can be supplemented with icons for LB locations.

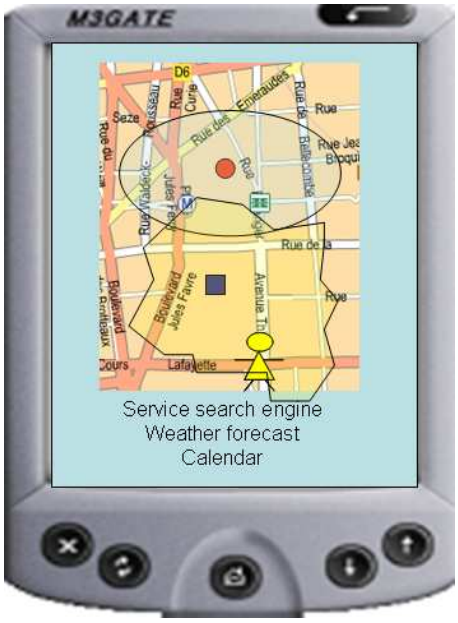


Figure 8. *Example of visual representation with reference locations and scopes.*

4 – Elements of graphic semiology

As reference locations are punctual, scopes can have different mathematical representations. A possibility could be to fill the scope area with graded colors with transparency such as the base map can be always readable. Such an example is given Figure 8.

An interesting solution could be to use the idea of Burigat and Chittaro (2007) [8] to put a sort of signal along each icon to show the relevancy of the displayed LB services.

5 – Conclusions

The goal of this paper was a preliminary study concerning the design of portals in case of multiple companies providing each of them several services. Two concepts were emphasized, reference location and scope. In this paper, we advocate that a unique visual portal can be an adequate solution allowing accesses to all services, whatever may be their respective providers. The idea of using either a map-based or a street-view solution instead of a text-only solution is very promising.

As reference locations are easy to depict and scopes can having more complicated mathematical shapes, adequate representations must be designed without altering the understanding of the base map; a solution based on graded and transparent colors filling the scope area seems an interesting answer. But for that some complementary cognitive studies must be carried out.

In order to realize the correct positioning of reference locations and scopes, information regarding geometric shapes must be provided in the service metadata. An extension of XML perhaps based on GML [4] can be an excellent candidate to describe the issues.

To conclude this paper, let us say that we need experimentation and also cognitive studies to propose a complete definitive system.

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