



Short-range wireless IoT

Benefits for Automotive Industry

About Beontag

At Beontag, we combine expertise in graphic and label materials, RFID technologies, and wireless IoT solutions to create connected ecosystems that drive digital transformation across global supply chains.

As a global leader in RFID and wireless IoT, sustainability is embedded in everything we do—from product development to manufacturing and customer collaboration. Supported by five R&D centers and more than 2,000 employees worldwide, we continuously innovate to deliver advanced technologies that help our customers meet their ESG objectives and accelerate their sustainability journey.

By pioneering the use of renewable and sustainable materials as alternatives to non-renewable resources, Beontag serves as a key ESG enabler across customers' value chains. Our solutions connect physical items with digital intelligence, enabling end-to-end visibility, enhanced operational efficiency, and full traceability throughout the product lifecycle.

Through actionable data and real-time insights, we empower organizations to optimize processes, reduce waste, improve resource utilization, and make informed decisions that lower their environmental impact and support long-term sustainable growth.

RFID and IoT Applications – benefits for Automotive Industry

In a car manufacturing environment, operational continuity and system reliability are critical. Industrial-grade short-range wireless IoT solutions from Beontag are used when reliability is a primary requirement.

Beontag's product portfolio includes industrial-grade **BLE beacons**, **RAIN RFID**, and **HF/NFC tags and labels**, developed in collaboration with leading automotive manufacturers.

These solutions support smart manufacturing use cases, including:



WIP

in demanding environments



Car body manufacturing

with high temperature and chemical exposure



Parts and components tracking



Container tracking

(plastic and metal)



Outbound distribution



Customer-specific manufacturing processes

Product authentication to combat counterfeits

How can an organization ensure that warranties are correctly supported? How can assembly teams confirm that the right parts are used? What happens if subcontractors introduce incorrect components or rely on counterfeit spare parts?

When building a secure operational structure, the risk of compromising safety or compliance needs to be addressed with robust identification and authentication mechanisms.

Trusted Product Identification & Authentication (NFC)



Simple & intuitive access

- NFC works with everyday smartphones
- Reading is operationally straightforward
- Requires clear guidelines for contractors & shop-floor operators

01100
10110
11110

Unique identity at item level

- NFC tags/labels store unique electronic identifiers (IC UIDs)
- Each tag corresponds to a specific item
- Enables consistent identification across processes



Traceability across the supply chain

- IC UID supports end-to-end traceability
- Tracks parts and components reliably during movement and handling



Security by Design

- Built-in NFC security features support authentication of parts/components
- Helps validate authenticity and reduce risks associated with incorrect or counterfeit items

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GRAVITY
family



ORBIT
family



STEELWAVE
MICRO II NFC



IRONSIDE
MICRO NFC

Prototype parts management

Prototype and component management can be implemented efficiently using **RAIN RFID**. Automotive manufacturers use reliable RFID solutions to confirm the exact components included in prototypes during test campaigns.

RAIN RFID supports tracking the prototype's movement—e.g., when it is transferred between a parking area and testing locations. In addition, **BLE** can be used to identify the vehicle's real-time location.

Prototype testing introduces operational complexity because activities may take place across multiple sites, both on and off the primary facility, including road and laboratory environments. Engine testing is only one part of

the overall process: it is often coupled with large assemblies comprising hundreds of components and multiple testing combinations.

Given the importance of new model development and high quality expectations, a dedicated prototype components tracking and identification system is required. Beontag tags and labels are designed for demanding manufacturing conditions where chemicals, impacts, and high temperatures are present. System reliability is anchored in the robustness of the underlying RAIN RFID technology. The performance of Beontag RAIN RFID tags and BLE beacons can be designed and optimized per application.

REQUIREMENTS

Various memory requirements

Demanding environment

Different component sizes

Reliable reading

BEONTAG SOLUTION

For automotive we offer also high-memory IC options to accommodate all encoding schemes, such as VDA.

Our portfolio consists of purpose-build tags, including paint shop compliant tags with temperature resistance up to 250C and tags for metal-heavy environments.

Options in tag footprint enable also tracking the smaller automotive components.

Reliability in reading comes from tag read range and mechanical durability. These are considered for our automotive product portfolio.

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Intelligent parts replenishment



Automated eKanban processes can use RAIN RFID solutions in which each eKanban label includes an RFID tag. When replenishment is triggered, the event can be transmitted in real time to the system, improving both accuracy and speed for just-in-time parts management.

This approach can also reduce costs by limiting manual ordering and reducing reliance on large inventory buffers. Real-time visibility improves both internal and external supply chain

execution: smaller batch ordering becomes easier, and suppliers can label parts at their origin, enabling straightforward follow-up workflows such as shelving at the vehicle manufacturer's warehouse.

Implementing RAIN RFID-based eKanban requires tag solutions adapted to different process steps and to various load carrier variants, including metal or ESD load carriers. In such cases, a dedicated RFID tag design is required.

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Supply chain management & container visibility

Outbound logistics and container management benefit from RAIN RFID tracking. RFID tags or labels can be applied directly to components, to containers—or to both.

When parts pass through a reader station, the system can automatically identify each item's identity and serial number.

Beontag industrial-grade tags and labels support tagging workflows across diverse processes and environmental conditions. Tag features can be optimized to withstand washing, chemicals, and impacts. When needed, tags and labels can also include human-readable visual data for operational convenience.

Since metal surfaces can affect RFID antenna performance, on-metal label solutions are used to ensure reliable read performance and straightforward implementation. Such labels can be provided in reel format and printed as needed.

Different form factors and feature sets enable tagging across a wide range of surfaces and materials. Because the RFID IC is secured within the tag structure, failure modes related to damaged unreadable barcode labels are less relevant for RFID labels.

For containers with long operational lifecycles, encapsulated RFID hard tags can improve investment efficiency by reducing missing-asset occurrences. For high-volume items (e.g., cardboard boxes), disposable RFID labels can simplify labeling operations.

Supply chain management and container visibility are among the most common RAIN RFID applications in process industries because benefits are straightforward to achieve: fewer missing assets, fewer recurring inventories, and accurate identification when RFID-tagged items arrive and depart facilities or work stations.

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Production control

Industrial-grade, robust passive RAIN RFID tags are designed to withstand the harsh conditions of automotive manufacturing—from the body shop through final assembly. The emphasis is not only on durability, but also on operational reliability and consistent process performance.

With a RAIN RFID real-time production monitoring capability, relevant manufacturing data can be made continuously available, such as body number, color, and production status. During paint shop operations—where bodies undergo chemical and coating exposure followed by baking—RAIN RFID body tags can replace legacy multi-technology

identification approaches, supporting a leaner and more integrated process.

With dedicated automotive RAIN RFID suppliers such as Beontag, performance characteristics and process results can be continuously evaluated and improved through tag and process optimization. In cases where unique manufacturing steps require specialized products, Beontag's design and customization services support development of tailored short-range wireless components, including thorough material knowledge and testing—often with product innovations based on a deep understanding of the manufacturing process and quality expectations.

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Outbound logistics

Efficient vehicle distribution requires **accurate identification and real-time visibility throughout the outbound logistics process.**

RAIN RFID distribution labels can be automatically applied to finished vehicles directly at the factory, eliminating manual handling and reducing the risk of identification errors. Designed to withstand outdoor exposure, transportation conditions, and changing weather, these labels remain reliable throughout the vehicle shipping journey while allowing clean removal when no longer needed.

By linking each vehicle to a unique digital identity, manufacturers and logistics providers can **automate loading verification processes** and gain immediate confirmation that the correct vehicle is being assigned to the correct transport asset—whether truck, railcar, or vessel. RFID portals positioned at loading gates or shipment checkpoints can automatically verify vehicle movements **without requiring**

line-of-sight scanning, helping accelerate dispatch operations and reduce bottlenecks. The value of real-time vehicle visibility has been demonstrated across automotive logistics environments. At **Saturno Trasporti**, an **RFID-based vehicle tracking solution enabled operators to identify vehicle locations instantly, reducing the time spent searching for vehicles and improving overall yard efficiency.** Real-time tracking data also minimized manual data-entry errors and provided greater operational control across thousands of vehicles moving through the logistics process.

Similarly, **Ford implemented a RAIN RFID-based vehicle identification system** at its Cologne vehicle distribution center, **enabling automated vehicle verification throughout outbound logistics operations.** The solution improved shipment accuracy, increased vehicle throughput, and enhanced visibility across

Key benefits



Automated vehicle identification and shipment verification



Reduced loading errors and manual intervention



Faster vehicle dispatch and transport operations



Real-time visibility of vehicle location and status



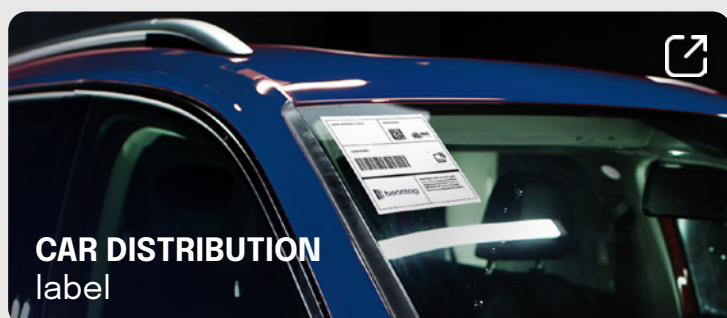
Improved logistics efficiency and traceability across the distribution network



Reliable performance in outdoor and harsh operating environments

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Tire traceability

Integrating **embedded Ultra-High Frequency (UHF) RFID technology** into tires during the vulcanization process creates an unalterable, durable **digital identity** capable of surviving extreme thermal and mechanical stress. By serving as a permanent data carrier, embedded RFID enables unprecedented operational transparency across the entire tire lifecycle.

On the factory floor, this technology streamlines **automated manufacturing workflows** and ensures precise **track-and-trace** monitoring during assembly.

As tires move into the supply chain, high-speed, touchless bulk reading drastically accelerates warehouse handling, automated audits, and overall **distribution efficiency**. Once in service, embedded tags continue to deliver value by enhancing fleet maintenance tracking, safety compliance, and real-time asset visibility. Finally, at the end of the product's life, this persistent identity provides the verifiable data required to meet evolving regulatory mandates—such as the **EU Digital Product Passport (DPP)**—while optimizing rubber recycling and driving circular economy initiatives.

Key benefits



Enhancing rubber recycling process



Traceability throughout full lifecycle



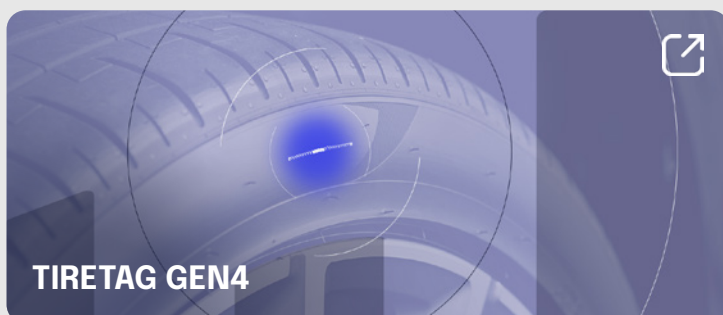
Improved logistic and inventory workflow



Reliable data carrier to meet DPP requirements

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Case Studies



Michelin: RFID-Enabled tires for full lifecycle traceability

As the automotive industry moves toward greater sustainability, regulatory compliance, and supply chain transparency, tire manufacturers are increasingly seeking technologies that provide visibility throughout the entire product lifecycle. To address these challenges, embedded UHF RFID technology has emerged as an effective solution for enabling reliable identification and traceability from manufacturing through retreading and end-of-life recycling.

Following years of development, testing, and validation across the industry, highly durable RFID-enabled tire solutions have been designed to withstand the demanding conditions of real-world operation while supporting future Digital Product Passport requirements. Michelin is among the manufacturers that have adopted RFID technology to enhance tire traceability and lifecycle management.

Millions of tires

Commercial and passenger tires enabled with embedded RFID technology

Up to

1 Million km

Reliable performance throughout the tire lifecycle, including retreading

Full lifecycle visibility

From manufacturing to recycling

Years

of experience in embedded RFID

By leveraging Beontag's embedded RFID technology, Michelin achieves seamless traceability across every stage of the tire lifecycle. The technology ensures reliable identification, supports automated data capture, and provides complete visibility from production through end-of-life management.

Business Impact

CHALLENGE

RFID-ENABLED OUTCOME

Product traceability

Unique tire identification

Operational efficiency

Automated tire tracking in production and throughout the whole supply chain

Sustainability requirements

Digital Product Passport enabled through RAIN RFID

Circular economy initiatives

Reliable RAIN RFID performance throughout tire lifecycle

Partner Perspective



RFID technology in tires plays a pivotal role in optimizing operations and enhancing efficiency. This system enables precise, automated tracking of each tire from production to retreading or recycling.

Laurent Couturier
RFID System Designer, Michelin

Michelin

Volvo Cars: Enabling Smart Manufacturing with RFID

As vehicle customization continues to increase, automotive manufacturers face growing challenges in managing complex production environments. Multiple vehicle models, customized configurations, and tightly synchronized assembly processes require reliable identification and tracking systems capable of maintaining visibility throughout production. To support its smart manufacturing initiatives, Volvo Cars implemented passive RAIN

RFID technology to uniquely identify and track vehicle bodies from the welding shop through paint operations and final assembly. The solution replaced multiple legacy identification systems with a single RFID platform capable of withstanding the harshest conditions of automotive production, including chemical treatments, paint application, and high-temperature curing processes.

One RFID solution

Replacing multiple identification technologies across production

High-temperature resistant

Reliable operation through paint and curing processes

Complete production tracking

From welding and paint shop to final assembly

Lean manufacturing support

Improved efficiency through automated identification and tracking



Business Impact

CHALLENGE	RFID-ENABLED OUTCOME
Complex product mix management	Unique vehicle identification and WIP visibility
Multiple tracking technologies	Single RAIN RFID solution across production
Production bottlenecks and waiting times	Real-time production flow visibility
Rework and process inefficiencies	Improved process accuracy and reduced rework
Customer-specific configurations	Correct vehicle-to-order matching
Harsh paint shop environment	Reliable tag performance under extreme conditions

Engineering for Extreme Conditions

Designed for **harsh paint shop environments**, RFID tags maintain reliable performance through **chemical treatments, paint application, and high-temperature curing processes**, ensuring **continuous vehicle traceability**.



TDM: RFID-Based Validation of Critical Safety Components

As vehicle platforms become increasingly complex, manufacturers require reliable methods to verify that critical safety components are correctly installed throughout the production process. For Troy Design & Manufacturing (TDM), a wholly owned Ford subsidiary specializing in prototype and production vehicle assemblies, manual verification methods were no longer sufficient to ensure complete traceability and quality control.

To address this challenge, TDM implemented an RFID-based validation system capable of uniquely identifying safety-critical components, capturing installation data, and verifying correct assembly even when components are no longer visible to operators. The solution provides automated quality assurance throughout production while integrating seamlessly with existing manufacturing systems.

100% read accuracy

Detects incorrect or missing component installations

120°C resistance

Validated for extended exposure to heat, vibration, and humidity

Automated build verification

Detects incorrect or missing component installations

496-bit EPC memory

Supports storage of component-specific identification data

Business Impact

CHALLENGE	RFID-ENABLED OUTCOME
Hidden safety components	Non-line-of-sight component verification
Risk of assembly errors	Automated build validation
Manual inspection processes	Reduced manual checks and paperwork
Complex RFID environment	Selective reading of targeted components
High-density tag environments	Accurate tire lifecycle records
Traceability requirements	Component-to-vehicle installation records
Potential repair costs	Early detection of mis-builds

Partner Perspective

Tagging these critical safety components has enabled a quality control process that verifies correct, or incorrect builds of these components

Diana Pardo
IT Analyst, TDM

TDM

Goodpack: Global RFID Visibility for Returnable Transport Assets

Managing millions of returnable transport assets across hundreds of facilities worldwide requires accurate, real-time visibility. For Goodpack, the world's leading provider of intermediate bulk containers (IBCs), traditional barcode-based tracking no longer provided the reliability needed to efficiently monitor asset movements, utilization, and availability across its global network.

To improve operational visibility and automate asset management, Goodpack implemented an RFID-based tracking system across its IBC fleet. The solution enables real-time monitoring of container movements, improves asset utilization, reduces losses, and supports accurate customer billing based on actual asset usage.



Business Impact

CHALLENGE	RFID-ENABLED OUTCOME
Limited visibility across global operations	Real-time tracking of assets worldwide
Manual administration processes	Increased automation and operational efficiency
Underutilized asset pool	Improved container utilization
Asset loss and theft risks	Enhanced tracking and accountability
Barcode wear and readability issues	Reliable RFID identification in harsh conditions
Complex customer billing	Accurate usage based invoicing
Inventory uncertainty	Precise visibility into asset availability

Built for Harsh Logistics Environments

The RFID tags were specifically selected to withstand the demanding conditions experienced by **returnable metal containers**. Mounted directly on galvanized steel IBCs, the tags deliver **reliable performance despite exposure to rough handling, outdoor environments, and continuous transportation cycles**.

Combined with RFID gates and handheld readers, the solution enables **accurate identification throughout the logistics network** while supporting long-term durability requirements.

Goodpack

CHEP: Achieving Real-Time Visibility Across Returnable Asset Networks

Managing millions of returnable containers across global supply chains requires accurate data, reliable asset identification, and continuous visibility. To help customers monitor assets throughout multiple operational processes, CHEP developed CHEP-TRAC, an RFID-enabled tracking service designed to provide real-time visibility and control over returnable transport assets.

To support this initiative, CHEP partnered with Beontag to develop highly durable RFID tags capable of surviving years of use, harsh manufacturing environments, and repeated cleaning cycles. The result is a tracking solution that enables customers to monitor assets anywhere in the value chain while improving data accuracy and operational efficiency.

Millions of containers

Tracked throughout the supply chain

Built for years of use

Designed to withstand harsh cleaning and operational environments

Anywhere, anytime

Cloud-based visibility across multiple locations

4-in-1 identification

RFID, barcode, Data Matrix, and numeric identifiers

Business impact

CHALLENGE	RFID-ENABLED OUTCOME
Limited visibility of returnable assets	Real-time asset tracking
Asset loss and damage	Improved accountability and control
Data inconsistencies	Increased data integrity
Manual asset management	Automated asset visibility
Operational bottlenecks	Faster decision-making and process flow
Harsh cleaning environments	Long-lasting RFID performance
Complex supply chains	End-to-end traceability

Built for long-term asset management

The RFID tags were engineered to remain **attached and fully operational over years of use**, even when exposed to repeated cleaning cycles, rough handling, and challenging industrial environments.

By combining durable RFID identification with cloud-based asset management, CHEP created a **scalable solution that supports visibility, traceability, and operational efficiency** across its global returnable asset network.



Saturno Trasporti: real-time vehicle visibility for automotive logistics yards

Managing thousands of vehicles across large logistics compounds requires accurate location data and efficient processes. For Saturno Trasporti, one of Italy's leading vehicle logistics providers, manually tracking vehicle locations created inefficiencies, increased the risk of human error, and often resulted in time-consuming searches across multiple storage areas.

To improve operational visibility, Saturno implemented an RFID-based intelligent parking solution developed by TechSigno using Beontag RFID technology. The system provides real-time vehicle location information, enabling operators to quickly identify, move, and manage vehicles throughout the processing workflow.



Business impact

CHALLENGE	RFID-ENABLED OUTCOME
Manual vehicle location tracking	Automated location management
Human data-entry errors	Improved data accuracy
Time spent searching for vehicles	Faster vehicle retrieval
Lack of real-time visibility	Live vehicle positioning
Multiple storage areas	Centralized yard visibility
Administrative workload	Reduced manual processing
Vehicle movement tracking	Complete location

Built for outdoor logistics operations

The RFID tags were **embedded directly into parking spaces** throughout the yard and engineered to withstand continuous exposure to weather, heavy vehicle traffic, and demanding operational conditions.

Combined with handheld RFID readers and cloud-based software, **the solution provides reliable location identification** while preventing unintended reads from neighboring parking spaces.

