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Location based services: Adding another dimension to smart cities



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Foreword

The story of India's economic development presents a mixed picture. The recent UN World Economic Situation and Prospects (WESP) estimates that India's economy is projected to grow by 7.6 per cent this year and 7.7 per cent in 2016, overtaking that of China's. Indeed, technological advances have made this order of growth possible. Alongside economic prosperity, there has been an exponential growth of urban population density. With the current state of infrastructure development, cities in India will be hard-pressed to cope with mounting population pressure. With the government's initiative to recast urban spaces with 100 smart cities, it will be necessary for new technologies to come to the fore. Emerging technologies, like Location Based Services (LBS) would be extremely beneficial and appropriate in handling the current state of economic development, urbanisation, population growth, level of infrastructure and rising expectation of the people.

Smart Cities around the world use GIS and LBS to obtain useful information for planning and for making processes automated, efficient and cost-effective. Geospatial infrastructure-backed LBS help decision makers in obtaining real time information, which city planners can use for city developmental purposes. Authorities receive, record and analyse location rich data to ensure safety and security of citizens and assets, and use such information in delivering citizen centric services like traffic advisory, emergency services, tracking vulnerable people and so on. Citizens of modern cities bank upon location services for getting day-to-day useful information like city routes, point of interest (POI), public transport schedules, traffic condition, break-down zones, toll roads, speed limit, parking places etc. LBS provide the appropriate information by targeting the right people at the precise location and at the exact time.

The current publication is an attempt by FICCI to align location based services with business and government processes. The report, jointly published by FICCI and PwC propagates mainstreaming of LBS technology for effective business management and decision-making. The objective of this report is to highlight the potential of LBS for smart cities. I am confident that this publication will provoke new thinking and help in widespread adoption of location based services in the country.

Dr. A. Didar Singh

Secretary General, FICCI



Foreword

Urban cities are expected to continue the exponential growth pattern both, in terms of population density and economic prosperity. This growth is directly proportional to the increase in citizen demands and expectations from city government authorities or the city at large. Citizen demands around the quality of living, sense of belonging, secure environment, information availability and technological connectivity has become an imperative with the increasing awareness and globalisation.

However, it has been observed over the previous few years, that the cities have not been able to keep pace with these fast advancing and evolving expectations. This has resulted in various urban concerns such as insufficient infrastructure, lack of affordable housing, economic disparity, traffic congestion, increase in GHG emissions as well as shortage in fundamental utilities such as power and water supply.

Despite these challenges, there is something charismatic about urban cities that continues to attract migrants from other cities and makes them stay put. To overcome urbanisation challenges, several global as well as Indian cities are exploring smarter ways of management to sustain the ever increasing city growth. The Indian government has taken progressive steps and has launched a nationwide initiative for transforming and developing 100 smart cities across India. Policies and strategies are being developed for this transformation aimed at improving operational efficiencies, maximising environmental sustainability efforts and creating services in order to address citizen needs. The smart city concept can be looked upon as a framework for implementing a vision of advanced and modern urbanisation. This vision projects the achievement of three goals, social equitability, economic viability, and environmental sustainability.

Along with spearheading smart city initiatives, India is witnessing advancements in technology as well as its adoption. There are cutting-edge technologies available in the market to harness information and data for improving government services and city functioning. Emerging technologies, especially location-based services (LBS), will reveal massive data streams pertaining to cities as well as citizens. LBS provide the right information and its real value while targeting the right people at the right location and at the right time. These technologies will enable the cities to refine service delivery as well as prepare themselves in the best possible manner, for addressing the megatrend of urbanisation. Combining and including LBS during the smart city master planning will help address the city needs in the best possible manner.

The objective of this knowledge paper is to highlight the potential of LBS in smart cities as well as present LBS applications with the help of a few international case studies. This knowledge paper has been prepared for a seminar organised by the Federation of Indian Chambers of Commerce and Industry (FICCI) on 'Location based services - 2015: Tranforming cordinates to business' to be held at New Delhi. The paper is intended to stir conversations on the possible avenues for leveraging LBS and amalgamating them in the smart city framework to enhance the quality of life for citizens. It will also facilitate decision-makers to take cognisance of the existing situation, ponder upon the way forward and possibly explore commercial avenues to improve revenue for the city's enhancement.

Neel Ratan

Leader, Government and Public Sector

PwC India

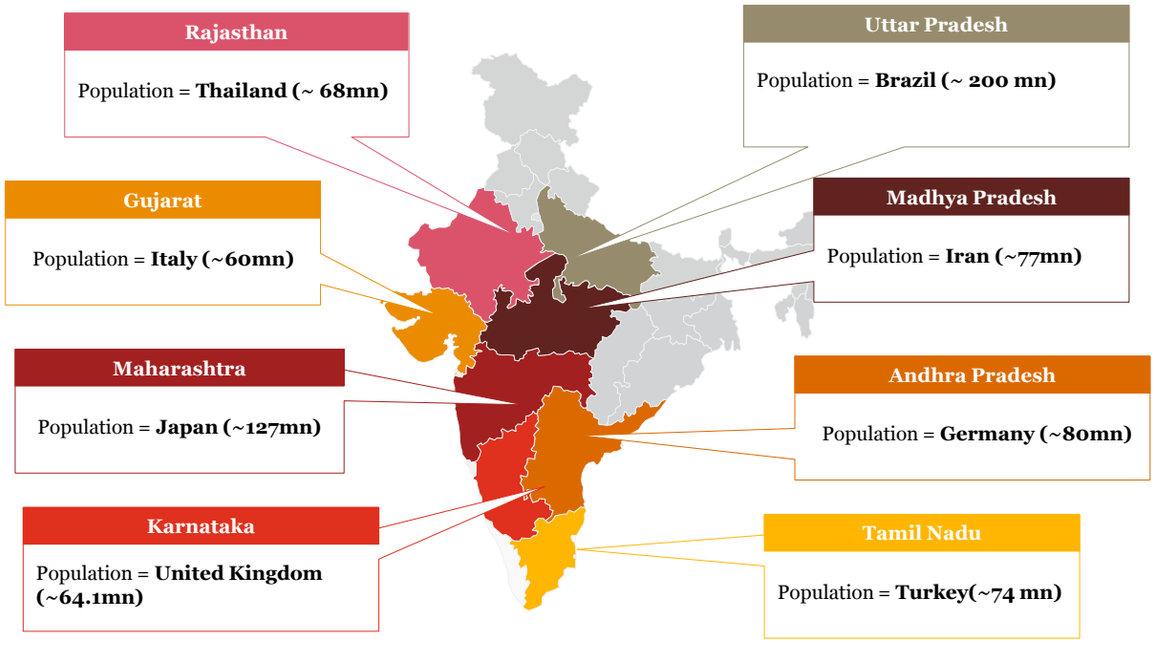
Living on the edge: Surging towards a prosperous future

Post the period of slump and stagnant economic growth, India is advancing to new heights with strong growth projections. Indian economy picked up pace in 2014 and is slated to chart a higher spending on infrastructure, renewed regulatory reforms and policies as well as a decline in inflation. The GDP is forecast to reach 7.8% in FY2015 owing to a better performance by the industry and services; this will be driven by polices and reforms aimed at addressing structural bottlenecks. The economy is further expected to achieve an exponential 8.2% growth in FY2016[i].

Cities, in all probability, will more rapidly grow over the next few decades. Urbanisation, though replete with challenges, provides avenues for growth and is the way forward as urban areas are emerging as economic drivers for nations. For instance, in the US, 52 metro cities accounted for 59% of its GDP and 55% of the overall population in 2o12. Likewise, in Brazil, 26 metropolitan cities or urban agglomerations having a population of over one million contributed 60% to its GDP and 44% of the population. India too, is the following the trend with urban regions contributing 57% to the GDP in 2012. This contribution from metropolitan cities is slated to only increase hereon. In 2025, 69 metropolitan cities are forecast to include 78% of the urban population of India. Metropolitan cities are emerging as trade and business hubs with numerous job and employment opportunities. People are hence migrating to these hubs for a higher standard of life and more attractive earning prospects. This shift to urban cities brings with it the potential for better economic growth, resource efficiency and overall well-being.

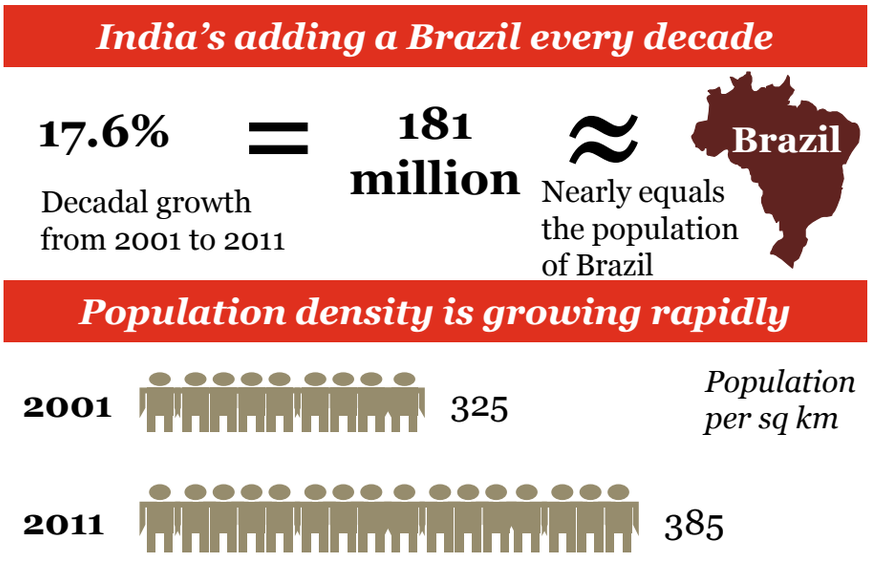


Depicted below are some major Indian states with popultion equal to various leading coutries.



In these states, majority of the population is concentrated in and around the major urban cities.

India's unbanisation trend:



If these trends are anything to go by, metropolitan cities certainly have the potential to help India achieve its objective of becoming a superpower.

However, if not managed properly, urbanisation can become detrimental. Mismanaged urbanisation can result in several economic, social and environmental challenges. Excessive conglomeration of population in urban areas will lead to restricted living spaces and real estate, shortage of resources such as power and water, traffic congestion, pollution as well as ineffective dissemination of public services.

It is important for city administrators to take stock of the situation, analyse the pros and cons of urbanisation and develop strategies to strike a balance between the city supply and citizen demands.

Smart cities: The way forward

Cities are seen as the engines of sustainable economic growth. Growth achieved by cities will be strongly linked to their ability to address issues related to urbanization. This is in association with addressing the social, environmental and economic issues in a holistic manner, while making the most of future opportunities. Governments across the globe have created transformation strategies for smart cities and adopted the philosophy of doing more with less by leveraging technological advancements. Barcelona, Amsterdam, Stockholm, Sweden, Seoul are perfect examples and have successfully adopted smarter ways for addressing urbanisation challenges while ensuring economic viability, environmental sustainability and social equitability.

The Indian government has also embarked upon the journey of smart city transformation and has announced the development of 100 smart cities. Emphasis is being laid on developing the right set of policies and strategies to propel the country's vision of becoming a leading global economy.

What are smart cities?

Smart cities have an integrated system for collecting, measuring, collating and broadcasting city data as well as making it easily accessible to stakeholders for efficient, effective development, governance and management. This model aims to maximise services to citizens as well as businesses for social, economic and environmental benefits.

Smart cities leverage ICT to mitigate most of the challenges attributable to rapid urbanisation.

Smart cities leverage technology and utilise existing and planned infrastructure investments to provide a higher quality of living to residents, a conducive investment climate for businesses and allow maximisation of resource utilisation and transparency for governments. They can be considered for organic integration of systems, IT infrastructure, physical infrastructure, social and business infrastructure. These systems work collectively so as to generate intelligent and actionable information for decision-makers.





Smart cities offer the promise of a better and more sustainable lifestyle in the following ways:

Optimised usage of resources

With the paucity of non-renewable resources, governments and citizens are increasingly adopting renewable and alternate modes of energy to minimise the depletion of fossil fuels and non-renewable energy sources. Also, it is becoming imperative to use ICTs and advanced technology solutions for optimising the consumption of resources such as power, fuel and water. These technology solutions, when adopted in energy, transport and waste domains, lead to direct economic and environmental benefits. This can be corroborated by customised energy consumption through instances such as smart metering, micro-grids, and dynamic pricing.

Better safety and security

Smart cities will leverage integrated public safety and security solutions such as smart cameras, pattern recognition, remote monitoring as well as red flagging through heuristic platforms in order to ensure a secure and safe environment for citizens.

Enhanced quality of life

Smart cities will leverage ICT in order to integrate as well as expand its vision for creating robust links between education, industry and government. They will provide superior amenities in terms of housing, schools, hospitals, institutions as well as entertainment and retail outlets, in order to provide an enhanced quality of life to citizens.

Connected and transparent public services

In the past, the efficiency of public and citizen services was driven by siloed e-governance initiatives. For instance, imagine a scenario wherein you have shifted to a new city and for municipal services, have sent out applications to multiple government departments for power, electricity and piped natural gas (PNG) connections.

What if, you apply for a PNG connection and your location information automatically gets updated in the city database as well. This feed is simultaneously sent out to post offices, electricity as well as water departments, police records, banks, schools, and taxation databases and they reach out to you for new connections. Such scenarios are gradually becoming a reality, as the focus is shifting towards a more connected delivery of government services so as to ensure a better experience for citizens. This integrated record management will also facilitate the delivery of holistic health services for citizens. Heath records of all citizens will be maintained on a central city database, thereby facilitating health practitioners to access your medical history easily. Ready access to services as well as their performance serves the cause of transparency and equity in city governance.

Smart cities: Urban components

Energy management

- Smart grid and meters
- Smart street lighting
- Advanced distribution management system with supervisory control and data acquisition
- Solar energy initiatives
- Renewable source of energy
- Energy-efficient and green buildings

Urban mobility

- Intelligent traffic management systems
- Integrated multi-modal transportation
- Intelligent pricing for public transportation
- Electric cars
- Environment sustainable mobility plans

E-governance and citizen services

- Smart online municipal services
- M-governance
- Participatory government
- Single-window clearance for businesses
- Disaster management solutions
- GIS maps for city departments performance efficiency and citizen services facilitation
- Integrated operation among various departments
- Data analysis and insight creation

Smart spaces

- Building automation
- Micro infrastructure such as sensor networks
- Urban heating and cooling systems
- Advanced HVAC and lighting equipment

Smart environment

- Green buildings
- Green data centres, green by IT and green of IT
- Pollution control systems, monitoring toxic gas levels
- Meteorological station network
- Forest fire detection
- Earthquake early detection
- Noise urban maps



Smart cities: Social components

Water management

- Smart meters and management
- Leakage identification and preventive maintenance
- Water quality monitoring

Waste management

- Real-time information of containers and waste bins
- Automated scheduling of waste collection and disposal
- Van roaster management and optimisation of resources based on actual requirements

Smart education

- Digital education
- Smart schools or colleges
- Simulation labs and incubation centres
- Student teacher and parents holistic connectedness

Smart surveillance

- Surveillance cameras and command centres analytics
- Situational awareness and analysis
- Simulation modelling and crime prevention
- Smart policing
- Home security systems
- Traffic violations

Smart healthcare

- Smart hospitals
- Improved clinical workflows
- Telemedicine
- Enhanced patient interactions
- Certified smart card readers for patient data security
- Updated healthcare information systems
- M-healthcare



LBS for a progressive India

With thriving employment and business opportunities, citizens in urban regions are witnessing a fast paced lifestyle and a rise in their disposable incomes. Higher spending power coupled with the demand for a comfortable lifestyle is altering the way cities function. Moreover, with the proliferation of technology, information and data are at the fingertips of citizens. People no longer rely on the good old mechanism of 'seek, wait and receive' for city services. For instance, we no longer have to wait in long queues for paying utility bills. Citizens can access the information related to their electricity consumption via an SMS and pay the bills from the comfort of their homes or offices with just a few simple clicks. This is not all, with technological advancements, electricity consumption can also be controlled sitting at far off locations via mobile applications and reduction in electricity bills can be attained by switching to alternate means of electricity source such as renewable energy. With every passing day, technology innovations are being explored and services are being developed for improving the quality of life for citizens. Emerging technologies are significantly permeating untouched territory and if utilised optimally, can add substantial value.

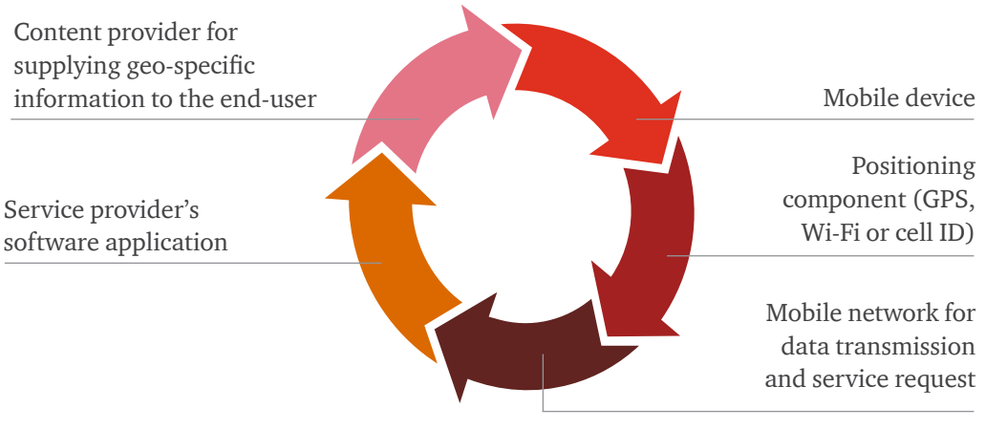
LBS bring with them the potential to drastically alter the way cities operate and at the same time add a new dimension to the lives of people.

Location is the key for providing value services to customers. These services integrate the location with geographic information systems (GIS) for adding value to the location data of a mobile phone or GPS user.

How do they work?

LBS are attracting the interest of various stakeholders and industries such as advertising, logistics, transport, urban planning, asset tracking and governance. They have the potential to make the dissemination of city services proactive as well as more prompt and are offered through portable devices such as a mobile phone by determining the device's geographical location through the mobile network operator's tower. Services are pushed to customers on the basis of their coordinates as well as back-end data analytics which provide an insight into the preferences and patterns of their choices.

LBS require the following basic components:



LBS function by pushing or/and pulling services into the mobile device of the user. Push services refer to location services that use position coordinates of the mobile device to give alerts such as weather information and service messages. On the other hand, pull services are those wherein the user requests for location-based information through a specific application, such as navigating to a specific location in the city by using map service. Therefore, LBS can be considered as an amalgamation of the internet, GIS and mobile devices. Geo-fencing is done through a software program which utilises radio frequency identification (RFID) or GPS for defining geographical boundaries. Once a device enters into the defined geographical area, messages or notifications can be pushed to the device.

LBS are a subset of the trend of integrating personal navigation and locational information into the life of consumers and mobile users. The proliferation of smart phones equipped with GPS brings home their value. However, LBS are not just reliant on smartphones to capture the location coordinates of a user. The location can be captured through multiple parameters including cell ID, GPS, Wi-Fi, bluetooth and near field communication (NFC). The cell ID is the most simple localisation method that relies on cellular networks. The position of a mobile terminal is identified via the ID of the base transceiver station connected to the user's phone at that moment. The GPS in the phone detects the location vis-à-vis satellites. The sensor in the phone reaches out to three or four satellites for figuring out the user's exact coordinates. Subsequently, triangulation technique is used for determining the speed, position and elevation of the mobile device. Wi-Fi points in urban areas and buildings can also be used for accessing the location coordinates of a mobile device.

Today, we barely see an application that doesn't use location information to provide a better user experience. Consumers now consider location a default determinant of the services they use, since it makes information more relevant and improves overall experience.

In a country such as India, which is on the cusp of a telecom revolution in terms of data services, LBS bring forth endless opportunities to transform the way services are delivered. These services provide enhanced value and open up avenues for a gamut of services that were unconceivable until just a few decades back. One may argue that the installation of GPS can also facilitate them but, given the high penetration and user density of mobile phones India, mobile phones are the best bet for this implementation. As of Q4 2014, India accounted for 12 million new mobile subscriptions while the number of overall mobile subscriptions in the country is 945 million[ii]. The mobile penetration rate of the country is estimated at 74%[ii].

Also, if implemented at city level, city administrators need not invest exclusively on the installation of GPS devices at multiple points to capture the data. Instead, leveraging the existing mobile devices across the city is a more practical approach for capturing data and pushing location based services.



LBS: Adding another dimension to smart cities

The smart cities evolution starts with strategy formulation and city master planning. The first step is to undertake a thorough assessment of the city's characteristic and demographic profile such as education rate, crime rate and pollution levels. This also includes understanding the city's theme (industrial, urban, IT, satellite, heritage), economy, trade and history, current challenges, pain areas, citizen profiling, government preparedness, improvement opportunities, and existing set-up as well as services. Though this can be done using conventional approaches and mechanisms, using LBS and analysing location data can enable city administrators to perform an accurate assessment that is more specificthan generic.

Location is a vital component of a networked society. LBS present a lucrative opportunity for the local administration to enhance its performance by leveraging location and citizen intelligence. Currently, citizen information and data, that are an asset for driving improvements in services and administrative performance, are largely under utilised. It is imperative for local authorities to pro-actively start identifying customer requirements and address them in a systematic manner to deliver more effective, targeted and better services to citizens and communities.

LBS, if implemented in a standalone manner, can be beneficial for operators, businesses and citizens as they focus on targeting the right people at the right location and at the right time. What if these LBS insights can be used for making our cities better for all the city stakeholders including the government, citizens and businesses?

The integration of LBS with smart cities will take them up a level. They can add another dimension to governance and city services such as transportation and utilities, making cities smart+. Imagine a scenario wherein you are walking past a dump of trash on the road and you click a picture with your mobile phone and post it on Twitter. Analytics combined with LBS can trigger an alarm at the municipality and they can leverage LBS to trace the team that is nearest to that spot to get the garbage cleared instantly.

LBS, when combined with data analytics and city demographics, has tremendous potential to tap into the pulse of the city and thereby improve the quality of life for citizens. Their integration with city demographics and data analytics leads to better insights as well as enables city authorities to target the right people at the right time and at the right place.

This integration is a win-win for both citizens as well as the government authorities. Moreover, this will empower city authorities to gain better insights into citizen requirements and accordingly plan as well as disseminate city services. This, in turn, will increase citizen satisfaction levels, thereby improving city branding which will further attract businesses and improve city revenues.

For instance, imagine a scenario wherein LBS are used to track the travel patterns of consumers on the Delhi Metro. When big data analytics are applied, it is deduced that the density of commuters between Connaught Place and Gurgaon is maximum during the morning and evening hours. To offload the rush on metro trains, city authorities decide to ply direct air conditioned buses from Connaught Place to Gurgaon during these hours. Advertisers and businesses owners will also have an opportunity to advertise their deals and offers, specifically targeted at working professionals, in these buses. This, in turn, will end up enhancing the revenue of DTC buses as well as businesses.

For making our cities smart+, it is recommended that the administration simultaneously initiates work towards the implementation of LBS for better city planning. The parallel implementation of smart cities and LBS will give city authorities a better hold on city functioning and service dissemination for addressing the aspirations of city stakeholders. Siloed attempts will only lead to replication of efforts as well as spiralling of costs.

Stakeholders in smart cities and LBS

The primary objectives of smart cities is to ensure environmental sustainability, economic prosperity, enhanced quality of life and inculcate a sense of belonging through measures such as participative governance. This sense of belonging will encourage citizens to contribute towards city initiatives as well as support the government in city functioning by volunteering for city welfare. Likewise, LBS are a common platform through which service enablers, regulators and consumers interact with each other and receive and provide services. Both smart cities and LBS have various stakeholders that form a part of the holistic city ecosystem.

Stakeholders for smart cities include employees, citizens, government and businesses.



Stakeholders and their requirements from a city

City council
- Ease of citien interaction and governance
- Revenue maximisation and traceability

Citizens
- Safety
- High quality of life

Industrial
- Reliable access to basic Infra like electricity, water, transportation network

Employees
- Intermodal transport for ease of movement

Commercial
- Logistics network to facilitate movement of goods
- Reliable access to basic Infra like electricity, water, transportation network
- Basic services to facilitate consumer interactions

Investors
- Adequate return
- Realisation within specified timeframe

In the smart city model, city authorities and the government are implementers and primary information providers. Moreover, government and administration are service providers and enablers in smart cities while businesses, citizens and employees are information consumers. On the other hand, in LBS, businesses and telecom operators become suppliers of information while the role of government is limited to being enablers and providers of LBS infrastucture.

Stakeholders role in LBS



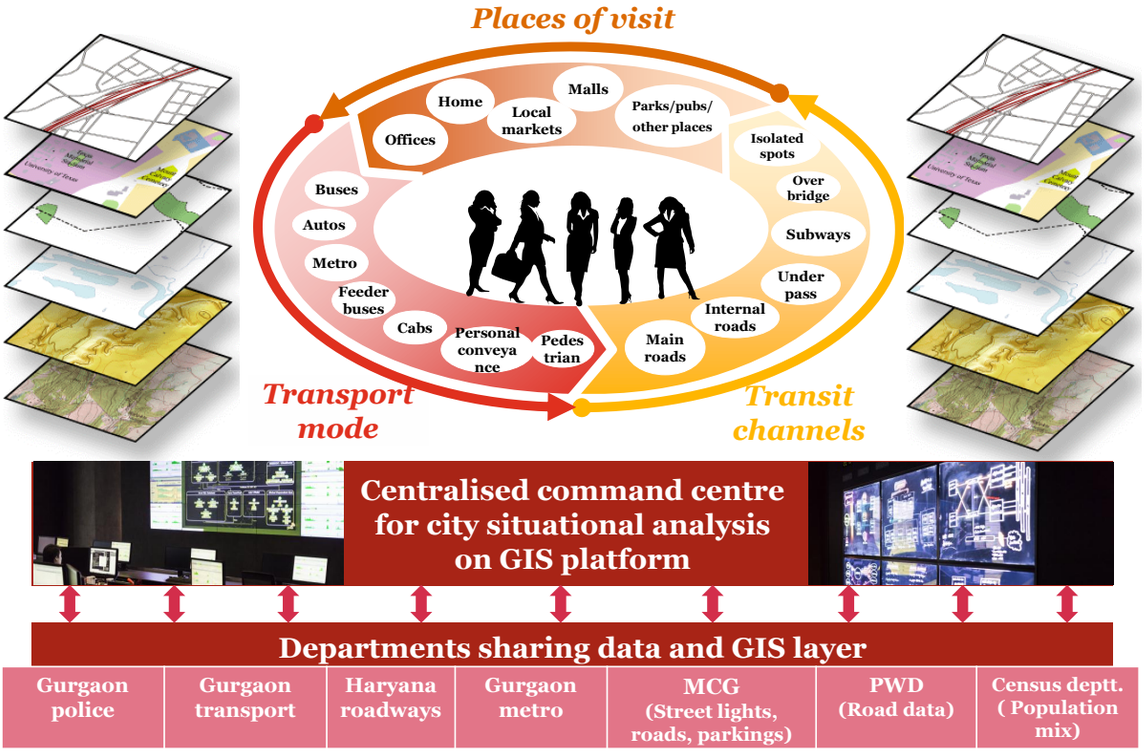
LBS application in various city domains

LBS in smart cities will usher in numerous opportunities to improve the quality of life for citizens. LBS have the potential to drastically transform city aspects. We have listed out scenarios on how LBS can facilitate and improve transport, safety and security, utility and location-based advertising.

Safety and security

Safety and security are two crucial aspects that significantly influence the liveability index of a city. The safer a city is, the better its economic and social prospects. LBS can play a crucial role in improving the security of a city, particularly for women.

In a typical day, a women travels to her place of work or to markets and malls via different modes of transport such as buses, autos, cabs and metro. LBS will make it possible for her family to track her journey to ensure that she has reached her destination safely, particularly when she is travelling late at night.



This is how LBS will work. The moment a female employee leaves her place of work, she will enter her phone number in the LBS database to activate tracking of her journey and sharing the details with her family member. In case of a detour from her regular route, her family will be notified via a text message about the change in her route. Moreover, with several abrupt changes in the route or stops at a point for a lengthy time period, an alarm will be triggered and access to her data will be provided to the city command and control centre on a GIS platform. The nearest rescue units will be alerted and city cameras in the neighbourhood will be identified that can be zoomed and panned in to check on her. Subsequently, any help, if required, can be rushed in instantly by city authorities. Consequently, LBS can contribute immensely in improving the safety and security of a city.

Transportation

LBS can also be leveraged for improvising the transport network of a city and further improve the mobility as well as last-mile connectivity for people. In the events of traffic congestions and jams, location-based data captured from user mobiles can be used to trigger alerts at city command control centres for rushing in help to ease congestion. Suppose a new metro route has been started recently. Metro authorities can leverage LBS to track stations with the maximum number of passenger exits and entries.

Subsequently, last-mile connectivity in the form of metro feeders or autos can be deployed at those stations to ease mobility. Moreover, LBS can be used for facilitating payments at toll points through digital wallets. The moment a vehicle enters the virtual network created by LBS near the toll area, a text message can be triggered to the user's mobile to seek permission for deducting the toll amount directly from his or her digital wallet. Similarly, LBS can be integrated with smart parking management systems for booking parking spaces or paying parking charges. text messages or app alerts can be pushed to users the moment their mobile device enters the virtual network boundary created by LBS.

Location based advertising

Presently, the most popular application of LBS is targeted and customised advertising. Relevant services can be pushed to user mobiles to improve experience. Currently, LBS are increasingly being used for targeted advertising by service operators. When a user enters an area, geo-fencing gets activated and nearby marketers can push their offers to the user. Moreover, offers can be pushed on the basis of past shopping history and user preferences. Therefore, relevant information can be pushed to the user at the right time and the right place.

For instance, a mobile phone user spending most of his or her time in office can be offered lower call rates by simply pulling the location data of the subscriber from the nearest base transceiver station to create a reduced rate zone. The information pertaining to time spent in a specific area can be sold to brands and marketers and other utility service providers for targeted advertising, resulting in increased brand awareness and thus creating a profitable proposition for both the marketer and the telecommunication services firm. Another instance of LBS can be suggesting the closest marketplace to a user by determining the geographical location of the user.

LBS can open up new revenue streams for telecom operators, marketers, businesses and advertisers.

Emergency management

LBS can prove to be useful for effectively handling emergency situations and crises. They facilitate in proactively informing the concerned departments to take corrective actions as well as inform other people about the crisis. For instance, suppose a fire incident has occurred in a building and a candidate was supposed to be attending a job interview in it. LBS can immediately issue notifications to guide people in the building to the nearest exit points as well as send an alert to the candidate about the situation.



LBS diagnostic tool

Mobile-based LBS are thriving at a rapid rate. With the use of GIS spatial data, location intelligence and other technologies, various LBS or applications can be provided to citizens.

It is important for city authorities to plan for services that are required and set their implementation priorities. This can be done by developing a comprehensive list of services and then qualifying them on the basis of the following vectors:

- **Requirement:** This will take into consideration the availability status of the service and the manner in which it is being delivered. High scores indicate criticality of the service.
- **Turnaround time:** This will take into consideration the implementation time required for the new services that qualify or the time required for modifying the exiting services for desired results. High scores are given for services with low turnaround time.
- **Dependency:** This will take into consideration administrative and technical dependencies. High scores are given for services with low dependency.

On the basis of the score across the above data vectors, city authorities can plan and execute the LBS.

High score: **3** Moderate score: **2** Low score: **1**

Description of services		Requirement	Turnaround time for implementation	Solution dependencies	Overall score
Emergency management	During emergency situation, response to be initiated on the basis of the location of respondent; nearest units of department like police, fire, hospital to be alerted	3	2	3	**8**
Incident management	Locating an individual calling to city emergency management agency who is either unaware of his or her exact location or unable to reveal it because of an emergency situation	3	2	3	**8**
Women's safety	Sharing location details of female employees leaving late with their family members for real-time tracking; user to log on through an app while leaving workplace at night and log off on reaching home	3	3	3	**9**
Crime, hotspot mapping	Planning for proactive crime mapping by tracing serial offender through wearable tracing device; also by tracking the locations or pattern of crime, next probable place or victim (geographic profiling) can be found	2	2	1	**5**
Smart parking	Notifying user about the nearest parking zones and its availability based on the location	2	2	2	**6**
Traffic compliance	Using sensors and locations for fine computation and enforcement system by tracking vehicle speed, signal jumping, etc	2	2	2	**6**
Wait less bus tracking	Aggregating location of bus, time estimate and traffic estimate to notify user about wait time for the mode of transport	3	2	2	**7**

High score: **3** Moderate score: **2** Low score: **1**

Description of services		Requirement	Turnaround time for implementation	Solution dependencies	Overall score
Smart healthcare 	Notifying user with chronic health issues about the nearby places; for example, informing about the highly polluted place to a person suffering from asthma	2	1	1	**4**
Geo-fencing 	Notifying users about best deals, offers, discounts when within the virtual fence of any restaurant or shopping mall	2	3	2	**7**
Check-in based contest and games 	Verifying user based on checked-in status and awarding user with discounts, coupons	2	2	1	**5**
Target marketing 	Utilising user preference, social demography, trends and opt-ins to provide app alerts or messaging	3	3	2	**8**
Location search 	Listings of local points of interest (merchant retailers, restaurants, etc.) depending on a geographic position of a mobile device	2	2	2	**6**
Smart transportation 	Planning smart transportation through safety routes and by managing transport according to congestion and usage	3	2	1	**6**
Smart policing 	Providing more vigilance and surveillance to the areas, roads most commuted; also according to the time clusters surveillance to be allocated	3	3	2	**8**
Business startups 	Profiling locations according to the demography, preference, trend	3	2	2	**7**
Family, friend locator 	Locating friends and family members, senior citizens and children; Locating nearby friends and colleague and referring them best deals, discounts so that extra points can be earned	2	2	3	**7**

Making it happen

LBS provide an innovative way for governments, businesses, advertisers, telecom operators and citizens to connect with one another and utilise each other's location data to facilitate better planning, service offerings and analysis.

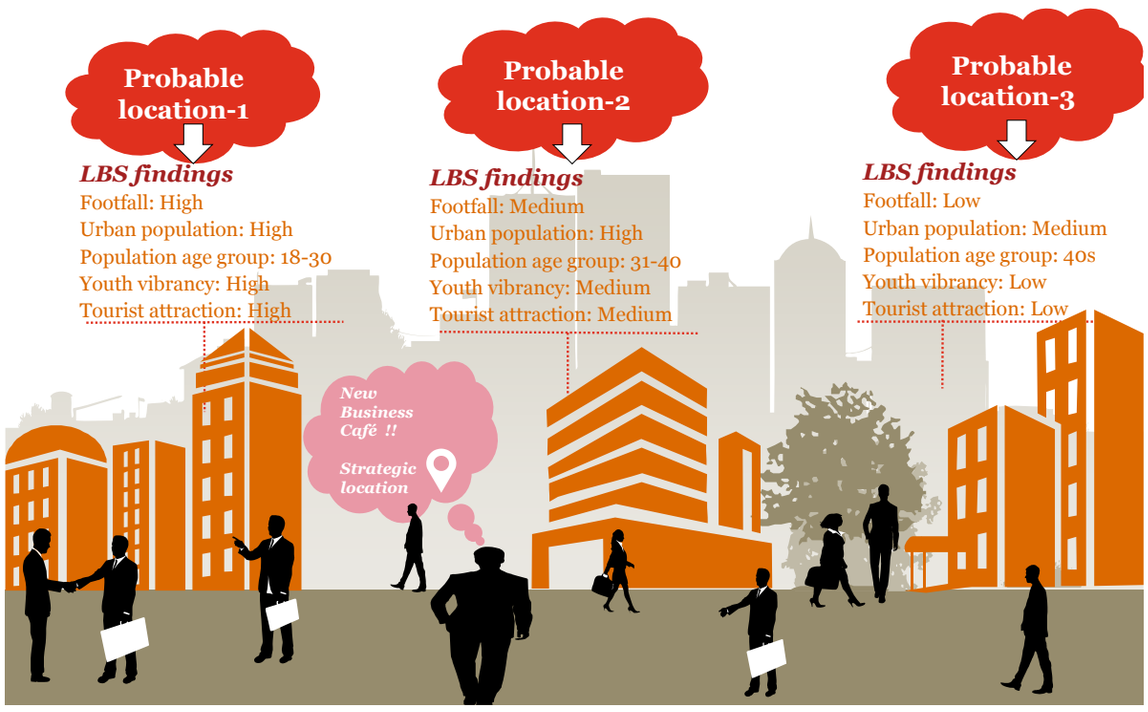
Consider an illustrative scenario wherein an entrepreneur wants to set up a new business venture in the leisure sector targeted at youngsters and working professionals. The entrepreneur is scouting for the best possible as well as the most profitable business sites to establish his venture.

This can be done using various approaches and computer modelling programmes. However, with recent advances in technology, site selection has transformed from an intuitive art to a nuanced science. Entrepreneurs can now leverage LBS along with analytics to understand the demographics, citizen mix, trends, behaviours, footfall, etc, in order to identify the most profitable business sites.

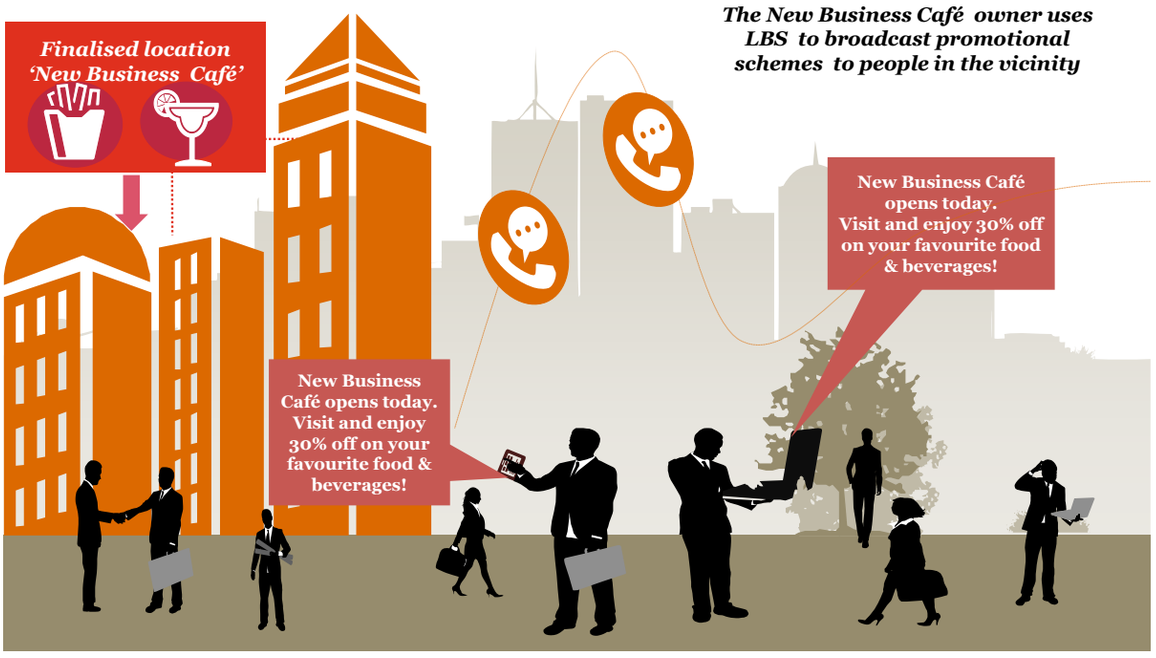
Once a site is identified, the entrepreneur can use LBS to locate the nearest government authority offices for taking requisite licences and clearances. He can also use LBS to identify nearby suppliers and vendors for his business in order to save on logistics costs and prevent unnecessary delays.

After the establishment of the business, the entrepreneur can again approach the telecom vendor for using LBS to launch a text-based campaign to send promotional and inaugural discount related messages to people in the vicinity.

Scenario 1: Using LBS for setting up new business

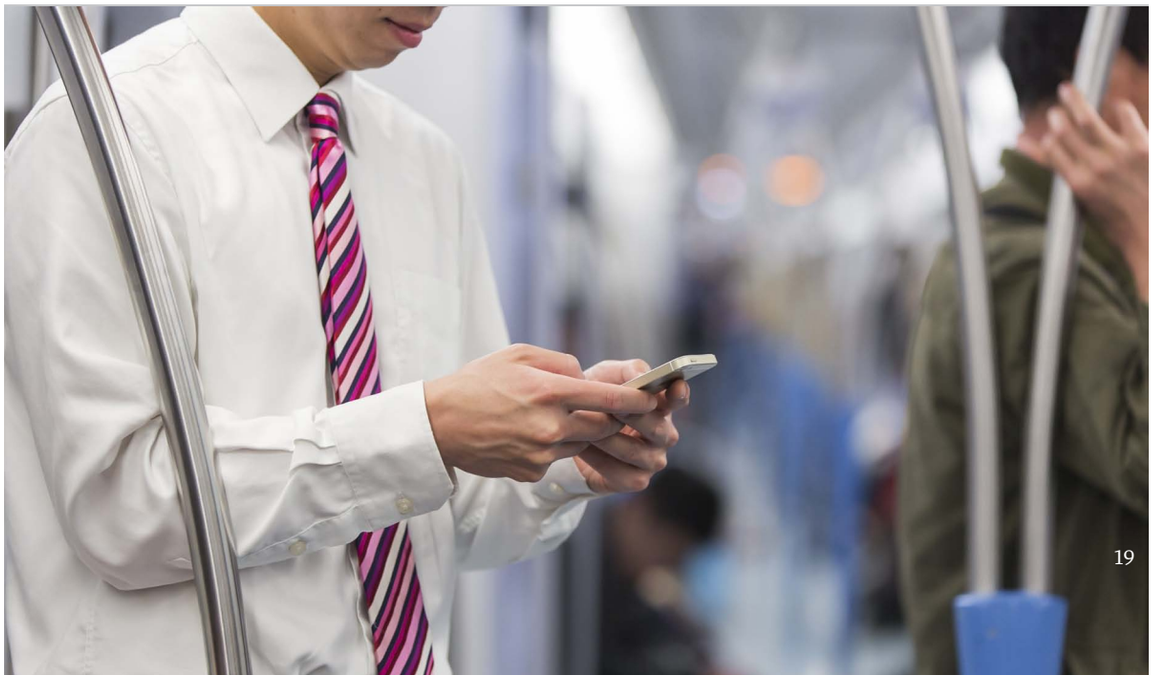


Scenario 2: Using LBS for making business profitable



Once the LBS ecosystem has demonstrated its efficiency and success, the government can consider the possibility of partnering with independent establishments and entities for promoting social initiatives and participative governance. Also, such entities may themselves proactively decide to give back to society and use their ventures to spread LBS awareness among people.

In this scenario, the entrepreneur can decide to allocate a dedicated section to promote government schemes as well as encourage people to register on mygov.in, the platform for participative governance. For this, he may install a kiosk with the details of all government schemes such as Beti Bachao Beti Padhao and Give Up LPG Subsidy. Also, the entrepreneur may have devices to facilitate mygov.in registrations as well as demonstrating its usefulness to customers. With increased footfall, government schemes will get promoted and business branding will also improve significantly, culminating in a win-win situation for all stakeholders.



Taking stock of key projects at the national and international level

National example of GIS and LBS: Delhi smart city

The Delhi government along with Geospatial Delhi Limited (GSDL) has planned to develop Delhi as a smart city with the vision of integrating geospatial data from all city departments so as to enable them for better coordinated analysis, planning, governance and management of resources. This will enable them to maximise their respective services to the citizens for overall social, economic and environmental gain. Towards this, the Delhi government envisages integrating the data of all city departments on a single map to provide single-window services to its citizens and businesses.

Project background

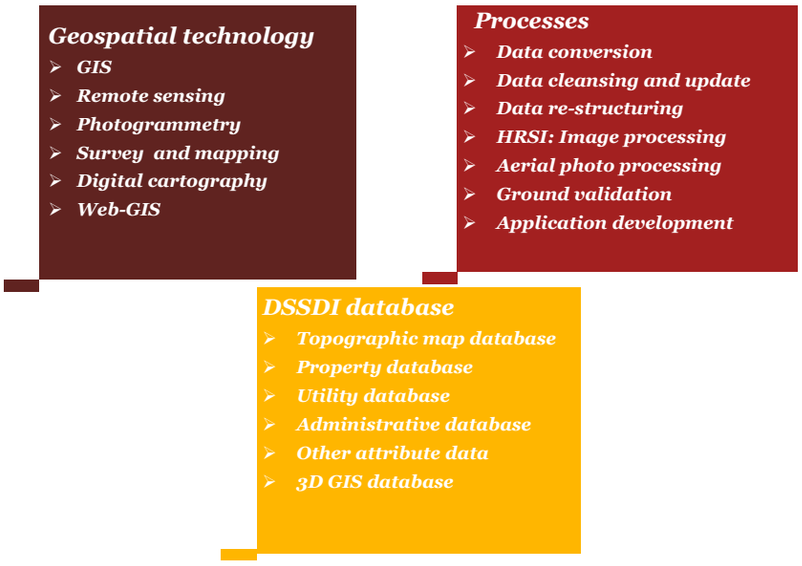
Geospatial Delhi Limited (GSDL) was formed as a special purpose vehicle to accommodate and facilitate the Delhi State Spatial Data Infrastructure (DSSDI) project. GSDL is responsible for framing and implementing policies for issues related to geospatial data in the National Capital Territory of Delhi (NCTD) and is also mandated by Delhi Geospatial Act 2011 to protect, nourish and maintain as well as create, update, manage, disseminate and share geospatial data for the departments of GNCTD.

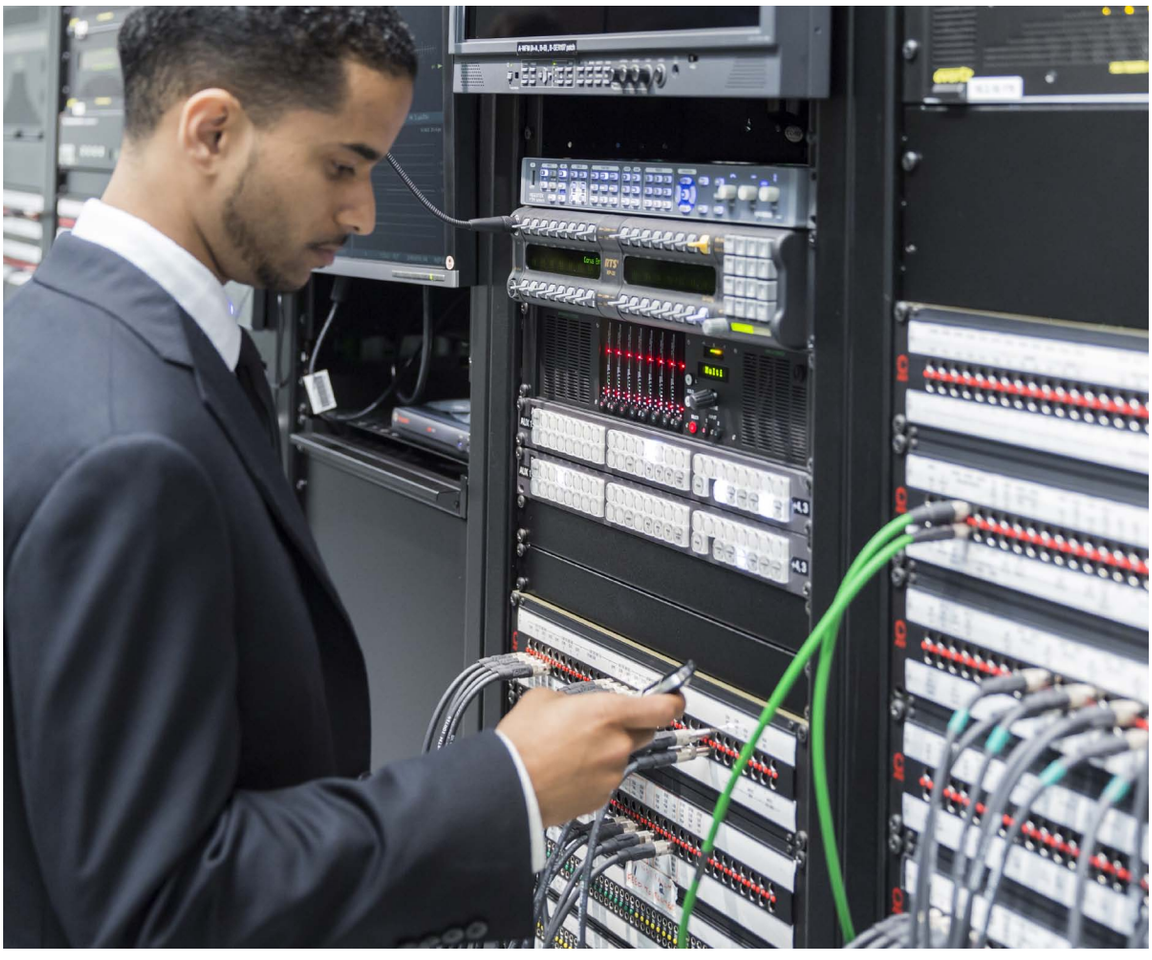
Under the DSSDI project, a huge database has been created with the objective of building the 3D spatial datasets using modern technologies. A base map has been created through photogrammetric procedures on a large scale (1:2000), using aerial photography substantiated by various kinds of field surveys, namely topographic surveys, property surveys of dwelling units, underground utility surveys (including water, sewer and energy utility) and field photography in order to generate textures for the 3D models of the buildings.

The geospatial data includes:

- Topographic map database
- Property GIS database
- Utility GIS database (underground, onground and overground)
- Administrative database and other attribute data

GSDL has developed and inventoried geospatial data for all real-world features in 3D in 1:2000 scale for Delhi. This centralised geospatial database repository will be utilised by different departments, local bodies and authorities through web-enabled applications. Base data has been developed using geospatial technology and processes.



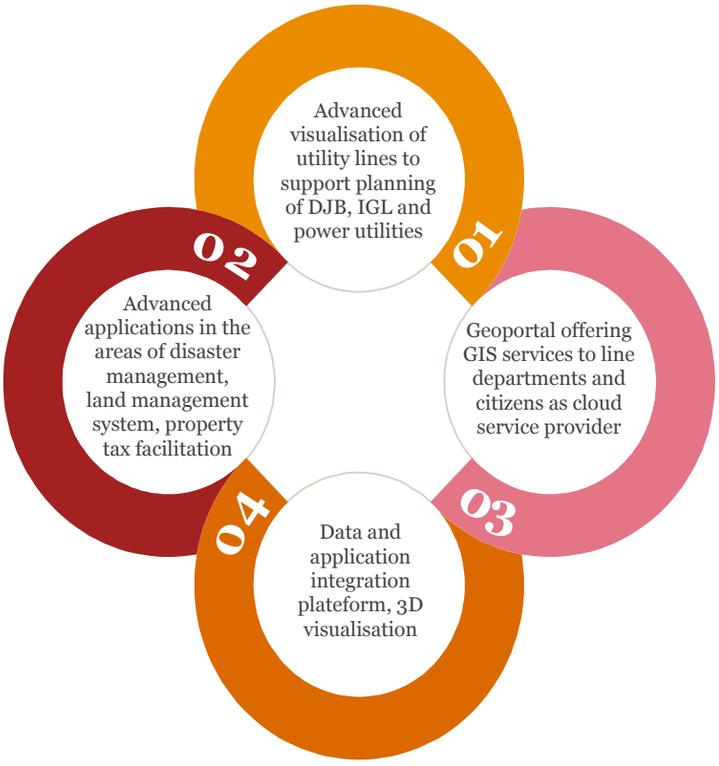


The data is related to and will be utilised by the following 29 line departments and companies:

1. Delhi Development Authority
2. Delhi Disaster Management Authority
3. Delhi Fire Services
4. Delhi Integrated Multi-Modal Transit System Limited
5. Delhi Jal Board
6. Delhi Metro Rail Corporation Ltd.
7. Delhi Pollution Control Committee
8. Delhi State Industry and Infrastructure Development Corporation Limited
9. Delhi Tourism and Transport Development Corporation Limited
10. Delhi Transco Limited
11. Delhi Transport Corporation
12. Department of Environment, Forests and Wildlife
13. Department of Health and Family Welfare
14. Irrigation and Flood Control Department
15. Department of Trade and Taxes
16. Directorate of Education
17. Department of Excise, Entertainment and Luxury Tax Department
18. Indraprastha Gas Limited
19. Mahanagar Telephone Nigam Ltd
20. Municipal Corporation of Delhi
21. New Delhi Municipal Council
22. North Delhi Power Limited
23. Office of the Chief Electoral Officer, Delhi
24. Office of the Labour Commissioner
25. Public Works Department
26. Revenue Department
27. Yamuna and Rajdhani BSES Power Limited
28. Directorate of Census Operation, Delhi
29. Office of Registrar Co-operative Societies

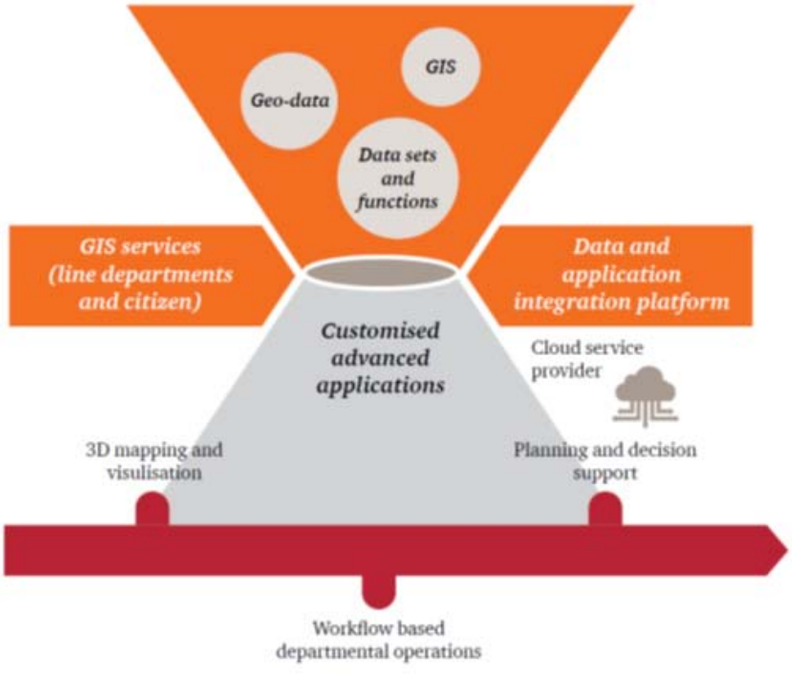
GSDL now plans to develop cloud-based GIS systems for all line departments to assist them in operations. The GIS system will be an integrated solution wherein cross-department layer access will be possible for better information-sharing and analysis. Under this initiative, GSDL also plans to develop a process-driven robust technological solution for continuous and seamless data updation by line departments.

The following key objectives are envisaged under the current transformation:



To do so, GSDL is in the process of understanding the individual requirements of line departments, reviewing existing databases and data gap analyses as per the requirements of the line departments for the upgradation of infrastructure to support the development and deployment of citizen-facing services and meeting the final objective of transformation of Delhi as a smart city.

The high-level integrated view of the solution



International examples of GIS and LBS

Smart city initiatives	City and country	Key objective	Description	Benefits or impact
Commitment to sustainability	City of Dubuque, Iowa, USA	• Energy efficiency and management • Checking water proliferation	Location-based sensors installed to trace the energy or water leakage and send its location to the concerned departments by geocoding it on GIS maps	Rationalisation of energy consumption, demand side energy management, water conservation, monitoring, savings, water surplus
Smarter safety services	Seoul, South Korea	Providing greater autonomy to children, the disabled, the elderly and Alzheimer patients	Smart devices have been developed which utilise LBS to track children and the elderly when they move out of designated location boundary; integration with city CCTV network to track the exact location of missing member	Family members and police department to be able to trace their missing members
Smart mobility	Seoul, South Korea	Traffic and transportation information dissemination	Utilising location intelligence of vehicles through GPS and superimposing it on GIS maps, providing real-time information about traffic congestion, alternate route, optimum route to specified destination and other modes of transport	Users gets real-time information to plan their journey accordingly
Smart tourist guide	Nice, France	Updating local resident and tourists about the recreational and tourist spots	Leveraging LBS and GIS, Nice delivered relevant information related to the tourist spots, buses, guest houses and hotels to its residents; tourists are also informed when they enter the city boundary	Availability of relevant information on the current travel location
Crime mapping and smart policing	Lincoln/ Nebraska, USA	Crime mapping, hotspot generation, crime trend	Tracking the locations of different type of crimes and offenders by LBS and geocoding them in GIS maps to generate crime map and hotspots for smarter policing	Proactive crime detection, rationalised police van allocations, efficient surveillance and tracking
City control centre	Rio De Janeiro, Brazil	A comprehensive platform for the storage and analysis of meaningful data, monitoring operations and the evolution of incidents	Collecting city level data through different sensors, analysing the data and hence utilising LBS to update users about the city level informations such as sudden climatic change, no-entry, traffic congestion, etc. according to their locations	Government has optimised its operation at the city level and can set priority order and alerts to create emergency command; also, the citizens are updated about city information on-the-go
On-the-go parking	Barcelona, Spain	Improved, efficient and sustainable urban parking	Using LBS and superimposing it on GIS maps to update user about the nearest parking availability	Citizens are updated with real-time parking information based on their locations
Smart business profiling	Pan America	Optimal business location identification based on trends, preferences and opt-ins	Determining location demography, preferences, opt-ins through LBS; this information is then utilised for location profiling for setting up of business	Selection of a prime and optimal business location, thus ensuring profitability and success

Smart city initiatives	City and country	Key objective	Description	Benefits or impact
Wait-less bus system	Dublin, Ireland	Improved bus transit system, information regarding the buses' waiting time and optimal route	Integrating location based geo-spatial data and buses timetable into a central GIS thus creating a dashboard; then utilising this dashboard and tracking real-time data information about bus timings; GIS also helped in	Efficient management of bus flow and detailed information about bus availability to citizens
Smart urban platform	Copenhagen, Denmark	Collection of city level data through pan-city sensors; Analysing LI for different sources for better city management	Utilising location intelligence of all city-level sensors, analysing varied location-based information from mobile phones, GPS in buses and cars to resolve issues ranging from congestion on roads, air pollution, water logging and efficient solid waste management	Availability of integrated and improved public services, efficient pollution, water and solid waste management
Smart healthcare	Pan Europe	Leveraging LBS and Wi-Fi to provide emergency medical services to the citizens	Under a healthcare programme called Caalyx a wearable device has been created which will measure special vital signs of the citizens and communicating with the healthcare services by sending the geographic location thus leveraging location intelligence	Provisioning of prompt and on-the-spot medical services; ailing person benefitted with greater autonomy
Smart citizen services	Tel Aviv, Israel	Providing tailored specific location through collaboration and crowd sourcing	Crowdsourcing location-based information from citizens and integrating it with cloud applications so that it can be accessed by others	Availability of information related to different events and activities across the city, encouraging more participation from citizen
Collective energy harvesting	London, UK	Tracking citizens who are either walking or using cycles, decrease in pollution	Citizens can make their presence felt LBS, they can be a part of the London Cloud if they are either walking or cycling, thus being the part of collective energy harvesting	Motivated citizens to use walking and cycling as a mode of transport; zero carbon footprint
e-Governance	Los Angeles, USA	City services to be delivered online, online complaint lodging	Leveraging location-based information dissemination to map city services and analyse complaints registered online through location-based pictures and videos	Availability of city services information with the citizens, quick and prompt grievance redressel
Smart disaster management	Haiti	Prompt emergency service, location identification, efficient rescue operation	Using LBS as a base, Ushahidi created an app which was used by the Haiti earthquake survivors to identify their location and convey them to rescue and relief workers; GIS mapping was also used to locate the nearest open area for setting up base camps	Millions of lives saved as locations were identified on a real-time basis and quick relief facilities such as food and water were provided

Key recommendations

We propose the following in order to mitigate challenges and ensure effective implementation of LBS along with smart city components across cities.

Use of LBS during assessment of city master planning

We are of the firm belief that assessment is the cornerstone of developing a successful smart city strategy. Prior to the articulation and development of any smart city strategy, it is important to take stock of the current situation of the city and its expectation, going forward.

This can be done using conventional survey approaches and discussions with stakeholders. However with LBS, we can go a step further in our assessment and generate specific results. LBS can enable us to comprehend city demographics, analyse citizen preferences, trends and needs based on location, as well as help plan according to citizen needs. Insights developed by aggregating location data with GIS and analytics can help city authorities take corrective measures, re-align the urban plan, devise suitable policies and plan for city transformation in a more scientific manner. For instance, the application of data analytics on LBS data reveals that commuter density is relatively low during the afternoon on a particular bus route in the city, whereas another bus-stop in the city faces high commuter density at the same time. With this insight, city authorities can re-look at the city mobility plan and reshuffle bus routes by pulling out some buses from the routes where commuter density is low and provisioning them on the routes with higher density.

Creation of single agency for generating, collecting and utilising location and geospatial data of a city

It is recommended to establish a single, nodal agency to carry out all the work related to location and geospatial based activities of a city. The charter of duties for this department can be as follows:

- To create, maintain, achieve and disseminate location and geospatial data for the identified city
- To develop and execute policies for issues related to location and geospatial data that needs to be protected, nourished and maintained
- To utilise all contemporary and emerging technologies to develop city insights for better city planning, functioning and meeting the end objective of building a smart city
- To provide location data analysis and geospatial information for the benefit of all citizens and the visiting population to meet their daily needs such as travel, leisure, information, tourism, during emergency situations, etc.
- To help city businesses and commercial establishments to better plan business operations using location and geospatial data
- To promote and create awareness for the utilisation of location and geospatial data and services by all government agencies, citizens, business and other stakeholders
- To facilitate industry and cross-country collaboration for knowledge-sharing, creation for further research and development

The Government of the National Capital Territory of Delhi (GNCTD) has incorporated Geospatial Delhi Limited to frame and implement policies for issues related to geospatial data in the National Capital Territory of Delhi (NCTD) and also facilitated in getting the Delhi Geospatial Act-2011 passed to empower Geospatial Delhi Limited (GSDL) to meet its business objective and garner support from all the Delhi government line departments. The brief of the Act is as below:

The sole custodian of spatial data infrastructure created under the DSSDI project and by GNCTD departments as well as other authorities will be Geospatial Delhi Limited. Ownership of geospatial data layers developed so far will lie with Geospatial Delhi Limited.

All departments of GNCTD and other authorities, both public and private in the territory of Delhi have GIS expertise, their own GIS cells and their spatial data repositories. It is mandated that the departments contribute their geospatial data to the central hub maintained by GSDL and that they update their data layers on a regular basis and share the updated data with the GSDL central hub. The advantages of GIS are seen in discovering and effectively utilising the association between spatial objects from different categories. This advantage becomes available to all stakeholders, thus giving them immense possibilities to explore and exploit this association towards more efficient and transparent decision-making in governance. GSDL, as a facilitator for this explosion of possibilities, needs to play a unique role in understanding the geospatial issues of governance and contribute to their solution through the geo-knowledge repository within its laboratories.

Policy for data security and privacy

LBS can pose a major challenge for data ownership and privacy and can give the impression of pervasive monitoring. Moreover, there are chances of misusing the data for commercial purposes. In addition, since the technology is still in its infancy, there are probabilities of hackers tapping into location data and taking undue advantage. The last thing a user will want is burglars exploiting LBS to choose potential victims. There is great potential societal value in pervasive sensing and mobile computing, but these capabilities need to be developed such that applications cannot infringe on the rights of the people.

Technical standards will surely be needed to support policies that protect citizens' rights to privacy. The government needs to prepare policies and set up frameworks to control the misuse of data and ensure that only constructive value is derived from public data.





Key actionables

Setting up a task force

It is essential to set up a task force that carries the single point agenda of effective implementation of LBS across the city by facilitating coordination and building synergies among all stakeholders including city authorities, telecom operators, businesses, advertisers, academia and citizens.

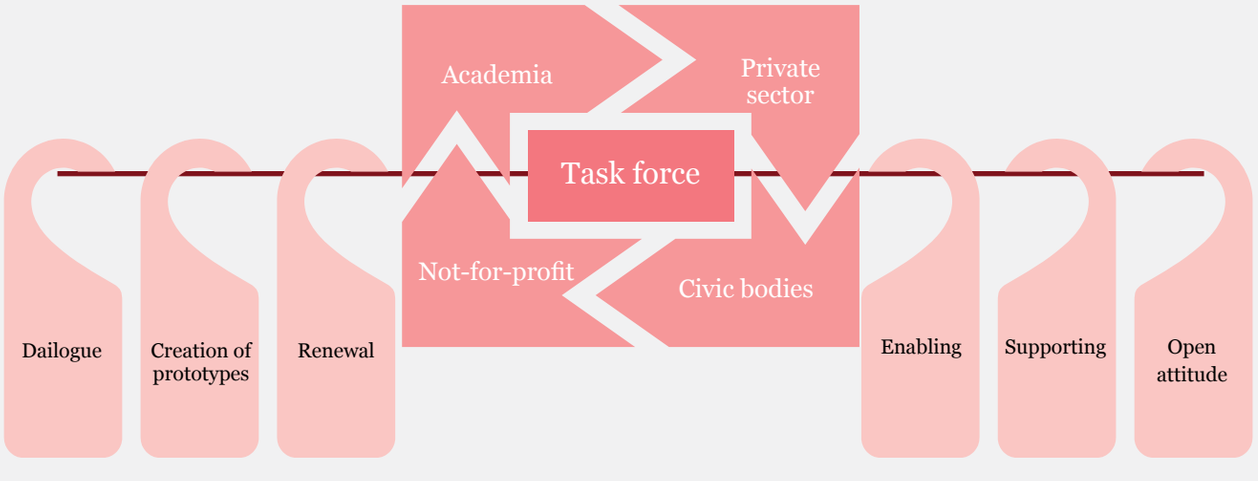
The objective of this task force will be to create a platform for knowledge exchanges, conducting research, innovations, policy developments, etc among public and private members, academic institutions, NGOs, global establishments, etc.

The task force should constitute experts from the following fields:

- Urban development
- Academia
- Consulting sector
- ICT sector
- Non-profit organisations
- Geospatial domain
- Telecom sector
- Advertising field

Task force key responsibility areas include the following:

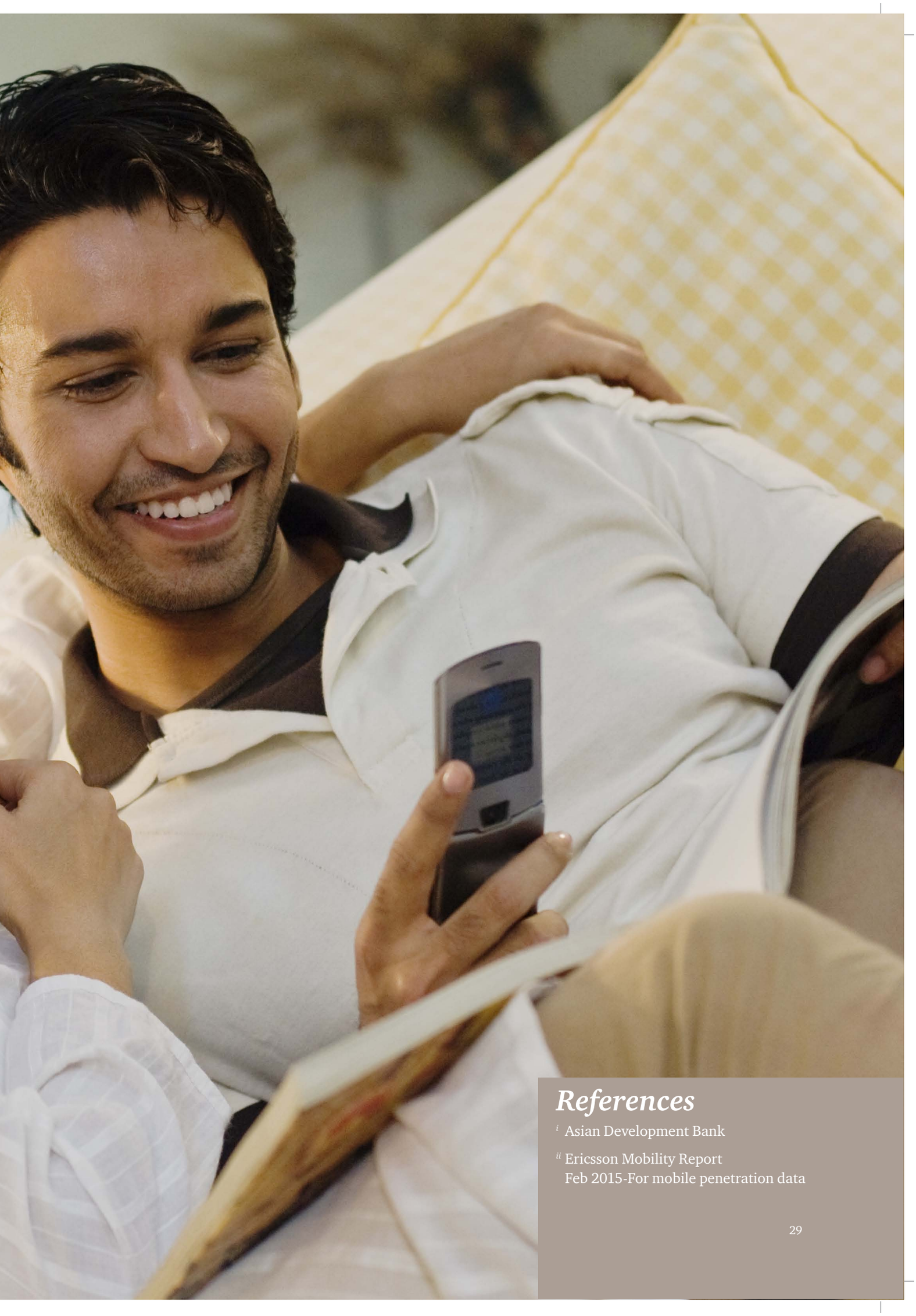
- Identify cities that can be taken up for carrying out LBS based assessment and identifying the real value contribution of LBS
- Establish a platform within identified cities for discussion on LBS initiatives, policy formulation, thoughts for nodal agency set-up, framework, governance aspects, implementation approach, best practices and case studies
- Create awareness of LBS integration with smart city strategy and schemes being developed across the country and facilitate coordination and amalgamation of various activities
- Facilitate dialogue among the pool of experts with inter-disciplinary competences for sharing thoughts and ideas



Conclusion

India is at the crossroads of massive transformation with initiatives such as smart cities undertaken by the government to revamp the country's landscape. Such ambitious initiatives must be backed by comprehensive city planning and assessment in order to gauge existing city scenarios and accordingly take next steps. LBS in smart cities can give new dimensions to how cities are governed and the mode and efficiency through which basic services such as power, waste management, water, transportation, etc. are delivered. Considering the benefits and efficacy of LBS in various international cities, Indian authorities must contemplate and strive to include LBS in existing and upcoming smart city projects. The integration of this technology will definitely go a long way in structuring a robust model for delivering service and value in the most effective way.





References

[i] Asian Development Bank

[ii] Ericsson Mobility Report
Feb 2015-For mobile penetration data

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Key contacts

Sumeet Gupta
Director
Head - Publishing / Homeland Security / Private Security / GIS

FICCI
Federation House, Tansen Marg, New Delhi 110 001
E: sumeet.gupta@ficci.com
T: +91-11- 23487515 (D) , +91-11-2373 8760-70 (Extn. 515)
F: +91-11-23765333

Gaurav Gaur
Assistant Director

FICCI
Federation House, Tansen Marg, New Delhi 110 001
E: gaurav.gaur@ficci.com
T: +91-11- 23487237 (D) , +91-11-2373 8760-70 (Extn. 237)
F: +91-11-23765333

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Key contacts

Neel Ratan
Leader
Government and Public Sector
Email: neel.ratan@in.pwc.com

Rakesh Kaul
Partner
Government and Public Sector
Email: rakesh.kaul@in.pwc.com

NSN Murty
Associate Director and Leader, Smart Cities
Government and Public Sector
Email: nsn.murty@in.pwc.com

Acknowledgements

Gaurav Gupta
gaurav.p.gupta@in.pwc.com

Monica Bhatia
monica.bhatia@in.pwc.com

Gagandeep Singh
gagandeep.singh@in.pwc.com

Abhijit Pandey
abhijit.pandey@in.pwc.com

Aalok Joshi
aalok.joshi@in.pwc.com

Media

Nandini Chatterjee
nandini.chatterjee@in.pwc.com

www.ficci.com

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