How to Choose the Right RTLS System

What to consider when choosing an RTLS System for your use case and environment.

The ability to secure and accurately monitor the location of assets and individuals has many beneficial applications in the healthcare, commercial and industrial environments.

The key to a successful real-time location system (RTLS) deployment lies in picking the right solution for the application and problems at hand and by following RTLS selection guidelines which we will cover in this whitepaper. We hope to help you be highly satisfied with your choice and realize a faster return on investment.

1.0 Environment

There are a few important aspects to consider when choosing an RTLS system for your environment, such as the availability of your facilities' power, network connectivity, and whether you are implementing a system for use indoors, outdoors or a mix of both.

1. Indoor vs outdoors: Organizations that operate indoors only will have a much broader range of providers to choose from than those outdoors, which have to be robust enough to withstand the elements.

1) **Ceiling height:** Your ceiling height may limit the type of equipment and vendor you can use.

2) **Explosive environments:** If your organization operates in an explosive environment, you will be limited to vendor technologies that are certified to safely function in explosive atmospheres.

3) **Hazardous environments:** Hazardous environments also require specialized equipment that can perform safely.

4) **Interference from internal structure:** If there is a lot of metal or other objects inside your structure that may interfere with RF signals, you will need more specialized solutions.

5) **Multi-floor:** The system should be sensitive enough to pinpoint the vertical location of the object without erroneously reporting locations on another floor.

6) **Dusty/dirty:** Systems implemented at dusty and dirty industrial sites will require rugged equipment designed specifically for those environments.

7) **Extreme temperatures:** In outdoor settings or certain manufacturing environments, equipment will need to be rated to withstand extremely low temperatures.

8) **Multiple sites or buildings:** If your organization has multiple sites or buildings, consider choosing a vendor with an enterprise grade system so that you can see your entire company across one screen in one system.

2.0 Tracking

Next, consider what your organization needs to track (people, assets, or both) as well as the kind of reports required

1) **How many assets or people need a tag:** Based on your needs, how many tags do you need to track your assets and people. This will affect your final costs.

2) **Cost of the tag:** The cost per tag will also affect your total hardware cost. To justify installing and purchasing a system you are going to want to look at the ratio between the area that you are covering, and the number of tags required.

3) **Battery life:** It is important to find the right balance between size/weight and battery life for your specific environment and application.

4) **Tag size:** The size of the tag often depends on battery life, ruggedness, and where the tag will be located. For example, a newborn needs a very small tag, whereas a bulldozer can accommodate a large, robust tag. Tags that must withstand the elements or have a long battery life tend to be bigger.

5) **IP rated or Ex rated:** An IP rating relates to a tag's dust-proof and waterproof certification. Ex rated tags meet safety standards for use in hazardous or explosive environments.

6) **Value of the asset:** Generally, you want the cost per tag to be lower than the asset being tracked.

7) **Tamper detection:** Decide if you need to detect attempts to remove the tag. For example, tag removal can be detected sensing changes in heat, light, or motion. RTLS bands with cut band technology provide an alert if the device is tampered with.

8) **How to attach to asset/person:** Consider the sensitivity of the skin of the person you are attaching a tag to. In industrial or commercial environments, also consider the gear that that person might be wearing. If an employee is wearing large, heavy gloves, it may not be easy for them to access or push a button on a tag. Or, a tag may need to be worn inside the employee's protective clothing so as not to expose the tag to excessive heat in the workplace.

In a seniors' care home or a behavioral health unit where patients may be destructive, tags should be attached so that the person is unable to reach them, or in a way that they are unable to remove.

3.0 Budget

Define your budget range based on your requirements and have it approved early based on a TCO-10 years (Total Cost of Ownership for 10 years) so you can build a case for the ROI.

Your total cost of ownership should take into account the following:
- Hardware
- Installation
- Software
- Tags
- Support in subsequent years

The return-on-investment (ROI) will be your definition of comparing the benefits you will gain from positive outcomes of installing the system, relative to the costs of implementation.

4.0 Team Buy-in

Involving stakeholder groups early in the project ideation process can help you garner support, clarify requirements, and remove potential implementation obstacles.

1) **Find an executive sponsor:** Enlist an executive sponsor and champion influencers who can help you make a case for the system.

2) **Include other staff:** Include other departments such as IT, security, health & safety and human resources in the planning stage. Consider involving those who manage employee accountability, personnel safety, or emergency man-down systems.

3) **Earn union support:** If your industry has a union, consult with them and gain their support.

4) **Define the employee privacy policy:** Be clear about how your organization's privacy policy relates to the RTLS system. For example, companies are using RTLS systems for contact tracing, and employees have questions about how the tracking data may be saved or used as it relates to their privacy.

5.0 System Integrator

You may be working directly with a vendor or with a system integrator. If you are working with a system integrator, consider the following:

1) **Have you used the provider in the past?** It can be beneficial to work with integrators that are already familiar with your company and facility.

2) **Are they supporting other systems within your facility?** Integrators that are already familiar with your other systems can potentially help you integrate other security systems into your new RTLS system.

3) **Are they familiar with RTLS?** If you are looking at integrating RTLS with other systems, then it helps to work with an integrator that is already familiar with RTLS.

4) **Do they have local staff?** Having local staff that do on-site visits to your facility can make the implementation process smoother.

5) **Do they have their own technicians?** Integrators with their own technicians (versus subcontractors) may reduce your implementation costs as it eliminates an additional layer of expense.

6.0 Vendor Product & Support

Choose a vendor for the right price, technology, experience, and support level.

1) **Expertise:** What is the vendor's level of expertise in RTLS system design, training, implementation and support? Is RTLS a single area of focus?
2) **Proprietary technology:** Do they offer proprietary technology they built themselves, or is it something purchased and repurposed as their own?
3) **What is the scope of services they offer? Do they offer:**
   a. **System design:** Can they help you with creating your system design?
   b. **Project Management:** Can they handle the project management for you?
   c. **Training:** What training do they offer for either your IT people or your system integrator? Are there documentation and training videos for your users? If you have a clinical environment, do they have clinical trainers that they can work directly with your nursing staff and healthcare workers?
   d. **Commissioning:** Can they support you on the commission of the go live, including testing?

e. **Technical support:** Do they provide Tier 1, Tier 2, and Tier 3, support, so that if there is an escalation of a technical issue, the vendor can support you 24/7? Also, is the support onshore or offshored, and do they outsource it or use their own dedicated technical support team?

f. **Warranty:** Find out what the warranty will be on the system and on the tags, as well as how they handle returns or replacements.

g. **Software updates:** Find out if the software updates include things like new features on top of bug fixes and updates, as well as how frequently they do software releases.

7.0 RTLS Technology Options

Passive vs. Active RFID

RTLS uses active RFID technology.

The difference between passive RFID tags and the active RFID tags used in RTLS systems is the presence of a battery. Passive RFID tags have a coil inside that is used to pick up a higher energy radio frequency from a reader, which causes the device to come to life and send its information back to the system.

An active RFID tag is different in that it has a built-in battery that can be used to transmit over a longer range. As a result, active RFID can do more things and does not need to be in close proximity to an exciter or antenna to operate. Compared to a passive RFID tag which needs to be within a few meters of the reader or antenna, an active RFID tag can be located as far as 100 meters away and still broadcast its information.

Attribute	Passive RFID	Active RFID
Tag Size	Small and Thin	Small
Tag Cost	<$1	$10-$100
Tag Life	Many Years	1-3 years
Range	<3 m	>100 m
Usable for RTLS	No	Yes

433 MHz Active RFID

433 MHz active RFID is widely used to attach a tag to healthcare patients such as infants and wandering patients with cognitive deficiencies. The technology is also used as a layer of security for healthcare staff who can use the tag to call for help under duress. The lower frequency 433 MHz tag is better than other technologies at penetrating objects, for instance when it is shielded by a person in the way or metallic structures.

Wi-Fi

Wi-Fi is arguably the most widely deployed active RFID technology today. The advantage is that it shares an active communication medium with the data communications infrastructure that is often in place already; hence, installation costs can be significantly lower than a dedicated RFID-based RTLS solution. The downside is that the RTLS in this scenario exists as an add-on to a technology that was originally designed for data communications. The power requirements are higher, which results in tags that are larger, more expensive and have a shorter battery life.

UWB

UWB is another technology that has been custom designed for RTLS. The advantage is its accuracy – within 30 centimeters, or the length of an arm. In comparison, other technologies will locate the tag within a few meters, which is good enough for situations in which you only need to pinpoint the right room to find a person or equipment within the room, and three or four meters away. In use cases where an item is hidden, for example a small but lifesaving piece of equipment, , UWB technology is better option. However, it does not work all that well in RF shielded and multi-path environments, due to its higher frequency and wide-frequency range of operations. A UWB system is also more difficult to deploy.

Bluetooth Low Energy (BLE)

Bluetooth low energy is an add-on to the Bluetooth standard that has been around a long time. The technology has been optimized so you can get good battery life and low power out of tags. Therefore, it matches performance in terms of accuracy to the active RFID and Wi-Fi technologies, but has a lower tag cost and infrastructure cost. However, it is relatively new and still evolving, so we do expect that the infrastructure cost may rise it transitions to enterprise grade rather than the commercial grade it is today.

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Characteristic	433MHz Active RFID	Wi-Fi	UWB	Bluetooth Low Energy (BLE)
Primary Purpose	RTLS	Medium Range Data Communications	RTLS	Short Range Data Communications
Frequency	433MHz&125kHz	2.4GHz&125kHz/IR/Ultrasound	3-4GHz	2.4GHz
Maturity	Very Mature	Very Mature	Mature	Evolving
Range	>100m	Up to 30m	Up to 100m	>100m
Accuracy	3-4m	3-4m	30cm	3-4m
Infrastructure Cost	High	High (but shared with data communications)	Very High	Medium
Tag Size	Small	Medium	Medium	Small
Tag Cost	$10-$100	$100	$10-$100	$10
Tag Battery Life	1-3 years	Weeks to multiple years	1-3 years	1-3 years
Behavior in RF Shielded Environments	Good	Medium	Poor	Medium

Picking the Right Technology

In general, 433 MHz technology is an excellent choice if maintaining contact is imperative, due to its strong range and ability to penetrate solid objects and work in environments with a lot of metal.

Since no single technology is superior to all others for every use case, organizations may choose to take an integrated approach of using 433MhZ tags for tracking people, yet deploy tags that use Wi-Fi or Bluetooth low energy technology to track equipment assets.

9.0 System Architecture

To choose the best RTLS solution for your use case, make sure the architecture of the solution serves your needs. Consider the following:

1) **Server:** Do you want to locate the server on-premise or host it elsewhere?

2) **Database:** How many tag events do you need to store?

3) **Desktop client / web client / mobile client:** What kind of access will you need? Office staff may need desktop clients while salespeople may require web or mobile device access.

4) **Export / API:** Is there an API and does the ability to import / export data exist?

5) **Reporting:** Are reports customizable to fit your unique needs?

6) **Hardware lifecycle:** Does the vendor manufactures the equipment themselves, or do they rely on third parties? The danger is that if their suppliers can't deliver, it could render the system obsolete.

10.0 System Design

There are also design considerations depending on your situation and needs:

- **Floorplans:** The design should use your floor plans so you can quickly identify all areas of your facility.
- **Visibility of Devices and Tags:** It's important to be able to see your devices and your tags in the system software. In addition, the system should self monitor to show the tags' battery charge, and whether all devices are online.
- **Type of coverage:** The size of your facility will affect the cost. For example, you may only need to track 100 items, but if you need to do it across a million square ft, you will find that the tag ratio to area is prohibitive.
- **Indoor, outdoor, or both:** Do you need to track people coming in and out of buildings? If so, you will need equipment rated for indoor and outdoor use.
- **Network availability:** The active RFID technology you choose will come with its own network requirements. Ensure your network can sustain the bandwidth and traffic; and that it has a perfect uptime and backup, so your system never goes down.
- **Power requirements & availability:** Your site may have special power requirements to factor into power availability, such as solar power.
- **Ceiling height:** The ceiling height will affect how the system should be designed, so that each floor has accurate coverage.
- **Landlord approval:** If you do not own the facility, you may need the landlord's approval to install the system on the exterior or in common areas of the building.
- **Color and size of hardware:** If your organization rents the space, the landlord may want the enclosure for the equipment to be a certain color or design.

11.0 Range and Accuracy

If a tag has a stated range of up to a thousand feet, it does not necessarily mean that the tag can be tracked that far within a specific system. While it is true that there are that that can absolutely go that far, it also means the asset is picking up the accuracy of the tag – which might be a thousand feet away.

You will need to decide if you require the accuracy of locating a person or an asset within 6 to 10 ft or 60 to 100 ft, which will impact your costs. To get higher precision on accuracy, more equipment will need to be installed. And for every device deployed, there will be installation and power costs. So, the questions to ask are, "Does the organization need to know how many people are in a designated area, or do I need to know if someone is sitting in a particular room?" Determine whether you require room-level accuracy, area accuracy, or simply portal detection to indicate who is entering or exiting the building.

Range

- Active RFID tags have a range from100s to 1000's of ft
- Active RFID tags require less infrastructure to cover large areas
- Active RFID tags are more resilient to environmental factors impacting RF like metal objects

Accuracy

- Accuracy is dependent on active RFID tag reader density
- Active RFID can achieve location accuracy of 6-10 ft

The best solution for any organization strikes a balance between taking advantage of the benefits of the range of active RFID and location accuracy for the use case.

12.0 Tag

For Employees, Patients, Visitors, Contractors and Others

For tags attached to people, consider:

1) **Size:** What is the right size tag for your use? Do you need a small, lightweight tag, or is a larger tag with more battery life a better fit?

2) **Options to attach:** How should the tag be attached? By badge, band or wearable? What is the most convenient option?

3) **Is the person capable of attaching the tag themselves?** Or do they need someone else to attach it for them? Is the tag easy for a busy nurse or employee to put on somebody else?

4) **Compliance:** Are they compliant with the best practices of your industry, or certified for hazardous environments?

5) **Waterproof:** If the tag needs to be worn for extended periods of time, it is beneficial to have a waterproof device that can be kept on during a shower or bath.

For Assets

For tags used on equipment assets, consider:

1) **Size of the asset:** What is the size of the asset to be tagged, and what kind of tag does it require?

2) **Tag replacement:** Will batteries need to be changed, or will the whole tag be replaced?

3) **Charging batteries:** How long should the charge hold? What is the ideal frequency for charging?

4) **Affixing the tags to assets:** How should the tags be attached to what you are tracking?

13.0 Partner Eco-System and Integration

In most cases, the RTLS system that you are purchasing or installing is likely to be part of a broader system that is doing more than just locating assets or people. Often, it is integrated with a security solution and should work seamlessly with the alarm management solution that has already been deployed. In addition, the RTLS system may be configured to work with a video recording system, so that if an alarm goes off, a video camera will automatically focus itself on the potential incident.

Partner eco-system integrations are third-party solutions that are designed to integrate with your vendor's platform.
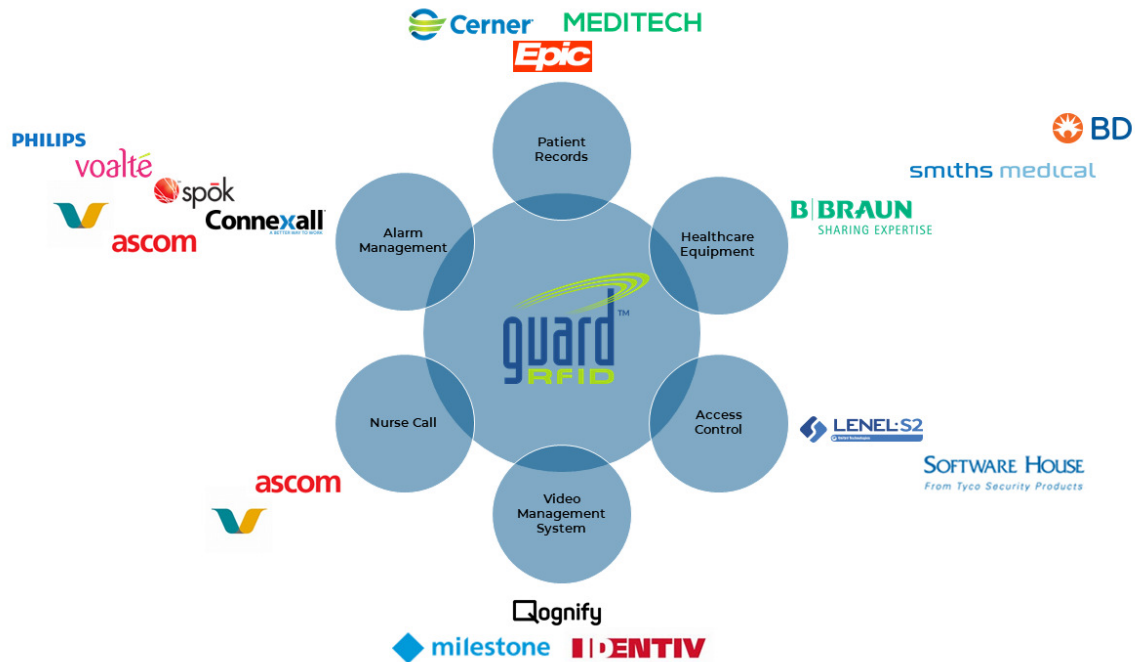
1) **Use Case and Requirements:** What do you want to achieve with the integration? What features in system A should show up in system B?

2) **Which UIs will be used:** If there is two-way integration, which of the two systems will be the primary system, used on a daily basis?

3) **What are the implementation options?**

   a. IHE (HL7) open standards
   b. GuardRFID REST API
   c. Third-party vendor API
   d. NRE for special requirements

4) **Configuration at Install Time**: When you install and commission the system, typically there are setup steps that need to be completed. For example, you may need to compare API's, and allow time and expertise to make sure you have set up and tested everything properly.

5) **Partner Updates:** How will partner updates be handled? Partners need to keep up to date with one another, or the integration may become obsolete and non-functional.

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14.0 Purpose-built System vs. Add-on RTLS

Finally, you should decide if you would like a purpose-built RTLS system, or try to add RTLS to another existing system such as your Wi-Fi.

In general, purpose-built RTLS on 433MHZ:

- Utilizes a frequency that is reserved for this purpose (and is therefore less prone to interference from other systems)
- Achieves better power consumption
- Results in smaller and less expensive tags
- Works better on people

On the other hand, with add-on RTLS:
- Wi-Fi was purpose built for wide area data communication, and may not be as efficient for RTLS purposes
- Bluetooth was purpose built for short range communication and pairing of devices

15.0 Next Steps

What can GuardRFID do for you?

GuardRFID is a purpose-built, multi-functional, enterprise RTLS system customizable for your industry and use case.

Organizations across the world choose GuardRFID for their healthcare, commercial, and industrial RTLS solutions to protect their investments and provide their employees with peace of mind.

If you have any questions regarding your potential implementation, feel free to reach out and book a complimentary consultation at: https://www.guardrfid.com/contact-us/