accialini

training & consulting

Recognizing

the need for RTLS

It's difficult to see if you don't have data!

accialini

training & consulting

Real Time Locating Systems are becoming a key technology in several sectors of applications

A **Real Time Locating System (aka RTLS)** enables you to find, track, manage, analyze, leverage, and otherwise use the information regarding where assets or people are located. RTLS exploit **IoT solutions**, i.e., cost effective devices such as RFID tags, BLE, UWB antennas and much more.

Everyone is experiencing how handy it is to use a GPS when we drive to new places: we don't waste time for planning, we don't get lost ad we know the shortest or the fastest way to reach our destinations.

RTLS solutions do what the GPS does outdoors, but indoors. There is more: RTLS can be applied in several situations we haven't even thought about, bringing numerous benefits for individuals and organizations in general.

Figure 1: example of RTLS application in a warehouse. Source: https://www.uwbleader.com/

So, the main question we want to answer is: **do we need a RTLS?**

In this Whitepaper, we present some applications of RTLS in real environments. We are sure that most of you haven't thought about the potential of such cost-effective technology!

Table of Contents

accialini
training & consulting

Tagging assets

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.

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 in many applications. Tracking can also be combined with sensors, such as a temperature sensor connected in the tag. In that case, you can not only determine where the sensor has been, but also see whether the asset has maintained or been stored at the right temperatures.

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 useful in almost every business or government facility.

Monitor usage of assets: 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

1

when the critical assets move without being close to the tags worn by the authorized personnel.

Trace assets: a 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: 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. Attaching tags to assets can help you in inventory reorder calculations, warehouse management, and some degree of inbound material planning.

Tagging people

By tagging people, you can locate them on demand, protect and guide them, monitor their movement or activities, and provide an 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. A 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, a 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 a large number of people in smaller areas.

 Provide an 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.
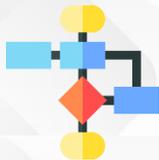
Improve workflow: by analyzing trends of the utilization of assets and how workers and visitors spend their time, significant improvements in work practices and methodologies can be achieved. For example, in an emergency department, you can determine the key changes in equipment, staff, or processes 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.

Sectors of application

Healthcare

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

✓ **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. A 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 elopement) as well as when a patient passes too close to an entrance or an exit. Another example is infant abduction prevention in which a 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 a 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 a 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 a 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 tripping over extra chairs, patient visitors, and other equipment — but a RTLS can perform the same task automatically, simply by recognizing the nurse's presence in the room.

- ✓ **Improve patient/family satisfaction**: a 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. A 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.

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 a 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. A RTLS can instantly identify what still needs to be done to each product. Historically, an alternative to having a 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 a 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.

✓ **Quality Management**: in some manufacturing processes, compliance with process times becomes fundamental to guarantee the satisfaction of requirements. Some specific examples include the processing of composite materials or heat treatments.

✓ **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.

Automotive

The automotive industry has been one of the early adopters of RTLS technology. A 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 poor quality**: auto makers reduce the cost of poor quality by preventing a vehicle with quality problems from being shipped while still shipping other vehicles. This can be achieved by using a RTLS to track information of finished vehicles from pre-delivery to shipment.

✓ **Manage supplies**: a RTLS locates critical tools and test equipment, and uses call buttons for replenishment of supplies.

✓ **Manage vehicles**: a 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.

Food & Beverage

The peculiarity of the food & beverage industry lies in the perishability of the products. Being able to establish exactly how much time passes from harvest to consumption becomes an extremely valuable activity. For this reason, RTLS systems can help to:

✓ **Maintain the cold chain**: in products that require freezing or refrigeration, such as meat and fish, it is possible to accurately track the temperature and time-frame of each product.

✓ **Manage processing**: during the harvest season, it is possible to identify exactly all the boxes with the various types of products, ensuring the priority of selected products in the processing phase (e.g., FIFO)

✓ **Warehouse management**: complex environments with numerous items such as breweries are becoming more demanding in terms of logistics and it's important to move and locate the pallets wisely in order to optimize operations.

Aerospace and defense

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

- ✓ **Manage supplies**: a RTLS locates critical tools and test equipment, and uses call buttons for replenishment of supplies.

- ✓ **Manage Fleet maintenance**: a RTLS can be used to manage check-in and check-out processes.

- ✓ **Track maintenance dates**: a 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.

- ✓ **Improve speed throughput**: a 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 always been 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 a 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, the safety of people in tunnel and mining operations can be improved. For example, they can:

✓ **Track worker location**: with a 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 a 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.

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 a 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.

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 a RTLS to help manage busy events, companies can:

✓ **Track and communicate with people attending the event**: a 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 a 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 a 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. A 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 a RTLS, you can:

✓ **Assist first response teams**: by using a RTLS, first response teams can more easily locate the teacher or student requesting assistance. With a 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 a 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.

Source: Ajay Malik, RTLS For Dummies, ISBN: 978-0470398685

How does a RTLS work?

RTLS are made of the following elements:

- ✓ **Tags**: mobile devices that are enabled with location technology
- ✓ **Location sensors**: devices that usually have a known position
- ✓ **Location engine**: the software that communicates with tags and location sensors to determine the location of the tags
- ✓ **Middleware**: the software that resides among the pure RTLS technology components and the business applications capable of exploiting the value of the technology
- ✓ **Application**: the software that interacts with the RTLS middleware and does work users are directly interested in

Moreover, **RTLS** can be implemented by using **different technologies**. Some of them are:

- ✓ Bluetooth
- ✓ Passive RFID
- ✓ Infrared
- ✓ Ultrasound
- ✓ Ultra-Wideband
- ✓ Wi-Fi
- ✓ … and more

	Quuppa (Bluetooth Direction Finding)	Bluetooth (RSSI)	UWB	Wi Fi	RFID	GPS
ACCURACY	< 1m	1-5m	< 1m	5-20m	1-5m	5-20m
REAL-TIME	< 1 sec	10-30 sec	< 1 sec	10-30 sec	10-30 sec	10-60 sec
BATTERY CONSUMPTION	Low	Medium	High	High	Low	Very High
RANGE	upto 300m	upto 300m	upto 200m	upto 150m	upto 5m	Global
IOT GATEWAY *	☑	☑	✕	☑	✕	✕
SMARTPHONE COMPATIBLE	☑	☑	☑	☑	✕	☑
TOTAL COST ** OF OWNERSHIP	€	€	€€	€€	€€	€€€
SCALABILITY	1000s of Tags	Unlimited	1000s of Tags	100s of Tags	1000s of Tags	Unlimited
SECURITY	★★★★★	★★☆☆☆	★★★★★	★★☆☆☆	★☆☆☆☆	★★★★★

* Capability to transmit data effectively for remote sensing
** Defined by cost of initial planning & deployment cost + 3-5 years maintenance

Figure 2: Comparison of different RTLS technologies. Source: https://www.quuppa.com/

But this is not all! Different techniques can be used to calculate the position in real-time:

- ✓ **Ranging techniques to estimate distance between the tag and a set of location sensors**
    - o Time of Arrival (TOA)
    - o Angle of Arrival (AOA)
    - o Time of Flight (TOF)
    - o Received Signal Strength Indicator (RSSI)
    - o … and more

- ✓ **Position estimation techniques that derive the position of the tag**
    - o Trilateration
    - o Triangulation
    - o … and more

Finally, the cost depends on other several factors, among which we find required accuracy.

As you can see, **the implementation of a RTLS implies knowledge in different areas of expertise.**

How to select the most appropriate RTLS?

At **Accialini Training & Consulting**, we will provide you with the proper support!

Thanks to our partners we are able to identify the most cost-effective solution based on your requirements.

This means that:

- ✓ **we help you to identify your needs**
- ✓ **we identify the most suitable technologies and solution providers**
- ✓ **we support you during the installation phase**
- ✓ **we assist you during the test phase**

Would you like to learn more about other opportunities hidden within new technologies?

We have an international network of solution providers! You can also take advantage of our courses in different formats. Check out our elearning platform: www. skills4i.com

For further inquiries, don't hesitate to contact us!

Accialini Training & Consulting

Calle Lugo 13, 2B – 18100 Armilla (Spain)

Mobile: +34 623195453

Email: nicola@accialiniconsulting.com

accialini
training & consulting

About the Author

Nicola Accialini is an Aerospace Engineer. After graduating from the University of Padua, he worked for some of the leading aerospace companies in international contexts.

In his professional career, he has managed projects related to the development of new products and the implementation of new production technologies that in 2016 led him to take an interest in the world of Industry 4.0 and the Smart Factory. Since June 2019 he has been living and working in Spain as a consultant and he supports companies in product and process innovation processes in the manufacturing sector.

Nicola Accialini

Senior Consultant

accialini

training & consulting

STRATEGIC SKILLS

TO SUPPORT YOUR COMPANY

www.accialiniconsulting.com