



KINEXON

WHITEPAPER

RTLS-Powered Automation in Aerospace

How RTLS Enables Automated
Monitoring and Controlling of Time-
and Quality-Sensitive Operations

Key Insights for Executives, Production Planners,
and Operational Excellence Managers

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Next Level Process Automation in Aerospace	



Summary

Leading aerospace OEMs and suppliers focus on automation to meet high quality and efficiency standards in production and intralogistics operations. Real-time asset tracking has become a critical business capability to continuously and seamlessly monitor processes from production to delivery. Real-Time Locating Systems (RTLS) provide the technical platform for automated monitoring by combining the necessary technologies and capabilities. In this paper you will learn more about RTLS and its applications in aerospace environments.



INTRODUCTION

Redefining Process Automation for Smart Manufacturing and Logistics

Reliability and speed are essential for today's just-in-time processes and workflows in the aerospace industry. Enterprises need to have a full and transparent overview of orders, production and repairs at all times, especially in fast-moving, complex environments. To achieve this, businesses are increasingly focusing on automating processes that were traditionally controlled and monitored by humans. Latest IoT technologies help make processes more efficient and reliable while minimizing the cost and risk associated with manual intervention.

Tracking mobile and stationary industrial assets such as production goods, transport vehicles, machines, tools or containers is a key prerequisite for the automation and optimisation of time- and quality-sensitive business operations. To orchestrate complex processes in an industrial environment, the location and status of all assets involved must be tracked continuously. This is where Real-Time Locating Systems (RTLS), consisting of sensors, receivers, network and control systems, come into play unlocking the full potential of process automation.



THE CHALLENGE

Tracking Industrial Assets in Real Time

Full synchronization of complex processes is crucial for efficient and reliable operations. Every single part of an aircraft turbine being disassembled for repair or maintenance must be fully tracked throughout the entire process. Operators must ensure that the necessary equipment and spare parts are delivered to the workstations on time to meet repair targets. In addition, the entire procedure must be tracked and documented in real time. This is just one example of many where manual processes reach their limits in aerospace environments.

To reliably control production and intralogistics, operators need to know exactly where to find moving assets, whether it's a tailored component, an urgent production order, or modules needed to reassemble an engine after maintenance. There typically are experienced professionals in charge of keeping operations fully under control and reliably managed. In practice, however, manual operations tend to be error-prone and costly. This applies not only to fast, complex industrial environments, but wherever reliability and efficiency are crucial.

Today, businesses can choose from a wide range of field-proven technologies to reliably and automatically track and trace assets in industrial environments. The challenge is to orchestrate hardware components such as transmitters and receivers, control and monitoring software, and network capabilities in a way that, in their entirety, fulfills the specific business requirements and drives continuous improvement across operations. Solutions that integrate all necessary technologies help simplify and accelerate planning and implementation.



REAL-TIME LOCATING SERVICES IN PRACTICE

RTLS Applications in the Aerospace Industry

Real-Time Locating Systems are transforming industrial operations by providing businesses with higher visibility and control over their systems and processes, unlocking significant automation potential while the highest quality standards are guaranteed.

Automated Tool Approval

The system automates tool tracing by converting manual documentation into real-time messages, enhancing tracking within quality systems. This reduces errors and saves time while ensuring reliable tool approval through automatic scanning and verification, preventing unintended operations during assembly.

Additionally, the solution enables seamless tracking of cordless tools by virtually connecting them, ensuring precise and real-time location. Its vendor-agnostic localization approach promotes flexibility and scalability, eliminating dependency on specific vendors and breaking down IT silos.

// When even the simplest tasks such as correct screwing are crucial in the assembly of aircrafts, automating the monitoring of such processes is a must."



Alexandra Worbs
Product Owner Industrial
Applications at KINEXON

REAL-TIME LOCATING SERVICES IN PRACTICE

Asset Tracking

Automated asset tracking enables companies to efficiently manage materials, tools, work-in-progress, semi-finished products, and OEM components. By digitizing moving goods, their location and status can be easily tracked, increasing overall transparency for employees. Automating the management of tagged assets like plastic totes in a kit car helps streamline processes as well as identify and reduce critical bottlenecks.

Use cases

Inventory management

Continuously monitor material demand and outflow and take early action if needed. Easy-to-apply sensor tags and automatic detection during operation allow simple tracking even of bulk items.

Process flow management

Manage and optimize the work-in-process status of any industrial assets such as manufactured parts, single components or fully assembled systems, custom tools and more involved in production processes.

High-value asset tracking

Efficiently monitor and manage high-value assets like refined materials, electronic components or goods that require special protection against theft and manipulation with greatest precision and reliability.

Specialty equipment tracking

Receive real-time notifications and documentation of rule violations related to the movement and quantity of specialty equipment to protect them against unauthorized access and manipulation and meet compliance rules.

SUCCESS STORY

Asset Tracking at MTU Aero Engines



MTU Aero Engines uses KINEXON RTLS Pro to track all manufactured goods in real time. From day one, the RTLS Pro system has ensured full transparency and increased efficiency in production and intralogistics.

The challenge

Employees tracked the position of manufactured components manually by documenting the production steps and the path of each part through production using software. This manual approach proved too inefficient and error-prone for real-time tracking.

The solution

An RTLS-based track & trace system continuously monitors the location of single components, assemblies and entire engines and automatically logs their journey through the entire production process, ensuring full operational transparency at all times.

The result

With KINEXON RTLS Pro, MTU Aero Engines set the technical stage for automated real-time localisation in production and beyond, e.g. to improve transparency and efficiency in maintenance and repair operations.

Find out more about how KINEXON RTLS Pro is taking MTU Aero Engines' asset tracking to the next level in our success story you can [read here](#).

REAL-TIME LOCATING SERVICES IN PRACTICE

Real-time Order Tracking

Automated order tracking and process management helps optimize industrial operations and reduce costs. Companies gain maximum process and material flow transparency and can track production orders in real time. This is particularly important for orders that need to be delivered on time.

Use cases

Real-time order tracking

In the aerospace sector, automation can drastically improve efficiency by eliminating the need for manual bookings and scans. By automating these processes, companies can reduce the time and labor costs associated with manual data entry, minimize errors, and ensure more accurate tracking of parts and components.

Automated quality control

Aerospace products and components are subject to strict regulations and standards. Through RTLS-based automation of manufacturing and logistics operations, companies achieve high-quality processes while maximizing efficiency and reliability. By automating manual tasks, such as searching for materials or documenting individual process steps, companies save resources that can be allocated to value-adding tasks and at the same time minimize the risk of human failure in time-sensitive operations.

Efficient material replenishment

Aerospace companies avoid material shortages and process idle times by optimizing the just-in-time delivery of materials to the production lines. This includes the entire intralogistics process, from inventory and order management through to delivery.

SUCCESS STORY

Premium AEROTEC



Premium AEROTEC uses KINEXON RTLS Pro to track manufactured fasteners that are shipped to customers either immediately after production or on a scheduled basis for further processing.

The task

Make information about the location and status of each manufactured component traceable in real time. Initially, employees will benefit from RTLS-based process automation. At a later stage, customers should also be able to track their orders live.

The solution

An industrial-grade RTLS enables the company to track the entire production process reliably from production to delivery. The location data for multiple sites worldwide is processed centrally.

The result

As part of a pilot project, a network of 50+ UWB anchors was installed in a short period of time to monitor the live status of 300+ production parts tracked via RTLS tags in four different production areas.

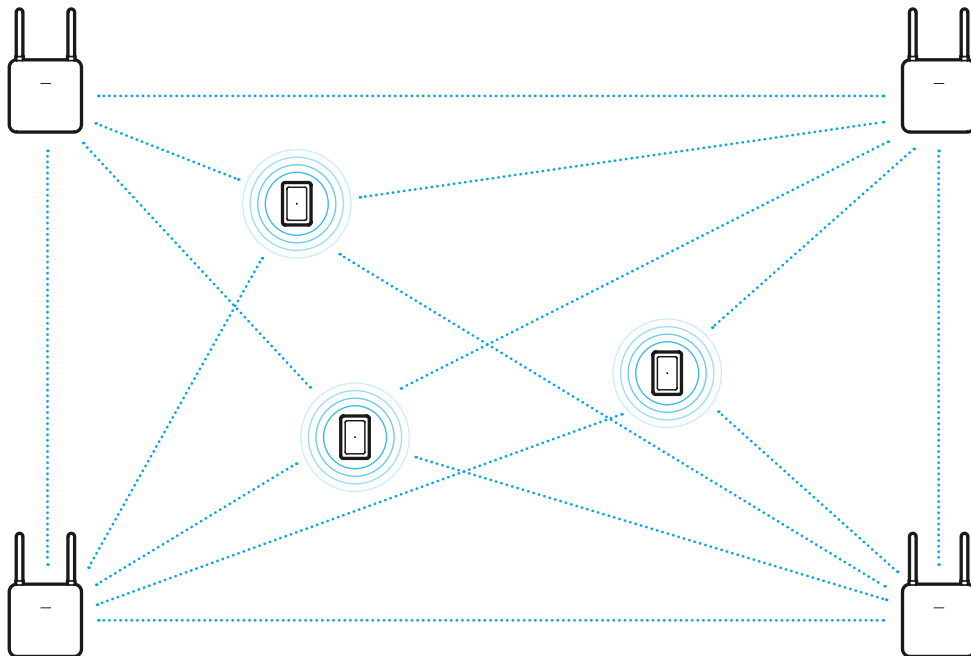
Find out more about how KINEXON RTLS Pro is taking Premium AEROTEC's order tracking to the next level in our success story you can [read here](#).

TECHNICAL BACKGROUND

RTLS-Powered Automation

Real-Time Locating System (RTLS)

Real-Time Locating Systems (RTLS) are essential for the automated, real-time tracking and localization of objects, typically within specific business areas like industrial production or warehousing. By integrating wireless communication, localization algorithms, and centralized monitoring, RTLS delivers precise real-time data on the locations of tagged objects. This enables businesses to efficiently track and manage their assets and processes, making RTLS a crucial component for optimizing and automating industrial operations.



Key Elements of an RTLS

RTLS refers to various technologies and capabilities that are being orchestrated to reliably locate physical objects at any time as they move through complex environments. Companies using RTLS aim to achieve full visibility of the status and location of every single manufactured item, vehicle, container, tool and other asset without any human intervention.

Tracking: Bluetooth/BLE, GPS, RFID, UWB and WiFi

Various technologies are available for the effective communication between hardware and software components. They differ in signal range, accuracy and energy consumption. The following overview roughly summarizes the most common technologies and their key characteristics.

Technology	Characteristics
Bluetooth Low Energy (BLE)	<ul style="list-style-type: none"> • Low-power communication • Short distances • Indoors
Global Positioning System (GPS)	<ul style="list-style-type: none"> • Accurate tracking outdoors • Using satellite signals • Large areas
Radio Frequency Identification (RFID)	<ul style="list-style-type: none"> • Accurate tracking indoors • Selective point-to-point data • Own or external power supply
Ultra-wideband (UWB)	<ul style="list-style-type: none"> • High-precision tracking indoors • Continuous real-time data • Minimum interference
WiFi-based tracking	<ul style="list-style-type: none"> • Uses existing WiFi infrastructure • Balancing accuracy and cost • Seamless WiFi coverage needed

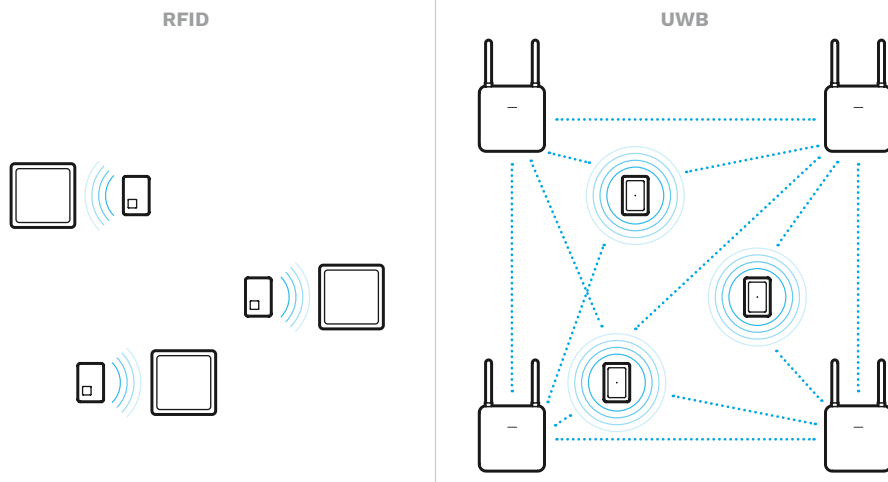
TECHNICAL BACKGROUND

RFID versus UWB RTLS

RFID is a cornerstone technology for wireless object identification in industrial settings. However, as the need for extremely precise localisation in dynamic industrial environments grows, UWB-based RTLS has emerged as a robust alternative to RFID.

RFID and UWB are both highly suitable for use in the aerospace industry. They mainly differ in the type of localisation data they provide: RFID delivers selective point-to-point data, while UWB is designed to provide continuous, seamless real-time data.

UWB is recognised as a highly accurate, reliable and dynamic locating technology and therefore has the potential to become gold standard for ultra-precise RTLS.



Localization: TWR, TDoA, AoA and PDoA

UWB utilizes light-speed pulses and precisely measures the arrival time of signals across a broad bandwidth to pinpoint transmitter locations with high accuracy, achieving distances up to 200 meters in line-of-sight conditions. Several methods exist to accomplish this, varying in their precision, energy efficiency, and suitability for dynamic environments with multiple assets to track. The most common methods are TWR, TDoA, AoA and PDoA.

- Two-Way Ranging (TWR) measures the round-trip time of a signal between two devices to calculate distance.
- Time Difference of Arrival (TDoA) determines location by comparing the time it takes for a signal to reach multiple receivers.
- Angle of Arrival (AoA) locates an object by measuring the angle at which signals arrive at multiple antennas.
- Phase Difference of Arrival (PDoA) uses the phase difference of received signals at multiple antennas to estimate location.

Modern RTLS systems designed for high-precision real-time positioning in industrial settings integrate multiple localization techniques to deliver optimal results. KINEXON RTLS employs TWR and TDoA to ensure maximum accuracy and energy efficiency.

TECHNICAL BACKGROUND

Hardware: Tags and anchors

The hardware components of an industrial RTLS consist of tags and anchors - mobile devices attached to assets emitting signals, and static devices that receive these signals, locating the assets in real time, and relay this information for further processing.

**KINEXON RTLS PRO X-TAG**

RTLS Pro Tags are small, portable devices attached to objects or humans that continuously transmit location signals to be tracked within an RTLS network.

**KINEXON RTLS PRO EPAPER TAG**

RTLS Pro ePaper Tags serve as intelligent devices that communicate with users through a nearly five-inch e-ink screen. These tags include a sensor that transmits positioning information.

**KINEXON RTLS PRO ANCHOR**

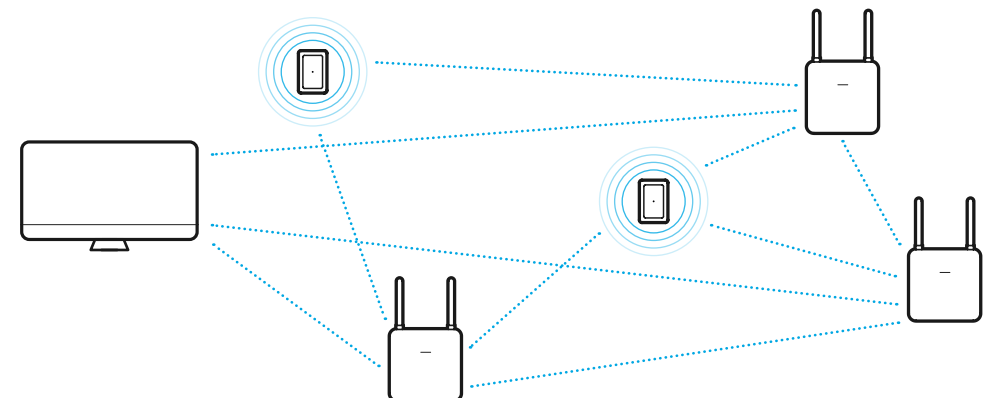
RTLS Pro Anchors are fixed devices strategically placed within a designated area that receive signals from RTLS tags to determine the precise location of the tags.

Orchestration: RTLS control software

RTLS requires network and control capabilities to unlock the true value of location-based process automation - regardless of the technology used to generate real-time location data. This is where the RTLS Control Software comes into play.

The KINEXON RTLS software ecosystem integrates state-of-the-art control and networking capabilities with a powerful operating system:

- Control Center refers to a web-based user interface providing a comprehensive overview of the RTLS, including system status, devices, and current system settings.
- Coordinator Software controls the synchronization of anchors and tags and processes the anchor data to create position data in real time.
- The KINEXON OS Platform captures real-time location data to enable dynamic workflows, actionable insights and connectivity to third-party ERP, MES, WMS.



TECHNICAL BACKGROUND

Security: Protecting RTLS against cybercrime

The high security standards in the aerospace industry require comprehensive protection of RTLS systems against attacks and unauthorized access from inside and outside the company. The maximum level of protection results from a combination of suitable security measures, the most important of which are listed below.

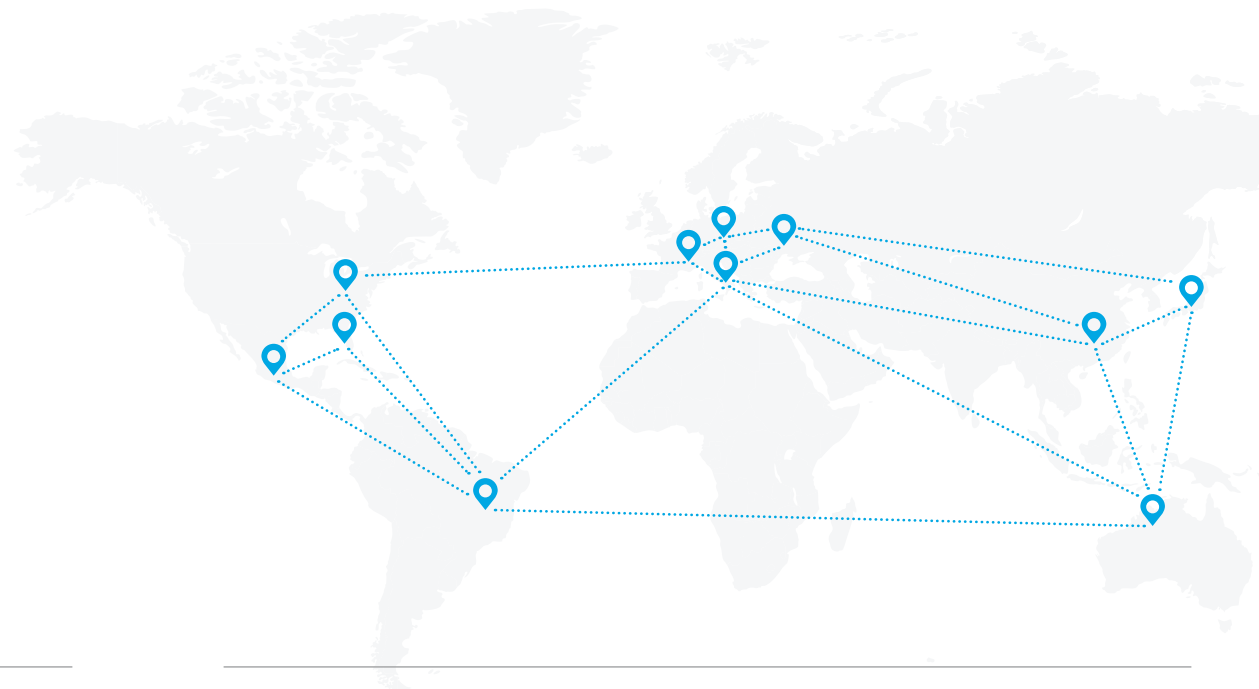
- Encrypted data transmission between RTLS sensors, tags and the central system using strong encryption protocols such as AES or TLS.
- Network security through the use of firewalls, intrusion detection systems (IDS) and intrusion prevention systems (IPS) to prevent unauthorized access.
- Regular software updates and patches to eliminate known security gaps promptly and keep the high security level.
- Protecting the physical infrastructure of the RTLS system, including sensors and tags, from manipulation or theft.
- Strict access control through user authentication and role-based rights management to ensure only authorized staff can access the RTLS system.
- Implementing redundancy and backup strategies to minimize data loss and downtime in case of an attack.

KINEXON RTLS offers a wide range of on-board security features that provide a high level of security for sensitive industrial environments.

Scalability: Multi-site RTLS

If production and intralogistics are spread across different locations on one site, across the country or even globally, a central RTLS management system is needed to connect all the dots. The data from all the sensors involved, regardless of where they are located, are pooled and processed in one place.

When new locations, assets or processes are added, the RTLS must be able to scale flexibly to meet the new requirements. Therefore, the entire system, hardware and software, must be designed for change and adaptation. The same applies to the ability to integrate if, for example, pre-existing RFID components need to be connected.



ABOUT KINEXON

Next Level Process Automation in Aerospace

KINEXON provides the leading AI-powered IoT platform for businesses to connect and automate operations.

As global technology leader in indoor location services KINEXON's real-time locating system and AMR & AGV Fleet Management offer solutions across automotive, manufacturing, and aerospace sectors to achieve real-time visibility and traceability of moving high-value assets, along with actionable insights to drive automation.

Leading customers such as BMW, SIEMENS, Airbus, Continental, or MTU Aero Engines utilize KINEXON's solutions to digitize and orchestrate physical processes, thereby enhancing efficiency, productivity, and quality while preparing for AI-supported operations.

Headquartered in Munich, Germany, with another office in Chicago, USA, over 250 employees drive innovation in the IoT landscape. For more information, visit www.kinexon.com.

Ready to automate your shop floor?

[Schedule a Meeting](#)

Learn more how MTU Aero Engines achieves complete material flow visibility with real-time asset tracking



[Read the Success Story](#)

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