Understanding Your Asset-Tracking Options

Each type of location-tracking technology has its own benefits and drawbacks. Here's overview of what you should consider.

By Martyn Mallick and Matt Teskey

June 25, 2007—The ability to track the location of assets, people and equipment—or anything of value to a business—has been garnering a lot of attention lately. This is evidenced by the number of demonstrations, sessions and announcements at industry trade shows; the emergence of companies with RFID and sensor hardware or software offerings; and, most importantly, the variety of use cases and real-world customer success stories being discussed.

When it comes to picking the best technology with which to track assets for a specific situation, companies have a wealth of options from which to choose. The ultimate decision is usually based on:

1. *The value, size and number of assets to be tracked.* This provides guidance with regard to the amount of money justifiable per asset, as well as the possible tag form factors.
2. *The required level of location granularity or preciseness.* Do you need to know the exact path of an asset around a building at frequent intervals, or just whether it is in a room? Do you need to know where an asset is in real time, or just where it was last seen?
3. *Existing technology investments.* Have you already invested in passive RFID or mobile devices? Do you have an existing Wi-Fi infrastructure throughout the area that can be utilized?
4. *Other business or technology requirements.* These include cost, integration, existing expertise and so on.

Factoring in all of these requirements, some companies may opt to use multiple technologies in conjunction with one another, to provide the desired performance or track different classes of assets from a single system.

This article provides an introduction to the range of technology options that can be used for asset location tracking. Typically, the overview sections discuss how companies can employ the technologies to track individual assets by attaching a tag or sensor to each unique asset. In some solutions, it may be enough to simply tag and track handheld readers, forklifts or other equipment, rather than tagging every asset.

If you track the location of equipment, you can use that location as the position of assets read by the mobile device (if the mobile device is an RFID reader), or of assets with which the mobile device is in some way interacting—for example, if a forklift at position X,Y has just dropped off shipment ABC, you can record that shipment ABC is stored at or near position X,Y. By using this model, companies may be able to reduce costs by tagging a small amount of equipment, as opposed to a large asset population.

Technology Options

The charts below provide an overview of various technologies used today for asset location tracking. Each provides a summary of the technology, discusses some benefits and drawbacks, highlights use cases for which the technology is suited and currently being utilized, and provides a small sampling of hardware vendors to

contact for more details regarding specific implementations.

GPS (Global Positioning System)	
Summary	GPS uses satellites and receivers to calculate the latitude, longitude and altitude of the receiver. GPS receivers are often embedded into mobile devices, including PDAs or dedicated GPS devices, to provide on-device logic and mapping/location feedback to the user.
Benefits	Technology maintained by United States Department of Defense; enterprises need to invest only in receivers, and do not have to create or maintain reader infrastructure.
Drawbacks	Reported location and actual location often differ by 8 to 10 meters; not suitable for indoor applications.
Common Uses	Military applications; consumer driving direction applications; exploration; equipment location tracking; stockyard asset management.
Hardware Vendors	Pharos, Identec Solutions, Garmin

Wi-Fi Real-Time Location Systems (RTLS)	
Summary	Wi-Fi RTLS offerings use a Wi-Fi network and combination of calibration and software algorithms to provide X,Y positions to certain Wi-Fi devices and custom Wi-Fi active RFID tags from the vendor.
Benefits	Leverage existing Wi-Fi infrastructure; generate real-time X,Y data; tunable to balance performance with battery life.
Drawbacks	Increasing the preciseness of the location data requires more Wi-Fi access points; Wi-Fi does not function as well outdoors, because there are fewer objects off of which wireless signals can reflect; the cost of Wi-Fi tags can be prohibitive, or the form factor inappropriate for certain asset types.
Common Uses	Tracking equipment and staff in hospitals; warehouse applications tracking forklifts, equipment and assets.
Hardware Vendors	Ekahau, AeroScout

Active RFID

Summary	Active RFID systems use battery-powered tags and specialized hardware/communications to provide visibility data, but typically not with X,Y granularity. Some solutions also incorporate environmental sensors in tags for environmental context.
Benefits	Flexible hardware configurations enable performance over wide distances with options for room-level granularity; tunable to balance performance with battery life; does not require Wi-Fi infrastructure; often provides the ability to incorporate other sensor data (temperature, light and so forth), along with location data.
Drawbacks	Technology tends to be proprietary in nature; cost can fluctuate greatly based on features and vendor.
Common Uses	Tracking specialized equipment in hospitals, cold chain or related applications where both location and related sensory data is required.
Hardware Vendors	Axcess, Identec Solutions, RFCode

UWB (Ultra Wideband)	
Summary	UWB systems transmit data across a broad range of radio frequencies using proprietary hardware (readers, sensors and battery-powered tags) and communication protocols, plus calibration and software to provide X,Y position data. Setting up a system involves placement of readers or reference tags at certain locations, calibrating the system and registering active UWB RFID tags.
Benefits	Does not require Wi-Fi infrastructure; some offerings are very rugged and suitable for outdoors; tunable to balance performance with battery life; very accurate location precision.
Drawbacks	Relatively new technology; not as proven as alternatives.
Common Uses	Market is not completely defined, but ideal for applications where high level of location accuracy is necessary.
Hardware Vendors	Ubisense, Multispectral Solutions

Passive RFID	
Summary	Associates fixed X,Y coordinates with passive RFID readers/antennas. When an antenna reads a tag, it associates the X,Y of the antenna with the tag at that specific point in time. Use sensors or multiple read points for directionality of movement.
Benefits	Leverage existing RFID investments/knowledge; flexible hardware choices; low-cost tags.
Drawbacks	Provides only choke-point-level visibility of assets at distinct read points; no visibility of assets between read points.
Common Uses	Event attendee tracking; location tracking of lower-value assets; recording of checkpoints.
Hardware Vendors	Motorola, Intermec, ThingMagic, AWID, Alien, Sirit

Mobile RFID/Bar Code— with RTLS Tag or Wi-Fi on Device	
Summary	Use an RTLS system to track the location of a handheld/forklift passive RFID reader. Any reads of RFID tags (active or passive) or bar codes by the reader are associated with the X,Y position of the reader (from the RTLS system) at the specific time the tag read or bar-code scan occurred.
Benefits	Higher-cost RTLS tags are used only on forklifts, so lower-cost tags or bar codes can be used on assets; leverage existing RFID tag or bar-code investments.
Drawbacks	No real-time visibility if the asset being tracked with an RFID tag or bar code is being moved in conjunction with a forklift or handheld that lacks an RTLS tag.
Common Uses	Inventory applications; warehouse management; stocking/picking applications.
Hardware Vendors	Motorola, LXE, Intermec, Psion Teklogix

Mobile RFID/Bar Code—

with Reference Tags	
Summary	Place fixed RFID tags (active or passive) around the location to be monitored (for example, spaced out on warehouse floor, affixed to shelves and so forth) and associate a fixed X,Y position with each fixed reference tag. When a handheld/forklift RFID reader reads a reference tag, the X,Y of the reference tag is used as the X,Y for the reader, and any asset tags read or bar codes scanned by the reader before the next reference tag is read.
Benefits	Low-cost reference tags used to cover location; variety of RFID tag form factors for indoor/outdoor/rugged applications; leverage existing RFID tag or bar-code investments.
Drawbacks	No visibility of mobile reader between reference read points; no real-time visibility of asset movement if a forklift or handheld without an RTLS tag is used when moving assets. A higher quantity of reference tags and associated calibration tasks is needed for greater location granularity.
Common Uses	Warehouse applications, stocking/picking applications.
Hardware Vendors	Motorola, LXE, Intermec, Psion Teklogix

Adding Value to Location Data with Business Logic

While the above technology summaries focus on hardware components, they glance over the role of software in providing the tools and business logic that allow users or systems to utilize the generated data effectively. The software layer includes the developer interfaces; hardware integration and abstraction; and management, configuration, calibration and custom business logic. Such software is required to bring data from any one technology above, or a combination of those technologies, to provide a truly complete solution.

What's more, it is often not enough just to take raw data from a system and show the last location on a visual map. Instead, most enterprise-class systems require configuration and maintenance, including the ability to register assets and define the business-level attributes of assets. These systems require advanced business rules and alerts to act on location information, as well as provide integration into enterprise systems. Sensor data may also need to be incorporated with location data, as many applications need to know the condition of an asset or its surroundings. For example, it may be nice to know that an asset is on a truck or in a storage room, but some enterprises may also want to know the temperature, humidity or other environmental conditions of the asset, as there may be business implications for certain conditions.

When designing a system, end users, developers and integrators need to decide which parts of the software layer they want to build and maintain themselves. They must also understand which software infrastructure platform could make their jobs easier, and allow them to focus on where they can differentiate and add the most value to the system. When employing a software infrastructure platform, it is important to choose one that supports the range of tracking technologies, as this provides the ability to move from one technology to

another, or to support multiple technologies at the same time.

Leveraging a software infrastructure platform also builds a knowledge base for future implementations regardless of technology, as developers and integrators can focus on the business logic of a solution instead of getting bogged down in low-level hardware integration, data mapping or location computations. The ideal infrastructure will provide the building blocks needed to get the most out of the physical technologies, while offering the flexibility to extend it through custom business logic to meet all of the solution requirements.

Making a Technology Decision

A common first step in investigating a location-tracking solution is to find a trusted integration partner who can help with the definition of the entire solution, help with the decision-making process and carry out the implementation. It is then important to clarify which assets need to be tracked, and asset size, value, composition, frequency of movement and importance will all be factors in technology selection as well. In addition, system requirements for cost, location accuracy and "real-time" versus "last-seen" data points must be determined. Whenever possible, it is important to evaluate any technology under real-world conditions in the actual tracking area to ensure that the technology's performance meets the system requirements.

As with any system that generates data, it is vital to clarify how location data will be used. Some systems require graphical maps with icons representing the location of assets on-screen, updated as new data is available. Other systems are alert-based, where various scenarios and exceptions are handled as they arise. Some systems may require location data to be fed into enterprise systems for future reporting, analysis or archiving. Thus, the data usage requirements must be considered—not only when choosing a location-tracking technology, but, more importantly, when considering the software layer.

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