

### Introduction

Location-based services (LBS) utilize mobile devices (like phones or PDAs) to identify a user's geographical position and utilize that information within an application. LBS has become wildly popular in the consumer space, with applications available through Twitter, Facebook, Foursquare, Google, and Apple that allow people to broadcast their location, locate friends, and access everything from nearby restaurant recommendations to coupons. Personal navigation systems are also part of the LBS sphere, providing drivers with turn-by-turn directions anywhere in the world.

The demand for these types of location-intelligent applications is growing rapidly. Gartner says the market for LBS doubled between 2008 and 2009; according to Juniper Research, LBS revenues are set to expand to more than \$12.7 billion by 2014. Frost & Sullivan has predicted that by 2014, more than 5 million U.S. field service workers will be using location-enabled workforce management solutions on their mobile computers.

What does this mean for the enterprise? Companies have been adopting LBS solutions for a number of line-of-business applications, including field service, field sales, route delivery, fleet management, maintenance, and routing/dispatching.

By combining LBS data with mobile computing technology, companies can more efficiently route service and delivery vehicles, improve asset and fleet management, accurately map repair and service incidents, improve employee security, and enhance customer service by providing accurate arrival times and avoiding delays caused by traffic congestion or incorrect driving directions.

Integrated location technology combined with mobile computing allows companies to develop and deploy powerful applications that can greatly improve efficiency and productivity in the field. Most mobile phones and mobile computers now come equipped with Global Positioning System (GPS) technology or wireless communication capabilities that can enable these types of location-based applications.

But to harness the power of location intelligence, users will need highly accurate and precise location data, delivered in real time. As we will see, not all LBS systems are the same nor do all manufacturers of mobility solutions leverage the latest in LBS technology.

### Types of Location-Based Technology

There are a number of different technologies that can be utilized in a mobile computer in order to provide location data. Each has its own strengths and weaknesses, but several can be used in combination in order to provide more accurate information.

### Global Positioning System (GPS)

The Global Positioning System (GPS) is a satellite-based global navigation solution that is commonly used for vehicle navigation and mobile phone location services. While GPS provides location accuracy of approximately 10 meters, the technology only works well when there is a clear line of sight between the GPS module and the satellite. Heavy cloud cover, high-rise buildings and

other obstructions can block the signal, and GPS does not work indoors. GPS solutions tend to work best in open, rural areas; urban locations may experience signal interference. The time to first fix (TTFF) can also be up to several minutes depending on conditions.

Assisted GPS (A-GPS) was developed to improve the TTFF rate for a mobile device. The A-GPS solution combines satellite data with an assistance server that is accessed via the Internet to more quickly determine the initial fix. This system, while improving speed, has the same inherent disadvantages as GPS such as the inability to work indoors, poor performance on cloudy days, and the inability to obtain consistent satellite data in urban environments.

## Cell Tower Triangulation

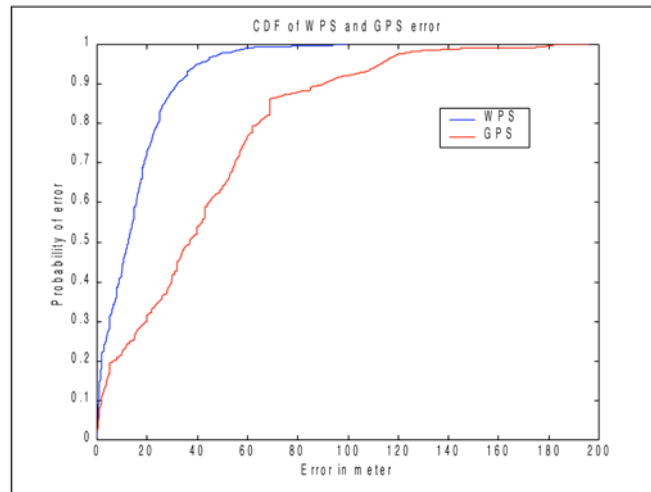
Mobile computers and phones can also provide location data based on their relative position to multiple cellular communications towers. This technology uses cell towers to triangulate an approximate position of the user based on the radio signals. Triangulation is not particularly accurate (it can only determine location with a precision of 200 to 1,000 meters), and is typically used in conjunction with other, more precise technologies.

## Wi-Fi Positioning (WPS)

Using triangulation technology, Wi-Fi positioning locates a mobile device relative to the location of nearby wireless LAN access points. A number of companies, including Skyhook and Google, have developed central databases that include mapping information on Wi-Fi access points. Skyhook alone has over 250 million access points mapped, collected via end-user input and specially equipped vehicles that drive through various locations gathering SSID and MAC address information from nearby access points, along with position information.

Wi-Fi positioning can work both indoors and outdoors, and can achieve an accuracy of approximately 10 to 20 meters. Used in conjunction with GPS data, it can provide highly accurate location information both indoors and in metropolitan locations where GPS alone will not suffice. Combining these technologies is also helpful in rural areas, where Wi-Fi access points are sparse. Wi-Fi positioning solutions can also be used in conjunction with cellular triangulation to provide a faster time to first fix.

Downtown, urban areas with typical city streets and buildings over six stories high are considered Urban Canyons and pose challenges to GPS systems. In this environment, the height of the buildings limits the ability of a device to obtain signals from satellites to obtain a location fix. WPS outperforms GPS in these environments as illustrated in the figure below.



There is another approach to Wi-Fi positioning that relies on proprietary, Wi-Fi-based tags (similar to radio frequency identification tags) that can provide accuracy down to 1 meter indoors. These solutions, from vendors like WhereNet and Ekahau, require end users to purchase tags and attach them to various assets, identification cards, vehicles and other items. This type of positioning solution (often referred to as a real-time location system, or RTLS) is typically used in a closed loop environment, such as a hospital campus or loading dock.

## Hybrid Positioning

Hybrid positioning solutions combine GPS, Wi-Fi positioning and cellular tower triangulation to provide better precision and a faster time to first fix. These solutions can also enhance system reliability regardless of environmental conditions, and work well indoors and outdoors. By combining these inputs, a hybrid solution can construct a composite position and provide the most accurate location available in any environment.

Skyhook, a Boston-based location services technology provider, has developed such a hybrid system—called XPS—that integrates the best of WPS, GPS, and cellular triangulation using a complex algorithm to combine these signals/outputs into a single position with a high degree of accuracy, usually within seconds.

XPS uses different techniques to determine which source system is the most reliable at any given moment, either by evaluating the degree of error in each source at any given moment, the usage scenario or the confidence history of each source. The hybrid positioning system also gets "smarter" the more frequently it is used, because the Skyhook client adds new Wi-Fi location data on the fly when it senses any new access points.

## Benefits of LBS in Mobile Computers

### Applications

Deploying a mobile computer with integrated location technology such as XPS can enable end users to derive even more benefits from their field-based applications.

**Improved Routing/Dispatching:** For field service and delivery applications, drivers can access accurate, turn-by-turn directions, and dispatchers can easily determine the fastest, most efficient route to each stop/customer location. When traffic or weather conditions change, employees can develop alternate routes on the fly using their mobile devices. In this way, companies can reduce the amount of time between stops, increase the total number of service calls/deliveries per route, and reduce fuel consumption and wear and tear on the vehicles. In some applications, fuel consumption can be reduced by as much as 10 to 15%. Just having access to GPS-based navigation tools has helped companies eliminate 30 minutes to an hour in employee downtime, along with hundreds of wasted miles.

Dispatchers can also easily see where each employee is located, and dispatch the closest employee when new jobs are added during a shift, or to respond to emergency conditions. This visibility can produce significant time savings (as much as 10 to 20%), allowing companies to reduce their labor costs while improving communications with employees and customers.

**Improved Asset and Fleet Management:** In addition to improving the routing/dispatching function, companies can maintain a real-time view of where each of their vehicles/drivers is located. Location data can help companies evaluate their asset utilization, thus avoiding unnecessary capital expenditures. Managers can also monitor drivers to ensure they are staying on their assigned routes, not making unauthorized stops or breaking other organizational policies related to vehicle or equipment use.

Further, location data can help fleet managers quickly locate and recover stolen vehicles and equipment. A number of companies have been able to avoid the loss of expensive vehicles and cargo by providing authorities with real-time location information for missing vehicles. An added benefit of LBS technology for fleet management is the ability for a mobile device to interface with the vehicle's black box and provide enhanced location based information to the driver or dispatcher in real time.

**Improved Customer Service:** With an accurate view of each employee's location, companies can provide more accurate delivery and arrival times, quickly respond to schedule changes, and validate or refute "no show" claims by customers. Time on-site data allows dispatchers to allocate the proper time to specific tasks based upon real data. In field service applications this gives the technician the necessary time to complete the job—a key component to quality and customer service.

**Improved Safety:** Field employees often work in remote locations, frequently alone. In the case of an accident or emergency, managers are able to pinpoint the location of any employee who has been involved in an accident, or who has otherwise fallen out of communication.

**Improved Workforce Management:** In field service applications, LBS data can help employees locate equipment or assets in the field quickly—utility workers, for instance, can be made more



efficient by eliminating the need to hunt for damaged poles, lines or transformers. Municipalities have used location data to map maintenance events, and identify problem areas in sewer and water systems. Real-time tracking can potentially allow employees to complete 25% more work orders per day or more, vastly improving productivity and allowing companies to grow without adding new labor and equipment costs.

In other markets, end users have been able to greatly expand their ability to utilize existing worker order and field service data in new ways. A number of police departments, for instance, have used location data to analyze crime patterns and alter force deployments. Field sales and service companies have been able to map current employee locations with former customer addresses so that their field force can make follow-up calls to past customers in between active service calls.

Location data also improves labor tracking and time reporting, because employers can verify the whereabouts of mobile employees when they clock in and out. Some companies have been able to completely eliminate overtime using location-enabled applications.

What makes these improvements possible is the marriage of accurate location data with mobile computing and wireless communications. While many mobile computer manufacturers include built-in GPS or A-GPS technology, these devices often suffer from slow time to first fix rates, unreliable service, or a lack of precision.

Other providers, such as Datalogic Mobile, have taken a hybrid approach in order to provide the most accurate location capabilities possible.

## Datalogic Mobility and Hybrid Positioning (XPS)

Datalogic is the third-largest provider of automatic data capture technology worldwide. For more than 30 years, major corporations have relied on Datalogic to supply them the technology to keep their retail, warehouse, and field force teams operating at peak efficiency.

Mobility solutions from Datalogic Mobile are based upon a full line of rugged handheld computers that are designed to meet the demanding needs of a mobile workforce. In 2010 Datalogic Mobile formed a partnership with Skyhook to include its Core Engine (XPS technology) on its latest generation of mobile computers.

Skyhook has been providing location-based data services since 2003. Its Core Engine technology leverages all three major location data sources and a massive database of Wi-Fi access point locations. Skyhook is the industry leader in XPS technology maximizing accuracy and minimizing TTFF.

In keeping with its leadership position, Datalogic chose Skyhook as its XPS provider. Skyhook's client is pre-installed and pre-licensed on every Datalogic Elf™ 3G device that includes 3G cellular, GPS and Wi-Fi connectivity. No other rugged mobile computer manufacturer provides XPS functionality on their devices, making Datalogic Elf the industry standard for speed and accuracy in location based functionality.

By integrating precise location technology within the mobile computers, Datalogic helps its customers increase support and management of field technicians and other employees via reliable location data.

### Conclusion

Location-based services can add value to mobile field sales, field service, transportation and other applications by providing the ability to track the location of employees, vehicles, and assets in real time. With this improved visibility, enterprises can boost efficiency and productivity while ensuring the safety of their employees and the reliability of their services. In addition, location data allows companies to better evaluate their asset utilization, routing efficiency, employee behavior, and other metrics.

While there are a number of technologies available to provide the location of mobile assets, a hybrid approach that leverages the best attributes of GPS, Wi-Fi positioning, and cellular tower triangulation can provide the fastest and most accurate positioning data.

End users can maximize their investment in mobility by researching what LBS technology devices under consideration contain. By selecting a mobile computer with a hybrid location-based service integrated into the device, end users can reduce return on investment time and be assured of their ability to take advantage of location-based applications now and in the future.

### About Datalogic Mobile Inc.

Datalogic Mobile is a global manufacturer of mobility solutions for retail applications, assisted shopping, warehouse solutions, and field-force automation.

Our diverse product range of rugged mobile computers includes pocket-sized computers, pistol grip mobile computers, and industrial PDAs designed to keep workers connected to their enterprise inside or outside the four walls. Our mobile computers use Cisco® Certified CCX radios for maximum levels of: RF security, data throughput, and efficiency. Datalogic Mobile computers use the latest technologies for voice and data communications giving mobile workers on-the-go connectivity.



*Datalogic Mobile has a complete line of rugged mobile computers for retail, warehouse and field force applications.*

Datalogic Mobile is the worldwide leader in Assisted Shopping. Over 350 retail stores have implemented Datalogic Shopevolution™ software and the Datalogic Joya™ handheld pod as their assisted shopping solution. Datalogic assisted shopping gives retailers a competitive advantage while reducing their operational costs. Joya makes shopping a multimedia experience that increases consumer loyalty.

Datalogic Mobile has worldwide presence in over 30 countries and over 800 business partners worldwide. A leader in technology, Datalogic has a growing portfolio of over 850 patents, eight research and development centers, and 300 engineers.

See us on the web at [www.mobile.datalogic.com](http://www.mobile.datalogic.com) or call 800-929-7899