Location Based Service for Restaurants

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Abstract

The paper describes architecture of a location based service; analyze the technical challenges in deployment, business, privacy and security issues. The location-based service described here is the one that provides a list of restaurants within a certain proximity to the mobile device user. The system has a restaurant ranking system which gives a rating based on users' recommendations. The analysis shows that a number of issues about the system that need to be understood and tackled in a satisfactory way for the service to be commercially successful.

Key words: Location based service, Business, Privacy, Security

1 Introduction

LOCATION-BASED SERVICES (LBS are wireless 'mobile content' services which provide location-specific information to mobile users moving from one location to another. They exploit knowledge about where an information device user is located and present e.g. at the user's request the nearest service, an ATM or restaurant. Mobile handset maker, Nokia has LBS embedded in its mobile devices, e.g. the N95, E61, and E90.

There are three types of LBS, i.e. pull, push and tracking [2]. A pull service is where the user request information, whereas a push service is where the information is delivered to the user without asking for it. In the case of push service, the service provider needs to have permission to send information to the user's mobile station. In this article I describe an example of a pull service one which requires the user to request the location of nearest restaurants within certain proximity.

Location is determined either internally by a device or externally by systems and networks with which the mobile device interacts. There are three different methods for acquiring user location data, i.e. the cell ID in mobile networks, the conventional Global Positioning System (GPS) [9] and the Assisted GPS (A-GPS) [13]. In mobile networks cell radius may not give accurate location of the user since cell size vary, i.e. in 2G can be about 6-9 km [11] while in 3G the cell size can be 1.4km [12]. The GPS is dominating because of its position accuracy of about 2-5 meters. However, assisted GPS (A-GPS) is one solution that is rapidly becoming more common because of its ability to provide location information indoors and in other harsh environments such as urban canyons and areas with heavy tree cover. A-GPS also offers faster positioning than does standard GPS, but it is sometimes less accurate.

The location based service envisioned in this article comprises a ranking system to enable choice of restaurants based on the restaurants ratings or other opinions and an advertising service which sends advertisements to customers.

In this paper I address some technical issues in the deployment of LBS for a restaurant, privacy and security issues. The rest of the paper is organized as follows: section 2 describes the location-based service architecture, section 3 challenges and concerns of LBS and section 4 concludes.

2 LBS Architecture

The general architecture for LBS provisioning is presented on figure 1. The components of the LBS system consist of the mobile device, communication network, the service provider and the gateway mobile location center (GMLC).

A ***mobile device*** is used to request the needed information.

The ***communication network*** is used for conveying user data from the service provider to mobile terminal and service request from the mobile terminal to the service provider. The communication network can be EGPRS network of 3G network.

The ***service provider*** provides current position and points of interests. There are three main functionalities of the service provider, i.e. the client authorization function, client location function and service provisioning. The client authorization function is responsible for providing access and subscription authorization to the client. The location function is responsible for transformation of received co-ordinates to local co-ordinates and mobility functions for location services, e.g. indicating where services are located. The service provisioning function provides the user with the right to use the service When registering for the service the user can also provide a list of preferred restaurants and has the possibility to change his preference.

The service provider has an interface to the restaurant ranking system which ranks restaurants based on different criteria, e.g. users' opinions, some critics, etc. This information enables the user to choose the best restaurant.

The ***gateway mobile location centre*** (GMLC) provides the interface between a mobile user and an external content provider. The gateway also provides firewall, authentication and authorization features to control access to the gateway from 3rd parties. The GMLC is defined in [3] with interfaces to VMSC, HLR, Service provider, another operator.

This LBS works as follows; when a mobile device user is on a particular location it simply requests information from

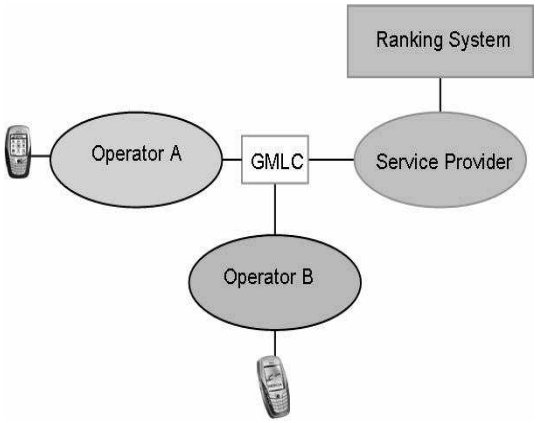

Figure 1: LBS Architecture

LBS based on preference and is given a list of restaurants. The LBS system provides service location to the mobile device and these are displayed on the mobile display map starting with the most recommended restaurant first, second best next, etc.

After the dinner and when the mobile device user is outside the proximity of the search area, the system prompts the user with a request to rank the restaurant. The customer is reminded periodically if response hasn't been received yet. The customer is also given an option to log into the web site where he can provide feedback in the comfort of his house. A text message with user name and password is sent to the customer to the user.

2.1 Use-case example

A mobile device is equipped with a digital map, e.g. Google map and a GPS embedded on it. The user interface is a display with widgets (window gadgets) having a menu that hierarchically opens up submenus and scroll bars, tool icons and various other buttons. The mobile device is used with the help menu to select the preferred restaurant and with the device the user can get a second opinion from a friend.

The user presses the LBS button to request service when within a certain proximity. The user is provided with a list of restaurants. The best restaurant is indicated by color green. There are 5 colors for instance, green being the best, black for good, yellow for fair, red for quite bad and white for a bad restaurant. The user may get a second opinion, by choosing from the list of his friends. Your friends are users of the system and have listed their reference of restaurants. Friends are displayed to provide their opinion if they are users of the system and have ranked this particular restaurant. A map of the preferred restaurant of choice and directions on how to get to the restaurant of choice is displayed. Additional information associated with restaurant, e.g. the restaurant's telephone number, free and unreserved tables, office hours of the restaurant are provided.

When the user gets to the restaurant information about his attendance is recorded and sent to the LBS system. The user is requested to rank the restaurant later on after the visit. There are five options for ranking overall satisfaction on food, service, ambience and cost based on 1-5 scale with 5 indicating highest satisfaction and 1 really bad.

The knowledge of user preferences may encourage owners of restaurants to send advertisements to their customers and this would require mobile advertising [17]. Incorporating this service requires business agreements between various players in this business model who see an economic incentive.

3 LBS Business model

The players along the value chain are mobile network operators (MNO), location based service provider, advertisers, content creators and restaurants owners (Fig. 2). For the mobile operator, the location based service for restaurant offers business opportunities for MNOs to expand audience to generate new revenue growth by introducing targeted advertising and transferring data. The mobile operator has full control over the mobile device and is in a position to subsidize the device and to offer the location based service in a package with other mobile services. The mobile operator would the mobile operator to take care of customer relationship management (CRM), i.e. sales, marketing and customer service.

The mobile network operator and LBS provider make revenue sharing agreement between one another. The restaurant owners would pay the content providers for creating content for advetising. When this content is ready the restaurant owners would take it to the advertisers who they pay for adevrtising their commercials. The payment for advertising space depends on time of the day and the duration of the commercial with evening commercials being more expensive as usual.

There are multiple services the user may want to use and it's very important to have a charging model that makes payment for services easy for the users and beneficial for the user and the mobile network operator. The mobile user may not want to pay for such service and therefore it can only given free of charge to incentivise the use of other mobile service which generate revenue for the mobile network operator.

However, there can be a special charging model for roaming users, e.g. tourists, business people. These tourists would prefer a daily or weekly charge dependant on the duration of stay. Also depependent on the roaming agreements, the roaming user may not be required to pay for such service. My personal judgement is that the LBS user shouldn't pay for such service.

4 Challenges and Concerns

The subsections that follow describe some of the challenges associated with the implementation of such a system in today's markets.

4.1 Technical challenges in deployment

The ranking system requires the users who have dinned at various restaurants to rank the restaurants they have visited and this posses a big challenge as to verifying the presence of users in the restaurants, i.e. they dined there,

- Verifying that the user dined at a particular restaurant

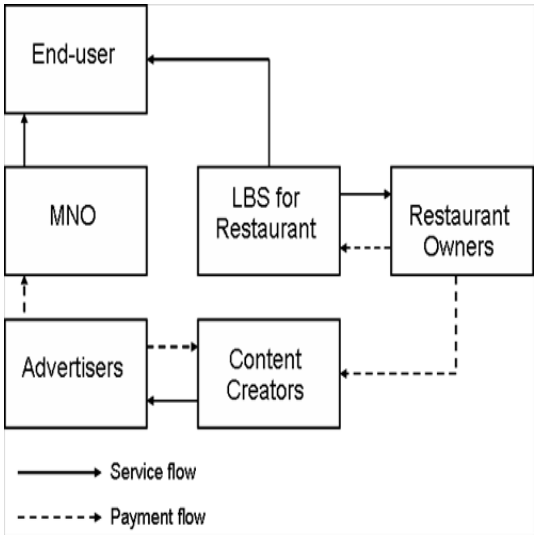

Figure 2: LBS busines model

- Setting/changing restaurant preferences and
- Taking into account compatibility of mobile devices.

Verifying that the user dined at a particular restaurant is challenging because presence of a customer in the restaurant might not necessary mean that the user dined at the restaurant; he might have dropped in just for a drink or came to meet a friend or simply liked the atmosphere there decided to sit for a while or something. However, the system needs to capture that the user actual entered the restaurant had something to eat or drink. The collecting of user presence information at restaurants poses a challenge. It would probably require an independent network or one incorporated to the wireless system which connects to the LBS provider. For example, the restaurants may be equipped with a sensor system which would collect information about their presence and send to the LBS system. This requires equipping a mobile device with sensor. When customer goes to a restaurant he'd put his mobile device against the sensor and his presence would be recorded or this can be done without user interaction.

There's one possible solution to this problem which may prove cheap and easy to use. The bills which the user gets should be marked with a certain LBS code, so that when the user pays the bill, information is sent automatically to the system to record that a user of particular name paid here with a credit card. From the credit card it's possible to obtain two essential type of information, i.e. the name of the user and credit card number. The LBS system should obtain names of users since these are mapped to the mobile use number the mobile subscriber integrated services digital network number (MSIDN). However, the problem arises when the LBS user pays cash, how can we link the payment (LBS code) to a person or MSIDN?

Setting and changing user preference to restaurants requires operation and maintenance tasks and procedures and might prove cumbersome if there are frequent settings and changes to preferences for the MNO. The may require an administrator or operation and maintenance personnel around the clock to serve customers. Instead of having an administrator for the LBS, it would be best to let the users do the changing of their preferences? Having users change or modify their preferences would be the most preferred solution for the operator. But giving access to the ranking system database requires a lot of trust.

The LBS provider is required by the restaurant owners to send adverts, e.g. promotions of new meals from time to time. Adding this functionality complicates the system a bit since it requires a mobile advertising solution to be implemented. The big challenge is adding value to the customers; think about what kind advertisement they would like. It's not appealing to get a text message saying go to the McDonald, a video clip would be better. Not all phones may support video or MMS therefore, the service provider should be able to filter appropriate content to send to the mobile device, text message, multimedia or video. This requires the service provider to have a functionality that identifies what the mobile device supports and what messaging service is subscribed by the user.

4.2 Advertising

Targeted advertising is good, but not all phones may support video or MMS therefore, the service provider should be able to filter appropriate content to send to the mobile device either text message, multimedia or video. However, there is some security issues related with mobile advertising, e.g. Spam wave, known from e-mail communication [16]. When targeted advertising is used the advertiser should have a good understanding that the targeted public will be pleased with the promotions and offerings end-users receive on their mobile phones because some offers sent to them may be irrelevant and of no interest at that moment in time. The frequency and the timing of advertisements should be careful chosen so that it doesn't annoy the users.

Research has shown that consumers are simply not ready for this kind of highly personalised advertising, especially on their mobile phones. At best they find it irrelevant and at worst they find it intrusive and an invasion of their privacy. For those who have experienced mobile advertising want control over the amount of advertising and the use of their data. They preferred 'pull' over 'push' advertising and they are willing to accept some advertising in return for 'free' content [1]. While in [5] they have shown that the quality of LBS content is an issue to be explicitly addressed in both practice and research.

4.3 Usability

When creating a global service one needs to think of a good service interface, something which when the user sees and use will enhance quality of experience. You need also to take into account the fact that different cultures have different appreciations. It's very important to speak t the user's language, minimize the user's memory load and the interface should be able to support different languages.

Interface implementation is possible when consideration is for a few languages in a particular country, but may prove challenging when requirements is for global coverage. Just

imagine having a device which you can use anywhere in the world. You may not speak or read the local language, just entering your preferred choice in English for instance, the system would simply understand (translates your input to local language) and giving you a map and directions to the restaurant in your language. If a Chinese visited England, would also get the map and directions in mother tongue. Putting it simply the service should be seamless and any user of any language should get access to it.

The interface should be good that you need not use help at all, i.e. it should be non problematic and have accurate information [10].

4.4 Privacy

Location based services pose various concerns related to privacy and security of users requiring a need for location privacy. The implication of this technology is that data about a subscriber's location and historical movements is owned and controlled by the network operators, including mobile carriers and mobile content providers. There is growing concern with

- Network operators collecting logs of mobile device users' location history
- The location history of mobile devices getting into the wrong hands
- Encouraging users to rank the restaurants,

Privacy threats have been discussed extensively in [6] and [15] and [8] and [4] focusing on anonymizing of the user and in [7] trying to create defense parameters that characterizes an anonymity set. However, in [8] Dr. Robert P Minch concludes that there's no single control that can assure privacy since not all uses of location information can be anticipated, and not all abuses can be prevented. In [18] authors propose a privacy management framework to support the privacy principles derived from EU Data Directive 95/46/EC of the European Parliament and the Council of 24 October 1995.

Sending messages to the user requesting them to rank the restaurant might be annoying at times, especially if you didn't dine there or just had a drink or simply popped in to say hi to a friend. The system would have to differentiate between those who dined and those who didn't.

4.5 Security

A tracking service requires also giving permission to the service provider to track you.

When creating something for public use it's important to thin about trade-off between usability and security. You need to find out if users really want to use the product and really feel secure. Therefore, it's important to capture the user's experience of feeling secure. The fact that the user's personal data is in the hands of other people make people insecure generally. The users need to feel that their privacy is important and secure, and LSB providers are committed to protecting the personal information users choose to share with them. It's vital for the operator to offer adequate security for maintaining user's privacy. However, LBS create a problem for the privacy of individual by not providing a fullproof security system to that highly sensitive information stored in its database. To obtain security, one needs to do a little compromise on his/her privacy and it's not obvious to what extent. In [14][18] authors show how trust, privacy and security are interrelated. In the privacy and security issues of LBS, there are four areas of concern, i.e.

- Control - a legal aspect
- Trust - a social aspect
- Privacy - an ethical aspect
- Security - a technological aspect

All four are mutually exclusive as control decreases trust, trust enhances privacy, which needs security, and security again increases control.

The LBS system deals with confidential personal information like location, personal mobile number, sort address and therefore secure transfer of information, secure data storage and protecting of user privacy is a requirement.

5 Conclusions

I presented an example of a location based service which provides list of restaurants within a certain proximity to the mobile device user. There are still significant issues that are hindering this technology from achieving a commercial success. Some are technical, business, privacy, data security and location-based service capabilities. Some are regulatory, i.e. each country has legislation that can greatly impact what kind of and how LBS can be implemented. LBS need to gain popularity for it to really achieve it potential; it's a service where user are still not sure there'd need and pay for since there are other alternatives to get the same information.

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