SIEMENS

REAL-TIME LOCATING SYSTEMS

Can boost efficiency, visibility, and safety while enabling digital twins

Real-time locating systems (RTLS) offer precise, end-to-end visibility of moving objects and people in production and logistic processes, while supporting digital twins to boost efficiency, safety, and productivity. **usa.siemens.com/beyond-locating**

SIMATIC RTLS

Real-time location capabilities across entire plant premises

Using a hybrid technology of ultra-wideband (UWB) and 2.4 GHz and triangulation techniques, the Siemens SIMATIC RTLS platform can locate objects and people equipped with transponders to within a few inches or centimeters of their actual positions with latencies of less than 1 second. It can also detect and report their motion, acceleration, elevation, and orientation. The RTLS system can then immediately relay all this positioning data to higher-level systems in real time, making it available for a variety of plant applications.

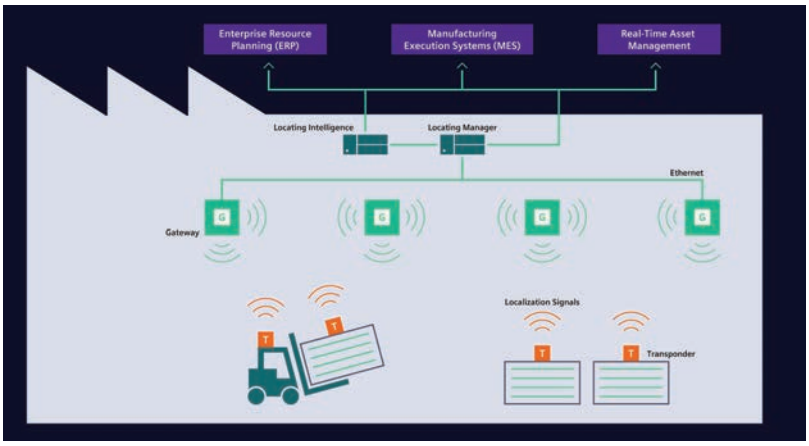


Figure 1. The Siemens SIMATIC RTLS solution architecture consists of (from bottom to top): (1) the data-gathering hardware infrastructure; (2) the locating server; and (3) the integration with higher-level OT and IT systems, with extensibility to cloud-based platforms, such as the Siemens MindSphere open IoT operating system, designed specifically for industry.

To enable its real-time location capabilities, the SIMATIC Locating Manager software calculates the position of each transponder by a method called Time Difference of Arrival (TDOA). Accuracy is increased still further using flanking measures such as automatic correlation of RTLS position data with the 3D model of the product and production environment stored in the digital twin. TDOA also helps extend the life of transponder batteries, ensuring reliable function over several years.

UWB, also known as pulse radio, provides "see-through-the-wall" radar-like capabilities, so little or no RF engineering is required to install. That's because its penetrating signals don't bounce off metal or get absorbed by liquids as other wireless radio technologies can.

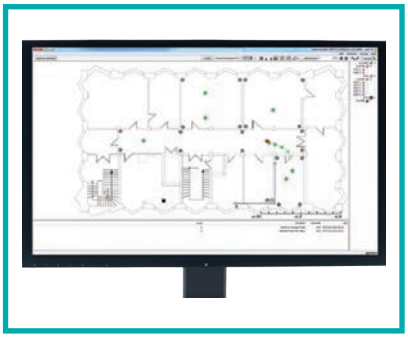
With an extremely wide frequency range (3–7 GHz), UWB uses a bandwidth of at least 500 MHz to transmit relatively low-energy wireless signals that can still provide short-range communications for location purposes. This alleviates the possibility of interference with other wireless systems in plants, warehouses, and any operating yards between or around them.

Siemens SIMATIC RTLS systems consist of wireless hardware transmission and signal-gathering infrastructure, a locating server, and the integration with the RTLS information and events to higher-level systems, as shown in Figure 1.

The SIMATIC RTLS portfolio features three interworking components:

Transponders. These devices are active UWB transmitters that come in various models and sizes for being fitted to material containers, workpieces, robots, AGVs, forklifts, and people's work badges or attire. Whether in motion or at rest, they send UWB signals at defined intervals to receivers called

Gateways. These devices are typically wall-mounted inside plants and warehouses and record the signals emitted by different transponders. Gateways have a steady position within the localization network and feature an interface for IT network connection. They serve as reference points for the localization calculations and enable the collection and transmission of localization data. At least four gateways mark the transponders' wireless signals with a fixed position and time stamp, then pass the data to the Locating Manager server. Localization data and optionally application-specific data can be exchanged between the wireless localization network and the localization server via the IT infrastructure.



Locating Manager. This server-based software application calculates the real-time position of individual transponders and relays the data to higher-level systems for use in RTLS-enable locating applications. With a rules engine as part of the Locating Manager application, it is possible to define specific events and locations and configure higher-level system responses, such as alerts and action commands are extremely easy to deploy and configure, especially because they do not require RF engineering. A qualified electrician's skills are all that are necessary. In addition, these RTLS solutions are highly scalable, so plant and logistics operations can add RTLS capacity in stages as site needs grow – right up to a company-wide infrastructure – with no additional configuration costs.

This scalability allows companies, which are taking their first steps toward becoming fully digital enterprises and using digital production twin operating models to conduct pilots, then invest further as the technology validates its value.

Higher-level systems integration. What's more, the Siemens SIMATIC RTLS technology and location data can be integrated in higher-level production systems, such as safety systems, manufacturing execution systems (MESs), and enterprise resource planning (ERP) systems.

For example, location data can be used by an MES to trigger a production step or execute an order to deliver more feedstock to production, while notifying the plant's ERP system to decrement inventory numbers and, if levels have fallen below par stocks, to order more from the plant's supplier.

RTLS data can also be used for fleet management of moving vehicles, such as forklifts, AGVs, and mobile robots. This can help to augment maintenance records and to assess utilization rates, helping engineers find ways to improve the availability and utilization of these assets.

To gain a complete enterprise-wide view across multiple plants, even those located on different continents, companies can use cloud platforms like Siemens MindSphere, the open IoT operating system, to link each one and combine its RTLS data with other plants' data streams. This capability can facilitate self-organizing plant operations, while also enriching data streams for advanced analytics.

Many other benefits. RTLS location data generated by Siemens SIMATIC RTLS solutions can help plant and logistics operators in many other ways:

Improved visibility, via the continuous monitoring of goods that combines process and position data to reduce waste and improve traceability.

Better container utilization, to ensure their location, availability, and accurate assignment.

Reduced costs, with more efficient processes and less extra work.

Improved productivity, by reducing or eliminating inefficient process steps.

Better quality, with fewer potential errors in material handling.

Diverse applications and use cases for **SIMATIC RTLS solutions**

Optimized maintenance, with RTLS-based guidance for service technicians.

Advanced logistics concepts, via AGV or forklift routing and better control of picking processes.

Improved documentation, by mapping actual location data of physical objects and personnel in motion against a workflow's engineered designs.

RTLS information can be employed in many ways, as subsequent use cases will illustrate. One application, for example, is the tracking of tools and how they are used in a production process, such as in auto interior assembly, illustrated in Figure 2.

In this scenario, a SIMATIC RTLS transponder is affixed to the powered, auto-fed screwdriver tool being used by a single assembly worker. The left diagram shows the tool's actual path into and out of the car body. The right diagram shows the real-time location of the tool, as indicated by the small dots.

With this data, it's possible to determine exactly where inside the car body that the worker is able to screw in a component, and the torque and angle of the screwing motion, the latter made possible by a sensor inside the RTLS transponder. In turn, engineers can analyze the movements and potentially find a more efficient, time-saving approach for workers to conduct this step in the assembly process.

Also, it's worth noting that, by coupling the RTLS location data with geo-spatial fencing technology, the screwdriver tool ceases to operate when the worker steps outside of the tool's defined work area. In this case, such a capability can safeguard workers against accidental injury from the tool's auto-feed function.

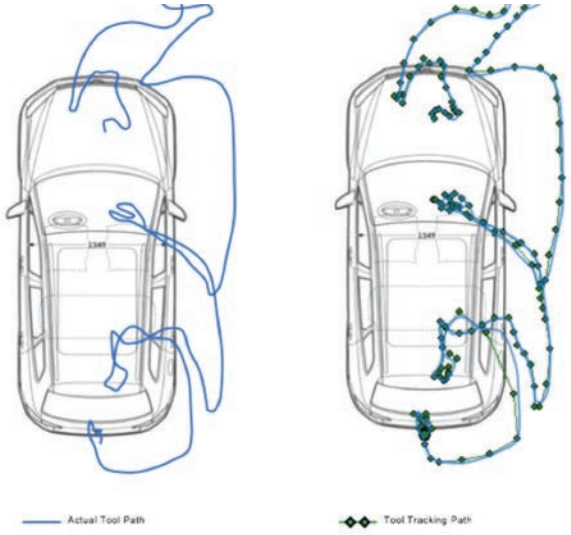


Figure 2. How the Siemens SIMATIC RTLS solution can track a powered, hand-held screwdriver's path during the installation of an auto interior, then analyze the tool's use for possible optimization of this assembly step.

Other RTLS applications and use cases include:

Inbound logistics

Standing time records: This SIMATIC RTLS application can provide automatic recognition of a vehicle's time of arrival on a premise and its departure from the premise. It can generate an overview containing the standing times of the truck, enabling operations engineers to reduce inefficient idle times.

Automated parking allocations: In this situation, a SIMATIC RTLS system can be used to automatically assign arriving supply trucks their designated unloading spaces as soon as they pass a plant's gates into its receiving area.

Access control: SIMATIC RTLS location data can automatically determine which RTLS-tagged vehicles are eligible to enter what areas. Gates will only open for vehicles with appropriate privileges.

Tracking delivered goods: The SIMATIC RTLS system records the location and condition of scanned delivered goods. In addition, scanned data can be linked to video recordings to associate video footage with the goods. Further processing steps can be tracked in real-time.

Intra logistics

Forklift localization: With all of the forklifts of a plant or logistics operation equipped with a SIMATIC RTLS sensors, their locations, routes, availability, and status can be called up instantly. In addition, access restrictions can be assigned with geo-fencing used to keep the forklifts from entering unauthorized areas.

Container and pallet localization: Products in containers or on pallets can be located via the location of transportation vehicles such as forklifts. The SIMATIC RTLS system knows the exact location as soon as a container or pallet is deposited at a designated storage location. The location is transmitted to the transportation vehicle driver's terminal device once the stored goods in the container or on the pallet have to be processed.

Container management: The SIMATIC RTLS system can record and monitor all container flows within a plant's container normal circulation patterns. This can ensure that the containers are available at the correct location, at the right time, in the right condition, and in the correct number at a minimum of costs. This reduces the chance of loss and optimize production processes.

Production logistics

Tool localization: With SIMATIC RTLS sensors attached, plant tools for an inch-perfect localization and furthermore supports the production process intelligently. For instance, various commands regarding a screw gun's torque control along the production steps can be stored or the battery status retrieved.

Work-in-Progress: Intelligent, real-time localization with SIMATIC RTLS can help plants automate specific steps along entire production lines. Machines, tools, and workers can get detailed information from the RTLS sensor on the workpiece about where it came from and how it needs to be processed. This can provide efficient process control and transparent material flows.

Production progress monitoring: SIMATIC RTLS can be used to monitor the different stages in a product's manufacture. It can provide detailed, time-based overviews of production progress, so engineers can gain insights how to better optimize the production process.

Outbound logistics

Product storage localization: Storage of overproduced goods can be localized to within centimeters. In automotive manufacturing, for example, overproduced vehicles are parked in large spaces, which often requires time-consuming and cost-intensive inventory management. But precise SIMATIC RTLS localization enables specific vehicles to be identified by location, eliminating physical searches.

Truck loading: SIMATIC RTLS can localize finished goods for truck loading, whether they're to be picked up straight from the production line or from a warehouse. This can simplify otherwise complex communications, reducing errors, and enhance the transparency of outbound logistics.

Departure time recording: Departure times of loaded, outbound trucks can be captured and recorded automatically upon the truck leaving the premise, using SIMATIC RTLS solutions. This enables plants to document times of departure and better monitor their logistics process.

People tracking

Manpower planning: SIMATIC RTLS transponders can be affixed to employee badges or work attire, including hardhats (see sidebar) to locate and track individual personnel through their shift activities. This way, plant engineers can conduct data-driven manpower planning to increase employee efficiencies, while ensuring headcounts are always optimized for variable plant workloads.

Workplace safety: With a SIMATIC RTLS infrastructure operating, plant operators can have exact to-the-second localization of all employees. This can be especially critical in inherently dangerous industrial work, such as mills, mines, excavation, and demolition. If an accident occurs, responders can immediately identify all affected employees, where they are, and even who is standing or has fallen.

Access restriction: Using SIMATIC RTLS technology, plant and logistic operators can ensure that only authorized employees can gain access to dangerous working zones.

Ready for **deployment today**

By providing real-time location data for physical objects and workers, whether at rest or in motion, Siemens SIMATIC RTLS solutions can help plants and logistics operations to achieve several key advantages:

Streamline workflows for greater efficiencies, asset utilization, and production throughputs.

Gain greater visibility into those workflows, by combining RTLS data with other data, and apply advanced analytics to identify process improvement opportunities.

Boost worker and overall plant safety, by knowing where workers are at all times and their status, as well as by restricting worker and vehicle access to accident-prone or inherently dangerous areas.

RTLS systems will supply the essential foundation intelligent production, enabled by the real-time synchronization of different production resources, such as mobile robots interacting with material-handling systems and production machinery. This means the actual location of a machine or robot will become a key variable factor, so autonomously controlled, highly efficient workflows can only be organized given a real-time view of a plant's current spatial configuration.

Siemens SIMATIC RTLS systems are proven in diverse applications in plants across many different industries. Today, they're helping these companies realize greater efficiencies, visibility, and safety in their operations, while establishing the basis of being a fully digital enterprise in the future.

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