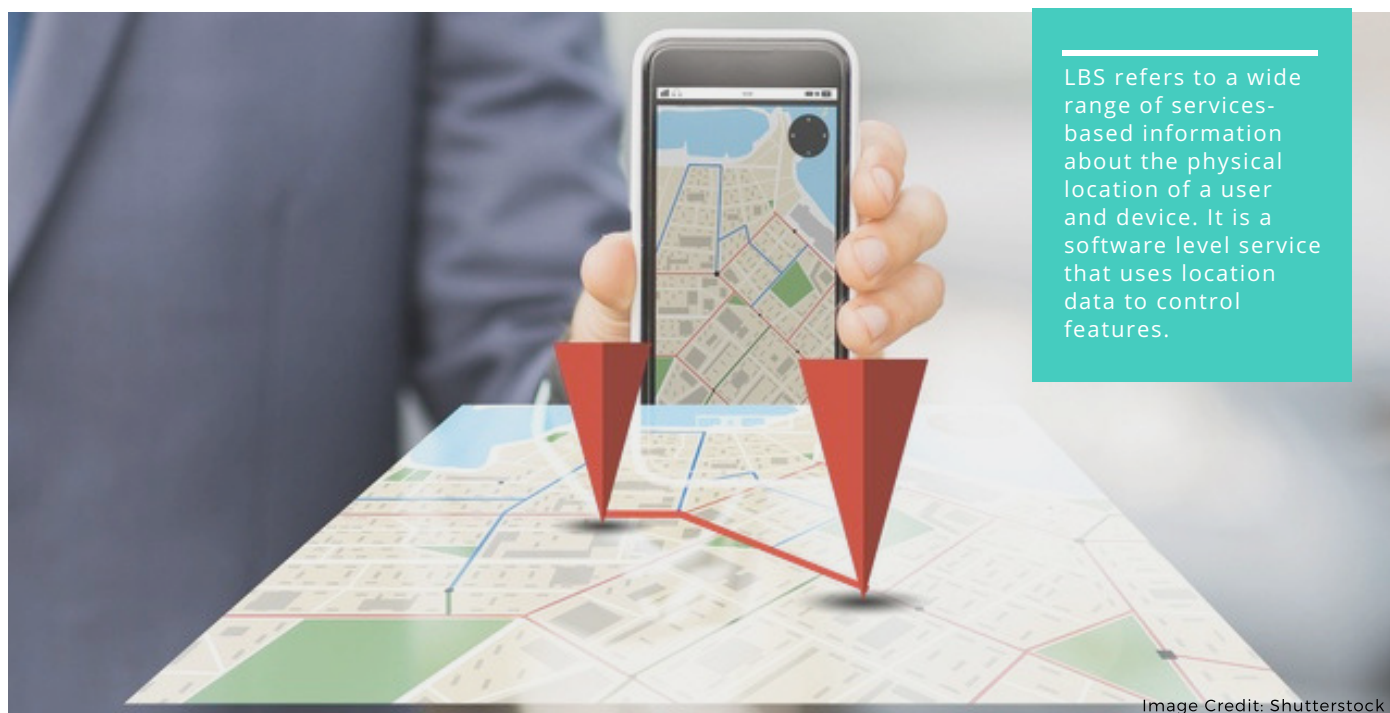


LOCATION-BASED SERVICES – THE WAY FORWARD

The concept of LBS is based on years of development and convergence of different technologies: GIS, GNSS, new information and communication technologies.

by G.K.Tripathy and T. Ranga Vital



LBS refers to a wide range of services-based information about the physical location of a user and device. It is a software level service that uses location data to control features.

Image Credit: Shutterstock

Accurate location is a critical factor in location-based services (LBS) and which is used for analysis and finding out the insightful inferences for businesses as well as government. The spatial patterns that location-related data and services can provide are one of its most powerful and useful aspect where the location is a common denominator in all these activities and can be leveraged to better understand patterns and relationships. LBS refers to a wide range of services-based information about the physical location of a user and device. LBS is a software level service that uses location data to control features. As such LBS is an information service and has several uses in social networking today. For the past few years, one could observe the transformation in

location-based technologies and geospatial information. Due to the popularity of geographic layer in everyday activities, people are getting more cognizant of the geospatial aspect of life. LBS application provides services based on the current physical location or a known location depending upon the proximity of the user. The user proximity can be determined by using mobile communication network or Global Navigation Satellite System (GNSS), Geographic Information System and Wireless Communication technologies.

Concept and Components

The concept of LBS is based on years of development and convergence of different technologies as well as an evolution of information society

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where context and customization of information is one of the first priorities for users. Looking at the technological background of LBS it can be presented as the intersection of several technologies: GIS and other spatial and positioning technologies, the Internet and the Web, and new information and communication technologies (NICTs).

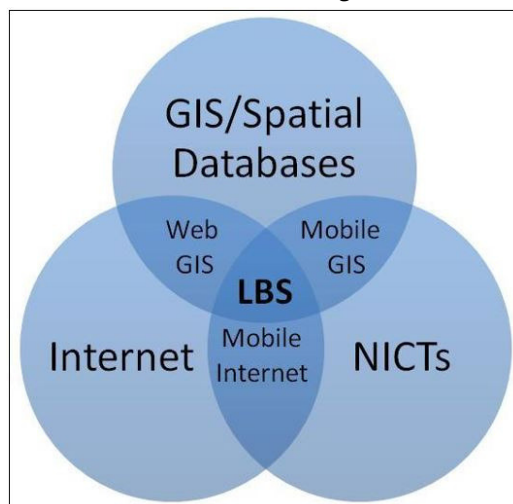


Figure 1. Concept of location-based services

Source: <http://geoawesomeness.com/>

The 'Web GIS' reflects development of Web mapping services that started operating in the mid-1990's (e.x. Mapquest.com) and were widely popularized all over the world by Google Maps launched in 2005 and other companies like MapMyIndia, SatNav Technologies etc.

This part reflects the evolution of many GIS Web as well based analytical tools including ArcGIS Online. The 'Mobile GIS' reflects the convergence of traditional GIS software and mobile devices (handheld computers, palmtops, tablets) that enabled field-based personnel to capture, store, update, manipulate, analyze, and display geographic information. Most of these solutions required downloading data to the mobile device. The 'mobile internet' presents the development of two technologies: wireless internet and modern mobile devices. The resultant of these technologies is LBS which is utilizing all parts of this equation. Taking into consideration growing progress in all those fields

including increasing computing power of mobile devices, the accuracy of positioning technologies, fast wireless internet connection and cloud computing, the LBS is playing a significant role among all the technologies.

Components of LBS

LBS architecture is only one of the challenges, the other one is providing a service, which will reflect user needs or create a demand for such needs and will allow service providers to make a return on their investment. Otherwise, the business is unlikely to be sustainable. Most of Location Based Services require several components, as is here the model of "5+1" components of LBS – 5 technological and 1 human-related is described.

- **Positioning systems** – allow geographically localizing the mobile device both outdoor and indoor using: satellite-based systems, Cell-ID, RFID, Bluetooth, WiMax, Wireless LANs.
- **Communication Network** – the wireless network that allows for the transfer of data between the user (thought mobile device) and server (service provider).
- **Service and Application Provider** – the LBS provider, including the software (e.g. GIS) and other distributed services and components that are used to resolve the query and provide the tailored response to the user.
- **Data and Content Provider** – service providers will usually not store and maintain all the information, which can be requested by users. Therefore geographic base data and location information data will be usually requested from the maintaining authority (e.g. mapping agencies) or business and industry partners (e.g. yellow pages, traffic companies).
- **Mobile Devices** – any portable device that has capabilities to utilize stated above components of LBS, for example, mobile phones (including smartphones), tablets, palmtops, personal navigation devices, laptops etc.
- **User** – operator of the mobile device and the person that is utilizing the potential of modern mobile device and infrastructures to get value-added information or entertainment.

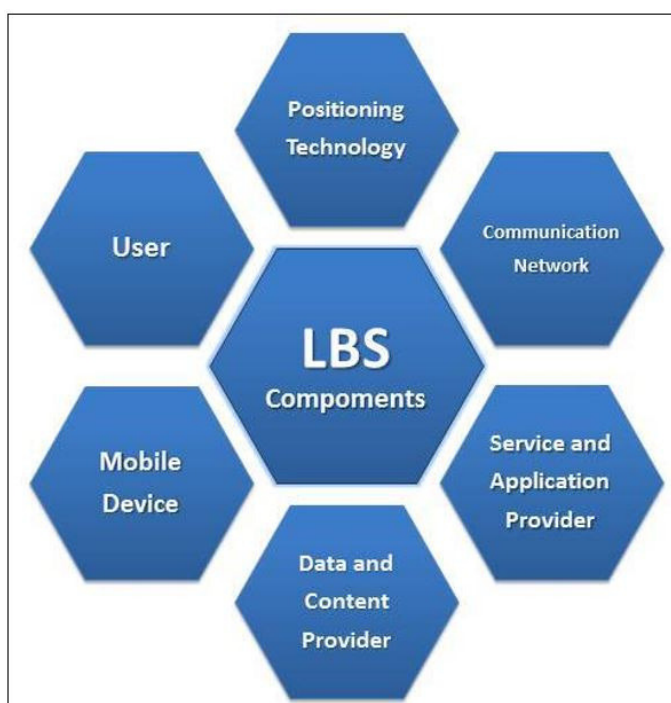


Figure 2. Components of location-based services

Source: <http://geoawesomeness.com/>

'Service and Application Provider' and 'Data and Content Provider' might be the same actor in the LBS architecture. For example, in the LBS application 3D World Gaze, Nokia is a provider of both the data and the application. The majority of smartphone LBS applications developed by using geographic data of one of the mapping services e.g. Google Maps, Yahoo Maps, Bing Maps, Open Street Maps.

Applications of LBS

It is almost impossible to catalogue all the applications of Location Based Services. In order to provide more useful, attractive and engaging social networks, apps and services, location-components have been added to new innovative projects. LBS applications are Navigation, Emergency, Tracking, Travel Information, Sports, and Information Services.

- **Navigation** - The Navigation services allow locating the exact geolocation of a mobile device using one of the available positioning systems and get direction and/or navigate a user to required location including vehicles, crafts, and pedestrians. The LBS approach to navigation gives a advantage over mobile navigation software using data stored on the memory of a mobile device because it potentially gives a user the access to the real-time data. The limitation of large volumes of data needed to be transferred over the wireless network is decreasing as many network operators offer unlimited or reasonably priced data transfer.

One of the examples of LBS navigation is mobile application Google Maps that can be accessed via multiple mobile platforms (Android, BlackBerry, iPhone, Palm, Symbian S60, and Windows Mobile). According to the study by market research Company Nielsen made in July 2011, 76% of adult Smartphone users operating on the Android OS in the U.S. have used Google Maps during last 30 days (Nielsen Blog, 2011). From the results presented in the other report made by The Pew Research Center's Internet & American Life Project one can learn that 55% of adult smartphone users in the United States use their devices to "get location-based directions and recommendations".

- **Emergency** - One of the fundamental application of LBS is utilizing the ability to locate an individual calling to emergency

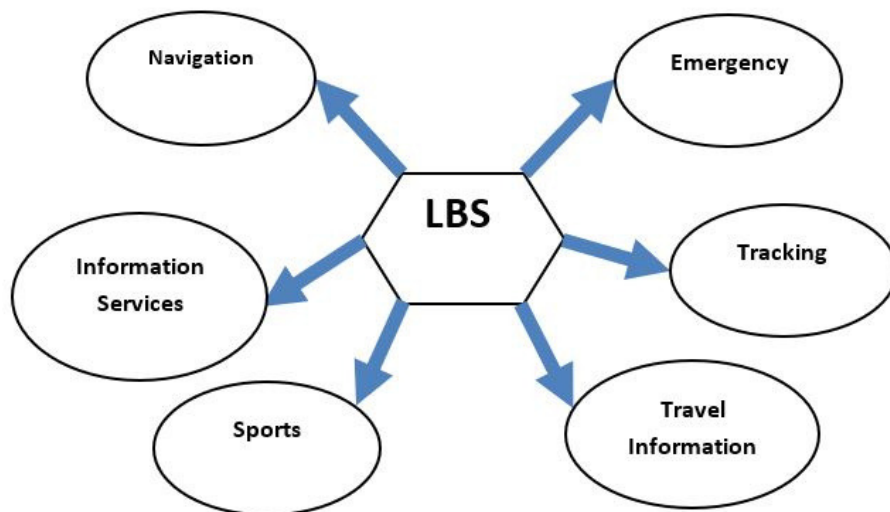


Figure 3. Application areas of LBS

response agency (100 for Police and 108 for Ambulance in India) as in Figure 4 who is either unaware of his/her exact location or is not able to reveal it because of an emergency. Based on this Geospatial information emergency response agency (e.g. ambulance, firefighters, and police) can provide help in a quick and efficient way.

- **Tracking** - Real-time tracking is one of the most useful applications of LBS. It can be used for people tracking: children, patients with dementia, prisoners, and employers to track their workers. LBS tracking solutions are used as well for animal tracking etc. Vehicle tracking is another broad application of LBS. UPS one of the World's biggest shipping

companies uses own location-based systems for management and logistics thousands of tracks. With fleet of over 60 000 vehicles, even one saved mile by every track per day means millions of dollars savings.

- **Travel Information** - LBS can deliver real-time travel information, such as traffic updates or weather reports, to the Smartphone, so the user can plan accordingly. Delivering services based on a traveler's location is a critical part of the mobile travel ecosystem, but using location alone misses the true opportunity for LBS. To deliver more effective location-based services, travel applications must combine location with context and relevance. LBS is evolving as part of general mobile trends and within a travel context. Competing entities, both within and outside the travel industry, are vying for a share of the lucrative location-based services market. The four primary functions of LBS for the traveler are:

- localization of persons, objects, and places,
- routing between them,
- search for objects in proximity such as restaurants, shops, hotels, or sights, and
- information about traveling conditions, such as traffic-related data.



Figure 4. Application of LBS in emergency Response

Source: <http://www.althos.com/>

Some of India's most popular mobile app for transportation, integrates city transportation for customers and driver partners onto a mobile technology platforms are:

- Google Trips : for travel planning, Oyo Rooms: for budget hotel booking, trivago: For hotel booking, Tripadvisor: Hotels and flights, MakemyTrip: Flight booking, Redbus: Bus booking, Ola/Uber/Meru: Online taxi booking.

- **Sports** - The potential of LBS and modern mobile devices can be used as well to monitor sports activities. Location-based application including Nokia Sports Tracker, Nike, Endomondo etc. has millions of users. The functionality of those applications allows a user to automatically collect and to visualize real-time his/her workout data, such as location, distance, speed, duration, or burned calories and store them on the server via Smartphone using Google Maps.

Mobile Location Based Gaming (MLBG) is a growing trend among LBS. MLBG is linking elements of traditional open-air field games (e.g. Hide-and-seek, Paper Chase) with new technologies available on mobile devices including positioning technologies, wireless fast speed internet, image recognition and augmented reality among others. MLBG can be defined as a location-based game that can run on a mobile device and by using a communication channel the game exchange information with a game server or other players.

- **Information Services** - Location-based information services refer mostly to the digital distribution of information based on device location, time specificity and user behavior. This is one of the most widespread and earliest implemented types of LBS utilizing both pull and/or push services. Nowadays the information is commonly delivered by external

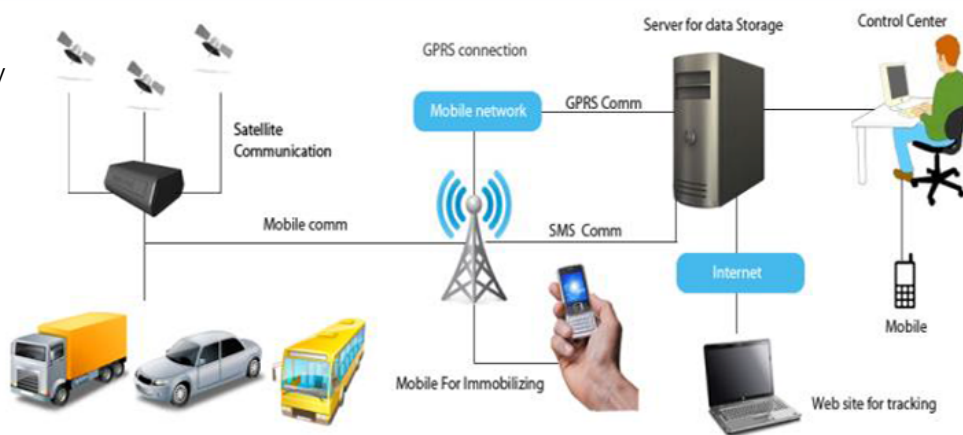


Figure 5. Various technologies and components of LBS tracking system

Source: <http://nexttechnosolutions.com>

providers with wireless internet via Smartphone apps (e.g. Yellow Pages, & JustDail). The scope of data and information offered by a service provider is very comprehensive and it includes local street map, a wide variety of points of interests (restaurants, gas stations, cafes, stores, pharmacies, hospitals, touristic attractions etc.), weather forecast, real-time traffic information etc.

Social Media - Social media has been widespread on the Internet and have become craved research topic. Social networks like Facebook, Google plus and Twitter changed the way how people communicate and maintain relations with friends, colleagues, peers or even a family. The development of location-aware mobile devices gave social media possibility to integrate location with content created users.

Geotagging - Geotagging is defined as adding geospatial metadata to digital media such as photographs, videos, messages, blogs, web pages and GeoRSS. Especially photo-sharing sites enabling geotagging are popular among users of LBS.

Geofencing - Geofencing is one of the key technologies used in Location Based Marketing. It refers to a virtual boundary created around a specified physical location or point on a map. It is used to test whether presence inside the area is true or false to trigger some sort of predefined

action, which in case of marketing refers to sending a targeted message.

Conclusion

Clearly, the evolution of LBS and the growing accessibility of mobile technologies have dramatically expanded the opportunities to use geospatial technologies. LBS Technologies such as wireless web, mobile internet enabled devices, mobile positioning, 4G and GIS solutions for wireless (data and application) plays an important role in the Navigation, emergency services, Tracking Services, Travel Information, Sports and Information Services.

References

1. *Convergence of LBS and AI*
2. geoawesomeness.com/knowledge-base/location-based-services/location-based-services-concept/
3. geoawesomeness.com/location-based-services-a-little-bit-of-theory/
4. www.rishabhsoft.com/mobile/location-based-application-development
5. www.canasean.com/canada-india-initiative-for-training-of-smart-city-planners/
6. www.crm4sure.com/crm-software-solutions
7. stfalcon.com/en/blog/post/5-hot-ideas-for-location-based-apps
8. *What are location-based apps*
9. www.cs.rut.edu/~ark5993/2.pdf
10. www.vbn.aau.dk/files/13669692/projectA.pdf
11. www.ijmlc.org/papers/224-C00278-007.pdf
12. www.ncbi.nlm.nih.gov/pmc/articles/PMC149402/
13. www.krazytech.com/technical-papers/location-based-services-through-gps
14. www.endomondo.com/
15. www.althos.com/tutorial/GSM-tutorial-location-based-services-LBS.html

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