

Chapter 1

Getting to Know RTLS

In This Chapter

- ▶ Figuring out how an RTLS works
- ▶ Discovering the need for an RTLS
- ▶ Applying an RTLS to various markets

A *Real Time Location System (RTLS)* enables you to find, track, manage, analyze, leverage, and otherwise use the information regarding where assets or people are located. Imagine being able to track people and assets at a local, national, or even global level. Retailers, military, law enforcement, emergency first response, healthcare, education, almost every business — even home life — can all benefit, or already do, by using RTLS technology. This chapter provides you with an overview of the RTLS — what it is and how it works — and describes who is using it and why.

Understanding How an RTLS Works

Location depicts or illustrates where something is well, located. With a *Real Time Location System*, or *RTLS*, you locate and track people and assets by associating a *tag*, a small wireless device, with each person or asset. *Assets* are items like laptops, projectors, equipment, and machinery. For example, you may attach a tag to office equipment (an asset) so that you can locate it within your office building; or you may carry an ID badge (a tag), and someone can locate you within the building.

Here are the parts of an RTLS, as shown in Figure 1-1:

- ✓ **Tags:** A mobile device that's enabled with location technology. A tag is usually small enough that it can be attached to assets or carried by people.
- ✓ **Location sensors:** Devices that usually have a known position. You use the location sensors to locate the tags that are affixed to the people and assets you want to track. For example, in the Global Positioning System (GPS), the satellites placed into orbit by the U.S. Department of Defense are the location sensors, and the location of tags (GPS receivers, such as the ones used in cars) is determined with signals from these satellites.

- ✓ **Location engine:** The software that communicates with tags and location sensors to determine the location of the tags. The location engine reports this information to middleware and applications.
- ✓ **Middleware:** The software that resides among the pure RTLS technology components (the tags, the location sensors, and the location engine) and the business applications capable of exploiting the value of the technology. You can think of middleware as the *plumbing*. Not only the specific RTLS application but also all other business applications used by the enterprise can be enriched with real-time location information.
- ✓ **Application:** The application (also known as *application software*, *end-user application*, or *software application*) is the software that interacts with the RTLS middleware and does work users are directly interested in. For example, an application that's always checking the location of kids in an entertainment park and then providing a Web page for parents to check the location of their kids.

The location engine, middleware, and application software may run on the same computer or on different ones. These applications also usually have a client interface such as a browser or PDA interface.

Chapter 2 covers the parts of an RTLS and how they work in much more detail. The following sections provide a more general overview of an RTLS to get you started.

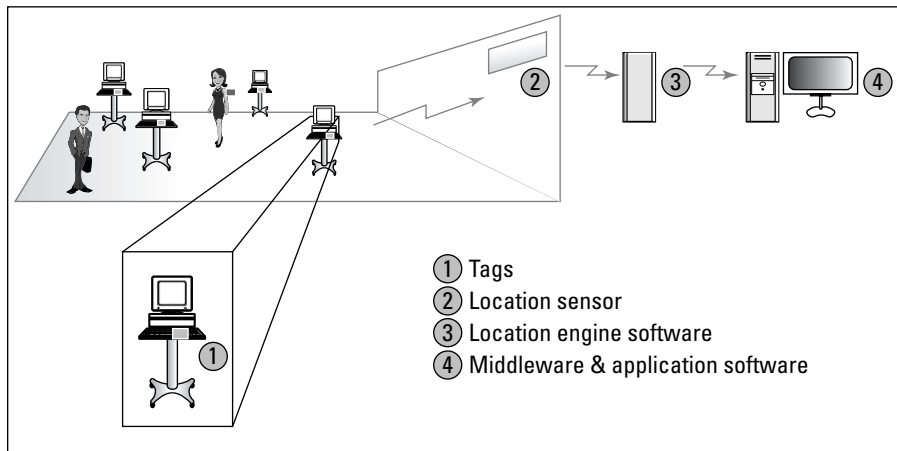


Figure 1-1:
The basic parts that comprise an RTLS.

Using tags to locate people and assets

To locate people and assets in real time, an RTLS continually monitors the tag locations. Then the RTLS passes the location information to an application that makes use of the data. Here are just a few ways you can use RTLS tags to locate people and assets:

- ✓ Attach tags to your company laptops so that you can get alerts when the laptops leave the building without the authorized owner.
- ✓ Attach tags to your school projectors so that you can track which classes have the projector.
- ✓ Build a tag right into the machinery so that you can track its location in the factory.
- ✓ Require people to carry tags, such as
 - Badges
 - Wristbands
 - Pendants
 - Ankle bands
 - Belt clips
- ✓ Build tags into items that people already carry, such as cell phones.

Adding value with bells and whistles

Besides the technology that enables the location engine to locate the tags, tags often have bells and whistles that add tremendous value to the RTLS applications. These extra features are described in the following sections.

Push buttons

Tags with push buttons (or call buttons) can be used in multiple ways. One of the most common uses is as panic buttons that can be carried by people for summoning emergency response. Whenever the person presses the panic button, the location engine provides the alert and the location of the person pressing the button. Another use of push buttons in tags is when connected to assets, people can use the button to indicate status, such as Asset in Use, Work Order Completed, or Asset in Need of Repair.

Voice to voice

If a tag has voice-to-voice capability, you can use it to communicate with the person carrying the tag based on her location. For example, you can communicate location-based voice messages to a tourist in a museum, a visitor in an entertainment park, or a person trapped in any number of places.

Buzzers, LEDs, LCD screens, and vibrators

You can use buzzers, LEDs, or LCD screens on tags to communicate with the person carrying the tag, to identify or locate an asset, and to communicate with the person who has the asset or is expected to check the asset. Here's how you can use buzzers, LEDs, or LCD screens on tags:

- ✔ **Buzzers** can emit sounds, preprogrammed voice messages, ringtones, or live messages to give the tag carrier information or alerts.
- ✔ **LEDs** can provide the tag carrier with messages based on LED colors and blink patterns.
- ✔ **LCD screens** can display text messages for the tag carrier.

Sensors

You can incorporate many sensors in the tags to gain information about the environment, the status of the person carrying tag, or the asset that has the tag attached to it. Here are some examples of how sensors can help you work more effectively:

- ✔ **Motion sensors** in the tag can indicate whether the person carrying tag is moving.
- ✔ **A temperature sensor** attached to a painting can indicate whether that painting is in optimum thermal conditions.
- ✔ **A carbon monoxide sensor** can indicate whether the person carrying the tag is in a safe environment.

Connectors

Tags can also have connectors that connect to various assets to communicate specific details about the asset or its operation state. For example, the tag can indicate not only where the asset is but also whether the asset is powered on. You also can use the tag to turn the asset on or off.

Writable memory

Tags can have writable memory that can be used to store some user data for that asset, such as the name of the equipment renting company that placed the equipment.

Knowing the location models

When you want to know the physical location of an asset or a person, depending on your needs, you may want to know the absolute position, relative position, or symbolic position:

- ✓ **Absolute position** is the absolute coordinates, such as latitude, longitude, and altitude. For example, the Taj Mahal is situated at N27° 10' 0 N, E78° 2' 60, and the Washington Monument is at N 48.629283 and W -121.831533 with peak elevation of 4,455 feet (1,357.88 meters) above sea level.
- ✓ **Relative position** is the distance in three dimensions with reference to a fixed point. For example, the security guard is standing at 10 meters south of the main entrance of the building.
- ✓ **Symbolic position** implies presence in a specific area (for example, the doctor is in the operation theater room) or presence near something or someone (for example, the child is near her mom).

To satisfy the needs of various applications, whether they need precise location or room-level location, various RTLS systems report the location of tags in one of the following ways (see Figure 1-2):

- ✓ **Presence-based locating:** In this model, the tag location is returned as to whether it's present in a given area. For example, if your boss is carrying a tag, you can know whether he's in the building.
- ✓ **Locating at room level:** In this model, the tag location is returned as presence in a specific room. For example, if a schoolteacher presses the panic button to summon security assistance in the event of a classroom emergency, the location engine reports the teacher's exact classroom to the security guard.
- ✓ **Locating at sub-room level:** In this model, the tag location is returned as presence in a specific part of the room. For example, in hospital rooms that accommodate multiple patients, such as dual-bed rooms, if a nurse is carrying a tag, the location engine can report how much time the nurse spent by each patient's side.
- ✓ **Locating at choke points:** In this model, as shown in Figure 1-2, the tag location is returned by a specific *choke point* (an entry or exit point, such as a door; it's assumed that people or assets move from one area to another through these choke points). By monitoring the time a tag was seen at a specific choke point, you can also determine the direction the tag is moving. In other words, you can determine whether the tag is present inside or outside an area and whether it's entering or leaving the predetermined area. For example, if all visitors to a facility are required to carry tags, you can determine on which floor or building the visitors are located.

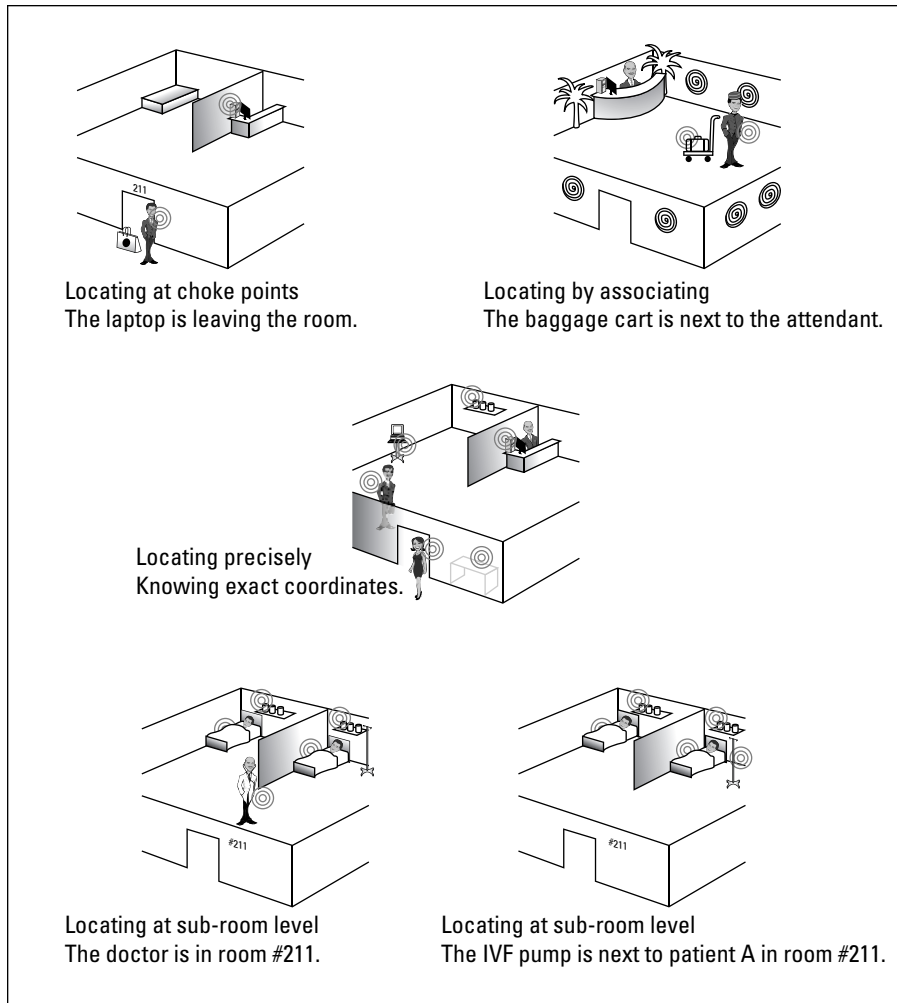


Figure 1-2:
RTLS
location
models.

- Locating by associating:** In this model, tag location is returned as proximity with respect to another tag (see Figure 1-2). For example, if each patient in a clinic wears a tag and each IVF pump has a tag, the location of the IVF pump is returned as present next to a specific patient. The billing department can use this data, which indicates how long the IVF pump was in use with any patient, to calculate invoice amounts. Or maybe you need to know whether the owner of a specific laptop is actually next to that laptop. Many securities, financial, or other location-based services can benefit by knowing this type of information.

- ✔ **Locating precisely:** In this model, the tag location is pinpointed precisely. You can pinpoint the exact tag location on the map of the world and/or in a given building. The location is reported as absolute or relative position as described earlier. Locating precisely is the exact form of RTLS, and depending upon the accuracy of reporting, the precise location information can be extrapolated to room level, sub-room level, association level, presence level, and choke point.

Knowing the underlying technologies

Many systems and technologies have been developed over the years by researchers and commercial companies to provide the location of people, equipment, and other assets. Today, an RTLS can be achieved using light, camera vision, infrared, sound, ultrasound, Bluetooth, Wi-Fi, radio frequency identification (RFID), ZigBee, Ultra Wideband, GPS, Cellular, and many more technologies. These technologies are discussed in detail in Part III.

Different technologies use different approaches, and each approach solves a slightly different problem or supports different applications. These systems vary in many parameters, such as the physical phenomena used for location determination, the tag's form factor and location sensors, power requirements, range, indoor versus outdoor applicability, and time and space resolution. Some technologies determine location at room level, some can determine presence only, and some can determine location precisely. Some technologies work well outdoors whereas others are tailor-made for indoors. Some work well in an office environment, and others work well in an industrial environment. Some need additional location sensors, and some leverage existing infrastructures, such as electricity or Wi-Fi in the building.

In some systems, the tag being located actually computes its own position (also known as *tag self-positioning*); in some, the software that locates the tag is external to the tag (also known as *tag remote-positioning*); and in others, the tag position is determined by recognizing the location of a nearby tag (also known as *tag indirect-positioning*).

But all RTLS technologies share the common goal of computing the location of assets and people as accurately as needed by the application, and they all succeed in their own way.

Recognizing the Need for an RTLS

For the past few decades, the research, development, and standardization of radio frequency identification (RFID), Wi-Fi, and many other wireless technologies along with the success of GPS as a consumer navigation application have contributed to a dramatic increase in the number and type of users requiring the needs for location identification.

In addition to the developments in technologies that are making it increasingly feasible to identify and locate any thing or individual anywhere in real time, it's the pursuit of *what, how many, and where in real time* that's driving the need for RTLS. Whether you're talking about businesses, consumers, or public sector markets, the need for an RTLS is arising from the inherent need for just-in-time actionable information — the right information at the right time and location — which is a fundamental concept to make effective decisions and take immediate action:

✔ **Business markets:** The need for an RTLS is being driven by an ever more mobile workforce, the need for continuous information about worker and visitor safety, the economic pressures for operational efficiencies, aspirations to increase profit margins, the need to handle recalls effectively, demanding customers, and the desire for enhanced customer experience.

Customers are becoming less tolerant in accepting deficient products or services due to the wide range of choices available. For example, if a company can't track its shipments in real time, it likely can't deliver the kind of customer service its competitors offer. With an RTLS, customers can pick up the phone or check a Web site and find out instantly where their goods are at any given moment.

✔ **Consumer markets:** Concern with safety and security, need of location knowledge for social networking, aging population, and need for Web 3.0 are driving the need of an RTLS. People want to know immediately where children and seniors are located. Consumers and regulatory bodies want the ability to track the food from the moment it's picked in the field to the time it shows up at the grocery store so that they can pinpoint the source of accidental or malicious contamination of food and issue appropriate recalls. The youth and singles markets want to use location knowledge in the social network, and people expect a lot of location-based information from their personal navigation systems and when they surf the Web.

✔ **Public sector:** The concerns about terrorism and continued breakdowns in emergency communications during major disasters have opened the doors to RTLS applications as complements, alternatives, or backups to existing systems.



The applications that are driving the needs for an RTLS vary depending on whether you're talking about business, consumer, or public sector markets, the needs of individual segments within those markets, and the particulars of the targeted geographic region.

Tagging assets

Tagging is the act of affixing a tag to an asset or person. Tagging assets enables you to locate assets on demand, track and protect them, monitor their usage, trace them, and manage and plan inventory. Here are some examples of what you can accomplish by tagging assets:

- ✓ **Locate assets on demand:** On large sites, equipment easily goes missing. People forget to return it, and a lot of equipment gets moved and isn't returned to its original location. If the equipment is tagged, the RTLS can determine the equipment location. Such an application is especially useful in environments like hospitals where it's important to locate certain equipment quickly in the event of an emergency. Similarly, equipment requiring predictive or preventive maintenance or pieces of equipment for which a repair order or a recall has been issued can be located easily.
- ✓ **Track assets:** Sometimes you need to know not only the current location of an asset but also where it's been. This information is useful — or even critical — in many applications, for example, in hospitals when the staff needs to verify whether an asset has been through a disinfectant room after being in a patient room. Tracking can also be combined with sensors, such as a temperature sensor connected in the tag. In that case, you can't only determine where the sensor has been, but also see whether the asset has maintained or been stored at the right temperatures. For example, this can be used to capture information about the conditions the food is subjected to on the journey from the field to the grocer.
- ✓ **Protect assets:** Attaching RTLS tags to assets provides alerts when an asset moves closer to the perimeter of the facility or moves out of the facility. This kind of application is applicable for almost every business or government facility.
- ✓ **Monitor usage of assets:** Attaching RTLS tags to critical assets provides security officers the ability to track their movement and locate them at anytime. Tags also enable security to take corrective actions to ensure compliance with regulations when an unauthorized attempt to move that asset within a facility occurs, or even when the asset is taken from the facility. Furthermore, the storage of dangerous goods, such as explosives or weapons, can be made more secure. In this case, however, these goods can be additionally protected to ensure that only authorized personnel can be permitted to be within range of these assets. Alarms or other types of signals could be provided when the critical assets move without being close to the tags worn by the authorized personnel.

- ✔ **Trace assets:** An RTLS can help achieve the level of traceability, as needed by consumers, businesses, or policy makers. With an RTLS tag, you can record the location of a container or an item along with the time when it was seen at that location on the tag itself. This way, when a recall is issued for a specific item, it's easy to track the suspected path.
- ✔ **Improve asset utilization:** Analysis of equipment locations and length of time spent in particular locations can lead to an understanding of how often various pieces of equipment are used, where they're most often used, and what they're used for. The results of these analyses can help in deciding how much equipment is required, where to put the equipment to enable optimum work usage, and when to schedule equipment maintenance.
- ✔ **Manage and plan inventory:** One way to keep track of inventory is to subtract how many items you've used from how many you've ordered. The remaining difference is what you have in inventory. Whether because of human error, delay in entering information in inventory management systems, scrap, or stolen goods, data from books for inventory counting is rarely 100-percent accurate. Many organizations prefer to use a physical count of their materials. This is a great way to manage inventory if you're a handmade violin manufacturer and you make one violin a week. If, however, you're an equipment rental company dealing with tens of thousands of pieces of equipment and have constant turnaround, a physical count might not be so simple. Or, imagine if you had over 100 different types of products and maintaining optimal inventory levels for different types of products was an essential part of your business. Attaching tags to assets can help you in inventory reorder calculations, warehouse management, and some degree of inbound material planning.

Tagging people

You can benefit from tagging people in many ways. By tagging people, you can locate them on demand, protect and guide them, monitor their movement or activities, and provide emergency response. Here are some real-world examples of what you can accomplish by tagging people:

- ✔ **Locate people on demand:** In hospitals, tagging babies and children enables staff to locate them within the hospital and generate appropriate alerts should the child be abducted or otherwise go missing.

- ✔ **Protect and track people:** One of the highest risks within a senior care or assisted-living environment is a resident escape. A resident escape can cause harm to the resident and can be an enormous liability for the facility. An RTLS can help in resident tracking, and when a protected resident attempts to exit a facility, doors can be locked automatically and appropriate alerts can be triggered.
- ✔ **Monitor people's movements:** Many unique challenges can be solved by monitoring people's movements. For example, by monitoring security guards, an RTLS can help ensure that facility surveillance isn't hampered by a security guard sleeping on duty. Another example is in a mall or a city where security forces can be dispatched on detection of an unusual event, such as large number of people in smaller areas.
- ✔ **Provide emergency response:** By making use of push-button tags, the tag wearer can summon assistance when faced with an emergency situation. This can be used by teachers or students in schools, nurses or patients in hospitals, lone workers working in hazardous environments, or police officers requesting other police officers in man-down events.
- ✔ **Manage evacuations:** In events requiring evacuation, such as a fire, emergency first response can determine who's evacuated and who hasn't been evacuated.
- ✔ **Police restricted areas:** By attaching the tags to criminals, employees, or visitors, areas that are restricted can be better policed and access can be allowed or disallowed based on privilege levels. Furthermore, at any given time, security officers can monitor the whereabouts of everybody and take appropriate actions when necessary.
- ✔ **Improve workflow:** By analyzing trends of the utilization of assets and how workers and visitors spend their time, significant improvements in work practices and methodologies can be achieved. For example, in an emergency department, you can determine the key changes in equipment, staff, or processes required to decrease the time from the decision to admit a patient to the physical placement of the patient in an inpatient bed.
- ✔ **Improve customer service and response times:** By analyzing trends of time the visitors are forced to spend at specific areas, appropriate customer service agents can be added at appropriate locations in the facilities. By rearranging the customer service agent count, the facilities can ensure that optimum levels of customer service are provided throughout the facility.
- ✔ **Improve structure of facilities:** By analyzing trends of visitor dwell times, the facilities can be better structured for maximizing the facility's purpose. For example, in a painting exhibition, if some parts receive dwell times significantly more than others, the temporary structures can be rearranged to improve the flow of traffic through the exhibition.

Putting an RTLS to Work

Because RTLS technology has the potential to provide radical improvement and advancements to efficiency beyond the ordinary scope of improvement, many sectors are currently using an RTLS. The following sections describe just a handful of these sectors and how they're using an RTLS.

Healthcare

Hospitals, clinics, nursing homes, and other healthcare providers are looking at an RTLS to improve the bottom line and the care delivery potential. An RTLS can help

- ✔ **Locate healthcare personnel.** Quickly locating healthcare personnel is critical when a patient or staff member summons assistance during an emergency medical situation.
- ✔ **Track the movements of patients.** Tracking the physical movement of patients helps ensure patient safety. This is especially important for the safety and security of Alzheimer's and dementia patients. An RTLS can alert staff and give the location of a resident who wanders too far from a designated area or tries to leave the premises (known as an *elope-ment*) as well as when a patient passes too close to an entrance or an exit. Another example is infant abduction prevention in which an RTLS enables immediate infant location tracking, mother/baby matching, automatic door locking, and so on.
- ✔ **Improve throughput management.** Tracking patient flows for throughput management can potentially address problems, such as extended waiting times, overcrowding and boarding in the emergency department (ED) and post-anesthesia care units (PACUs), bumped and late surgeries, and lack of available routine and intensive care unit (ICU) beds. For example, using an RTLS reduces waiting and transfer time for patients because it may require less time to find staff or a wheelchair to transport the patient. Using an RTLS also enables close synchronization of housekeeping with patient discharge, enabling a faster bed turnaround rate.
- ✔ **Track equipment.** Tracking expensive or shared equipment, such as infusion pumps, saves time and helps staff to more easily find equipment that's recalled or due for preventive maintenance. Tracking equipment more quickly also improves inventory control, which reduces rental and purchasing costs.

- ✔ **Improve productivity of nurses and caregivers.** Because an RTLS can automate many tasks on the basis of location and in real time, it can reduce many mundane and repetitive tasks that nurses and caregivers encounter on a daily basis. For example, a nurse or a caregiver typically has to go into a room to cancel a call or trip a registry light manually — which often involves in tripping over extra chairs, patient visitors, and other equipment — but an RTLS can perform the same task automatically, simply by recognizing the nurse’s presence in the room.
- ✔ **Improve patient/family satisfaction.** An RTLS can improve a patient’s family satisfaction by increasing their awareness of patient location.
- ✔ **Improve staff safety.** Nurses face acts of violence, threats to safety, exposure to abusive language, and aggressive behavior from staff, patients, and visitors. An RTLS can become an important part of the solution by giving nurses a tool to request emergency assistance during a crisis.
- ✔ **Track personnel.** Tracking personnel alleviates security concerns by monitoring unauthorized access in restricted areas.



An RTLS is important for healthcare management personnel, other healthcare personnel, managed services providers, and those who are looking to solve complex issues in their respective healthcare organization.

Manufacturing

Manufacturers are always trying to do more with less. Manufacturers use RTLS technology to

- ✔ **Find products.** Often valuable production time is lost because the pallet with the right materials isn’t where it should be and a search must be carried out. Armed with an RTLS and status information, manufacturers can reduce search time, which improves productivity and material flow while ensuring higher asset utilization.
- ✔ **Track progress.** At any given time, a manufacturing plant can contain thousands of products in various states of assembly. An RTLS can instantly identify what still needs to be done to each product. Historically, an alternative to having an RTLS was to have workers use bar codes or paper to track the stage of the product. One major problem with such an approach is that many employees forget to scan or enter the data.
- ✔ **Trace parts.** Using an RTLS enables manufacturers to trace parts, which can be used for recalls or investigations.

- ✔ **Track production items.** Many manufacturing processes are lengthy and have hundreds of steps that take place often in several different factory buildings. Being able to track production items accurately across a plant and link the location to the manufacturing stage results in fewer errors and improved workflow.
- ✔ **Find tools.** Manufacturers often need to tag shared tools so that they find them when needed without slowing production.
- ✔ **Locate works in process.** A *work order* is an order received by an organization from a customer or a client or is created internally within the organization. In a manufacturing environment, a work order is converted from a sales order to show that work will begin on the manufacturing, building, or engineering of the products requested by the customer. Tagging work orders can enable you to locate at what stage of manufacturing that specific work order is. A supervisor can also use some LEDs or other indicators on tags to communicate urgency levels for specific work orders.



The interaction between workers, machines, tools, work areas, and the products they're manufacturing has a significant location component. Whether in automotive, aerospace, computers, semi-conductor, or discrete manufacturing, RTLS technology can deliver improved quality at a reduced cost to make the manufacturing operations more competitive. An RTLS provides context and location-aware support to workers improving quality by reducing errors (and therefore reducing the cost of fixing them) and increasing efficiency by reducing process execution times. The devices and tools used by the workers can be made to know where they are and in which relation they stand to the production materials.

Automotive

The automotive industry has been one of the early adopters of RTLS technology. An RTLS helps in material logistics, vehicle management, and during manufacturing. Here are just a few tasks the auto industry accomplishes by using RTLS technology:

- ✔ **Reduce the cost of quality:** Auto makers reduce the cost of quality by preventing a vehicle with quality problems from being shipped while still shipping other vehicles. This can be achieved by using an RTLS to track information of finished vehicles from pre-delivery to shipment.
- ✔ **Manage supplies:** An RTLS locates critical tools and test equipment, and uses call buttons for replenishment of supplies.

- ✔ **Manage vehicles:** An RTLS reduces the average dwell times for finding vehicles by improving in-line/off-line vehicle tracking, vehicle (yard) management, dealer lots, and resale auction lots.

Aerospace and defense

Significant opportunities exist for an RTLS to help aerospace and defense. By using an RTLS, you can

- ✔ **Manage supplies.** An RTLS locates critical tools and test equipment, and uses call buttons for replenishment of supplies.
- ✔ **Fleet maintenance management.** An RTLS can be used to manage check-in and check-out processes.
- ✔ **Track maintenance dates.** An RTLS is flexible enough to track maintenance dates for critical support equipment and trailers across thousands of feet of open flight line or even while they move through metal cages in a warehouse.
- ✔ **Speed throughput.** An RTLS can perform spot locating and auditing capabilities to speed up throughput at critical transit points.

Research and development

Safeguarding research prototypes or products in early stage of development has been always a concern for research and development (R&D) facilities. Here are some tasks you can accomplish with RTLS technology in R&D:

- ✔ **Monitor and protect prototypes:** RTLS can enable the R&D teams to effectively monitor, inventory, or locate their prototypes, and have processes in place when an unauthorized attempt to move a prototype within a facility occurs. Prototypes can also be protected to ensure that only authorized personnel can be permitted to be within range of these prototypes.
- ✔ **Enforce escorting visitors:** Use an RTLS to enforce how visitors will be escorted. For example, you can specify who will escort visitors or how far away from an employee a visitor can be before an alert is triggered.
- ✔ **Police restricted areas:** By using RTLS tags, R&D facilities can distinguish between personnel and visitors and then track and locate them within a facility. Through the use of an RTLS, areas that are restricted can be better policed.

Retail

Marketing and customer service are prime concerns for the retail industry. RTLS technology helps improve performance in these areas by enabling retailers to do the following:

- ✓ **Understand consumer behavior:** By attaching tags to carts, retailers can obtain valuable data about consumer behavior and use this information to rearrange retail merchandise.
- ✓ **Improve customer service:** By having store employees carry tags, retailers can have the nearest located customer service agent assist customers when they request assistance.
- ✓ **Improve sales:** By attaching tags to products, retailers can have automated shelf management processes set up where the clerks in a store room can be notified immediately when the inventory of a specific item on the shelf goes below a specific level.

Mining

By using RTLS technology, people in tunnel and mining operations can improve safety. For example, they can

- ✓ **Track worker location.** With an RTLS, tunnel and mining operations can track the location of workers and record them in real time so that in the event of a disaster, everyone's most recent locations can be known immediately. You get a snapshot of where everybody was immediately before the disaster.
- ✓ **Enforce worker safety.** With an RTLS, you can ensure a full and functional set of protective and safety equipment is carried by all workers before entering a mine as well as all the time.
- ✓ **Assist emergency first responders.** The RTLS helps first responders to effectively locate the trapped miners and determine routes to the nearest safe exits.

An RTLS can also provide financially rewarding asset-tracking possibilities where the location of tools and vehicles can be available in real time to achieve improved asset utilization.

Visitor information

Visitor identification tags have long been used to provide security for office and industrial facilities. Because these tags can't be located from a distance, the effectiveness of these tags is limited by the need to escort the visitor at all times, which may not be practical. With an RTLS, you can

- ✔ **Track and locate personnel and visitors.** By using RTLS tags, security officers can identify who's within each section of a facility and track their movements to ensure that compliance with security regulations is maintained at all times.
- ✔ **Police restricted areas.** If visitors and employees wear RTLS tags, areas that are restricted can be policed better.
- ✔ **Ensure safe evacuations.** RTLS technology can also help address another challenge for the facilities — the safety and security of all visitors during unforeseen evacuations. Rescue personnel usually have well-defined systems to account for employees, but the records for people visiting the facility are usually too scattered or available only in lobby areas that may not be accessible during fires or other emergencies. If visitors wear tags, they enable a more targeted search and rescue operation in case there are visitors who might not have made it out of the building.

Industry conferences, amusement parks, and temporary setups

Industry trade shows, amusement parks, and county fairs have thousands of pieces of equipment that are set up temporarily, thousands of attendees, security staff, cleaning personnel, administrators, and other support staff. With an RTLS to help manage busy events, companies can

- ✔ **Track and communicate with people attending the event.** An RTLS enables the companies or other attendees to locate and contact attendees, exhibitors, administrators, or other support people while they roam throughout the conference facility.
- ✔ **Monitor equipment status.** With an RTLS, companies can more easily take inventory and monitor the location of all temporary equipment.

- ✔ **Improve booth layouts and set exhibit space purchase price.** By analyzing the trends of visitor dwell times in past shows, the exhibition organizations can modify the booth layouts and price exhibit space based on the dwell times it can potentially receive.
- ✔ **Locate missing persons.** Security staff can use an RTLS to help people locate their lost group member, such as a child.

Public safety

One of the primary government roles is providing safety and security for its citizens, property, critical infrastructure, and natural resources. Natural disasters, crimes, emergencies, terrorist attacks, and the threat of terrorist attacks require rapid response from public safety agencies, such as firefighters, police, and so on. An RTLS enables many applications that help people do their jobs better and save their own lives:

- ✔ **Determining man down:** Should a responder be struck down with an injury or unconsciousness (a *man-down event*), the RTLS can alert the main emergency response personnel with an accurate location of that person. The alarm can be activated by making use of one or more sensors, such as lack of motion, shock, and so on.
- ✔ **Locating firefighters:** The RTLS can guide searchers to locate firefighters in trouble.

Education

Terrorism and violence in schools and universities have added notable priority on emergency and first response services in schools. The increased popularity of online social networking has created the demand for real-time location, as well. With an RTLS, you can

- ✔ **Assist first response teams.** By using an RTLS, first response teams can more easily locate the teacher or student requesting assistance. With an RTLS, you also enable the teachers or security to target communication with the students or staff located in the distress area.
- ✔ **Identify people's locations.** By using an RTLS, participants in a social network on campus can find each other's location. This way, you can receive alerts when a friend is within a certain distance or get advice from people in the same locale.