



Term Paper
LOCATION BASED SERVICES
(LBS)

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Abstract

This term paper concerns about Location-Based Services (LBS). LBS is basically all services or applications that provide the user with useful spatial information based on his location, with the assistance of the Geographic Information System (GIS). LBS has gained a huge attention for the recent years because of the benefits it provides. In this term-paper, a brief description of LBS and its components. The mechanism of LBS is explained in short to show the steps a service passed by. Some examples of LBS applications are listed here with their benefits. Importance of Implementing LBS is shown through two case studies. Some issues are mentioned which have an active area of research. Finally, few recommendation are there for future enhancements.

Keywords:

LBS, GIS,

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1. INTRODUCTION

1.1 Overview

The huge, successive and rapid advancements in technology in recent years played a major role in peoples' everyday activities. It simplified lots of challenging issues and tasks. The advances in GPS and wireless communications technology and the growing popularity of mobile devices, such as smart phones and PDAs, the need for location-based applications has gained significant attentions. Location-based services or applications (LBS) are the applications or services that provide the users with valuable spatial information. They are mobile services that combine information about a user's physical location with online connectivity and are transforming the way people work and play [16]. LBS answer more than the simple question "Where exactly am I on the map now?" or "To which direction am I driving at the moment?". LBS, Simply, determines the user's location with the assistance of Global Positioning System (GPS) or using other techniques such as the mobile networks. User's location and acquired service is then delivered to the service provider which decides where the target that best fulfills the users need with the help of huge list of spatial information databases it contain . Some mobile devices may have databases that enable users to search and to be guided without the need to send request to service providers. That seems to be faster but surely results would be limited compared to those from source databases. LBS is a useful technology for a wide range of uses; it is an important tool and extensively used for emergency services while it may be helpful in entertainment or gaming application at the same time.

1.2 Paper Objective

This paper includes a basic introduction of Location-based services (LBS).

Objective of this paper is Gaining an understanding of components of LBS and underlying technologies. This included location collection technologies such as GPS and to provide the reader a clear understanding of LBS and its basics, to give a brief explanation of LBS operation, to give a variety of LBS uses and applications, to show its importance through a case study and finally to mention several limitations and issues where more attention should be paid by researchers and developers.

1.3 Paper Methodology

This paper will not include any project steps or technical experiments. Rather, it is "for knowledge sake". It will follow the method of collecting and viewing a literature review of the LBS, its working techniques and applications.

2. LITERATURE REVIEW (BACKGROUND)

2.1 Location-Based Service (Definitions)

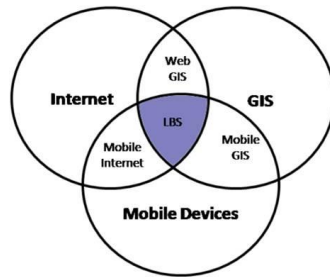


fig 1 LBS

The **figure 1** shows simply where LBS lies. LBS is the emergence of three significant technologies: Internet, GIS and Mobile devices. The next chapter will explain each part with further details.

The recent years witnessed advances in Global Positioning Systems (GPS), wireless communications technology and growing popularity of mobile devices, such as smart phones and PDAs. In addition to that, great geodatabases contents of spatial features were collected and integrated with these systems. All of these advancements caused the need for location-based applications to gain significant attention. LBS may be defined as a "mobile computing application that provides information and functionality to users based on their geographical location"[6]. They are mobile services that combine information about a user's physical location with online connectivity[16]. Others may define them as geographically-oriented data and information services to users across mobile telecommunication networks. So, knowing one's location on the map or in which side of the city isn't that valuable as it used to be few years ago. What users are more concern about is where their points of interests are or what is the route to a certain destination with the least traffic

congestion . Looking at the definitions above, reveals the strong relationship between LBS and the (spatial features& attributes) databases or in other words the (GIS).

2.2 Short History and Some Statistics

The U.S. Global Positioning System was originally developed for military purposes, with only a degraded signal available to civilians. But a change of policy in the 1990s opened full accuracy to all, and today GPS is used worldwide as a free, ubiquitous means of determining position. In 1990 International Teletrac Systems, founded in Los Angeles CA, introduced the world's first dynamic real-time stolen vehicle recovery services. In year (1996) the US Federal Communication Commission (FCC) issued rules requiring all US mobile operators to locate emergency callers. It's difficult to determine when LBS were first used but in terms of mobility, according to [8], the first truly mobile computing devices began to appear in the 1980s (in the form of a Hyperion portable computer with two 5.25 inch floppies, an alphanumeric screen, an Intel 8088 processor). Since then mobility has become an increasingly important factor in computing, and today we expect to find far more powerful performance available in devices that can fit in a pocket.

The simplicity of use and great experience gained by LBS, pushed the market and people rapidly to the adoption and demand for variety of areas and fields, The following recent studies show the jump of number of LBS users across a short period of time:

- Based on studies and surveys done by [17], three-quarters of smartphone owners are using location-based services. Their report shows that in Feb 2012, **74%** of smartphone owners (in US) use their phone to get real-time location-based information, while percentage was **55%** in May 2011. in addition, **18%** smartphone owners use geosocial or “check-in” services, up from **12%** in May 2011.
- As mentioned by [11] , ABI Research made a study says: "Among wireless subscribers, **332** million used LBS solutions in 2011 and industry experts expect that number to increase to nearly **2.2** billion by 2017".

2.3 LBS and GIS

GIS and LBS have a lot of meanings in common. LBS is a combination of GIS and communication network system. In addition, all location service allow users to display the information they need, position and preference. Then by using GIS database and telecommunication technology, the service provider may provide and deliver information according to the user need. Then, users can use LBS service to answer some questions about the place with geographical information and the most convenient way to go there. we can say that LBS has its origin in GIS and is an intersection of different technologies including GIS, mobile Internet and telecommunication. So GIS is an inseparable part of Location Based Service like Global Positioning System (GPS), Radio Frequency Identification (RFID) and location enabled Wi-Fi [4].

3. LBS COMPONENTS, TECHNOLOGIES AND WORKFLOW

Normal users of LBS may frequently acquire spatial information but not realizing the components this system relies on or the stages the request passes by before getting a useful results. This chapter will clarify these parts.

3.1. LBS Components

LBS contain four main components: mobile devices, positioning, communication network and service providers. Fig 2 shows these components:

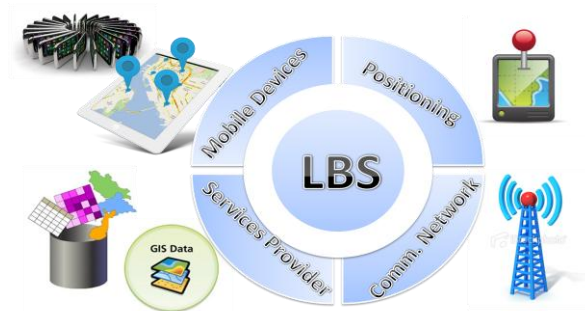


fig 2 LBS Components

- **Mobile devices:** this component represents the user's location and the service needed. Devices may be smartphones, PDA (Personal Assistance Device), laptops or any machine has the mobility property. Applications with user interfaces are designed for devices for simplicity of use.
- **Mobile networks:** considered as the medium of requests and services delivery from and towards the users. This offers the mobility to devices.
- **Service and content provider:** calculation of the position, finding a route, searching yellow pages with respect to position or searching and requesting specific information on objects of user interest from maintaining agencies.

- **Positioning:** It means locating device coordinates which is the most important point of the system. Positioning may be determined by the well-known Global Positioning System (GPS) or using the network towers as illustrated in fig3.

- GPS: positioning using GPS requires the existence and connectivity to at least three GPS satellites and this is considered the most precise positioning method. GPS is a built-in function in all new mobile devices such as smartphone and PDAs.
- Network: network-based technique is to calculate the time difference between the transmitted and received signal. Then multiply the calculated time difference by the velocity of light to obtain the distance.[10]. It's not as accurate as GPS. Accuracy increases as the number of surrounding towers increases.

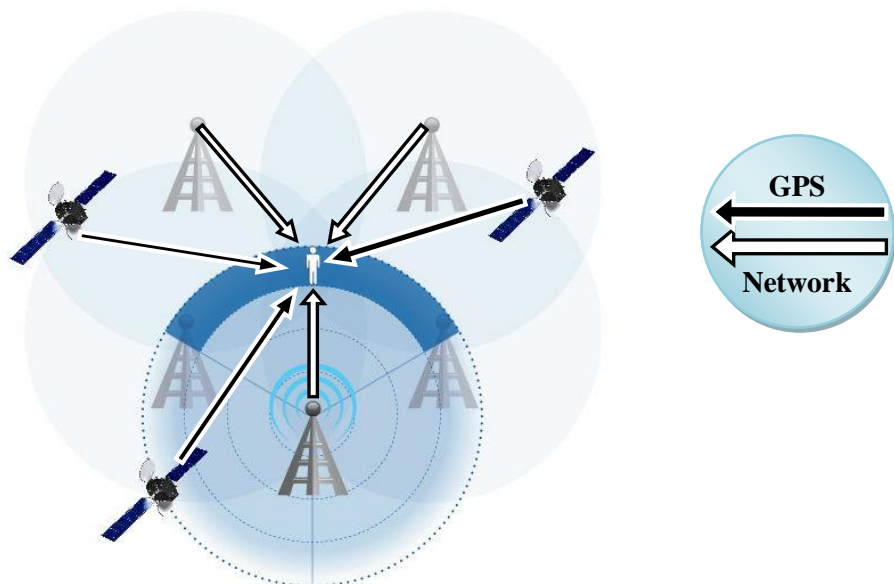


fig 3 Positioning Methods

- Wi-Fi: position may be determined even using Wi-Fi networks.

LBS components may be presented from another point of view in different architecture as generalized in Fig4.[6]

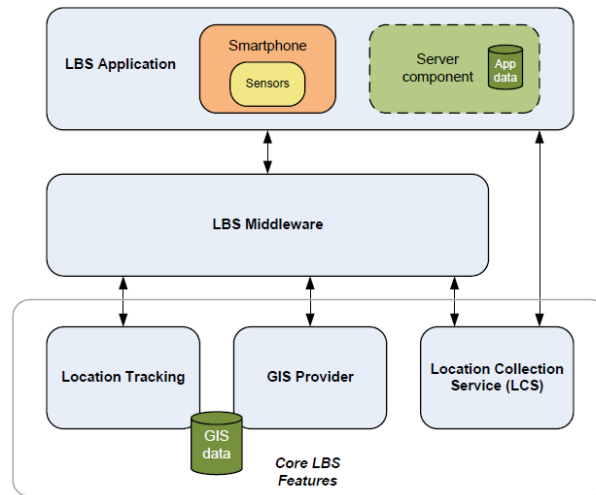


fig 4 LBS Architecture

Here is a brief description of these components;

- **LBS Application:** application such as a “find my friends”. This consists of a smartphone component, which has a number of sensors, and a server component that includes application-specific data.
- **LBS Middleware:** This wraps access to Core LBS Features (Location Tracking, GIS Provider and Location Collection Services) to provide a consistent interface to LBS applications.
- **Location Tracking:** stores location trace of individual users. it contains data that allows a user's route to be determined and potentially predicted.
- **GIS Provider:** provides geospatial functionality for many LBSs including map information, map visualization and directory services.
- **Location Collection Service:** performs location collection to get latitude and longitude of specific user via GPS or middleware (Network)

3.2 LBS Working Mechanism

The following steps & fig5 show in general the mechanism of how LBS works:

- The user's device locates itself either using GPS satellites or using other techniques such as mobile network or Wi-Fi.
- The user makes a request using a pre-installed software on the device which has a Program User Interface. This request is being sent with the current location through the communication network.
- Communication network stores the address of the device and redirects the request to the suitable service provider according to the request and service type.
- The request then will be processed by the service provider. The needed data provider will be consulted to provide a useful answer of the request.
- When all data is available for the service provider, it dose final processing and calculation on it such as the routes and directions. Then, sends the answer or service back to the user's device through the communication network.

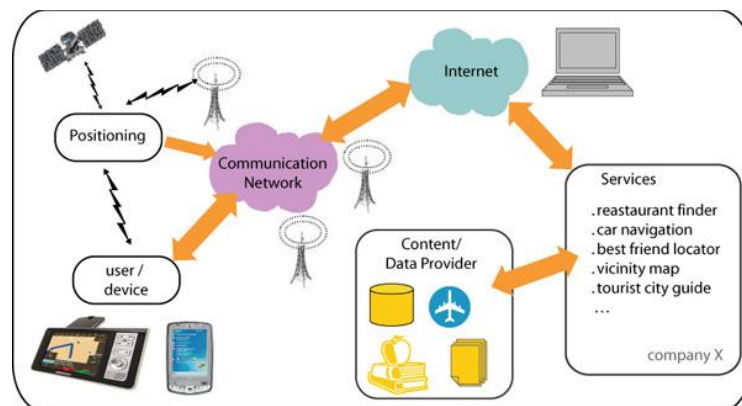


fig 5 LBS Working Mechanism

4. LBS APPLICATIONS

As mentioned earlier, Location-Based Services has a rapid growth in popularity recently. A reason behind that could be the wide range, variety of choices and increasing number of **LBS APPLICATIONS**. Individuals, commercials and even governments are using LBS apps and all are enthusiastic and expecting more in different fields.

This section will focus on LBS applications and mention several examples.

- **Navigation (POI)**

Navigation is the basic and mostly used application or service. By typing the name of wanted services or destinations, list of results will appear to choose from. Then, a turn-by-turn route will guide you from your current location. A lot of navigation softwares are available for every single type of mobile devices.

- **Traffic Status**

This type of applications gives the user a live feedback of traffic congestion. Alternative routes will be suggested if needed. A live video streaming may be provided in some regions, Turkey as an example.

- **Local News/Weather Forecasting**

Depending on your current location, your device will be updated with number of local news. It may include the news headlines, weather forecasting or warnings or even a sale advertisements of nearby shops.

- **Family/Friend finder (Social Networking)**

Number of parents may use this type of applications to know their children location. Others may use them to tell friends of their place or that they visited a certain place.

- **Assets and Vehicles Tracking (AVL)**

These application are widely used by companies who have multiple vehicles to track them and make sure they are in the locations that they should be at.

- **Emergency Services**

It is one of the most early and important applications. The emergency caller's location is determined to be able to serve him/her as soon as he/she calls.

- **Gaming**

There are a lot of entertainment applications where players are grouped based on their locations. They come in many forms of playing scenarios.

5. CASE STUDIES

5.1 Cal Building and Maintenance (CBM)

Based on the solutions provider [7], CBM is a Construction company with a small fleet which is located in the United States.

Challenge: CBM faced a successive disputes from client regarding the number of hours that their service technicians spent on the job. They also had suspicions that their service technicians were inflating the hours worked on their field reports. They needed to find a way to alleviate the doubt the customers had and find out if they were paying their workers for more time than was actually worked.

Solution: The first week after GPS Insight had been installed, CBMI caught three separate technicians inflating their field reports.

“GPS Insight has saved us a minimum of 10% on our labor costs, since we believe we were losing up to 45 minutes per day per employee based on faulty timekeeping and outright misrepresentation on field reports. The average number of hours paid for each of our technicians decreased approximately 8% starting immediately after GPS Insight was installed”, says Dan Zaharoni. He added, “However, work performed by the same technicians actually increased since they were forced to be accountable for each minute of their day.”

5.2 Early Warning Location-Based in Australia [2]

Early Warning Location-Based Alert System in Australia: Australia has recently started to test its national mobile alert system. Tests have been done in Western Australia and Victoria to warn people about bushfires. The Victorian state government accompanied with Telstra partnership and with the cooperation of Emergency Management Australia (EMA) have successfully tested a trial emergency alert system that simultaneously telephoned every landline in a specific area. Victoria State will initiate a mobile emergency alerting system that will be able to send SMS alert messages and emails to people in specific areas in case of natural disasters or emergencies (Dunn and Collier,2007). Another similar system will be introduced in New South Wales (NSW).

The system sends SMS warnings and emergency information in the case of terrorist acts or natural disasters to all mobile users in suspected or endangered area. The information will include details like evacuation procedures, advices in case of bushfires, alternative routes, etc. The system is expected to operate with all mobile service providers. (The Australian, 2007). Both systems in NSW and VIC are supposed to function in 2007.

6. SOME CURRENT ISSUES

6.1 LBS & PRIVACY

Privacy of users comes among first issues when talking about LBS. It is a renewable and active area of research. User's location and related information are considered private unless they share them. Knowing someone's past and current location may lead to predict it for the future. This may be misused by other unauthorized parties. An example mentioned by [6]: By knowing the purchase of a holiday package as well as noting that the purchaser's current location is not his or her home city, it can be deduced that the person is currently out of town. Planned thefts could take place.

Provided in [6] several available privacy solutions:

- Anonymization: number of requests from multiple users are grouped together to be processed by an LBS provider at once. The aim of Anonymization is to ensure that the LBS will not be able to link requests to specific users. An intermediate trusted system called an “Anonymizer” performs this aggregation and returns specific responses to users.
- Cryptographic techniques: Cryptographic techniques such as encryption and secure hashes are commonly applied to conceal information. Researchers have applied some of these techniques to hide user's identities.
- Accuracy filtering: While a high-accuracy technology may be used, applications may not need such high resolution, so a client application can reduce the accuracy of its location when sending requests to LBS

providers, thereby reducing the possibility that the LBS provider can identify the user's exact location.

- Transformation of location request data: A “client only” solution that has been proposed is for the client application to transform the location information in the request, and inversely translate the coming response.

6.2 Visualization Enhancement

Current LBS contents and services are well suitable to be displayed on maps of smartphones/PDA screens. A new area of research raised called Augmented Reality, where real images are mixed or augmented with artificially created views. These extra views may provide additional information about certain locations. There is no need for users to interpret data on a screen or map because it is presented alongside what they can physically see. An example of this, displaying augmented images and information based on the device location and orientation using "GPS" and direction "compass or sensors". But this will display what should be there rather than what exists is in reality. Another scenario could be: a user points his/her smartphone camera towards a certain feature. Then a real-time system should recognize and interpret this feature then display related artificial or historical images or useful information.



fig6 Augmented Reality

7. RECOMMENDATION AND CONCLUSION

LBS is widely used and is spreading rapidly among all field of life and all categories of uses such as personal, commercial and governmental. This spread comes because of the essential help it provides in saving money, time and even lives.

Further advances in visualization technologies are also expected, from basic improvements on how information is displayed on maps, to new augmented reality displays whereby location-based information is made visible alongside point of interests through a camera view.

Next generation LBSs promise to deliver even more interactive services to users and create a huge knowledgebase of location-tagged information.

The future of LBS in the both consumer and enterprise arenas promises to be very exciting.

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