

# WHITE PAPER

Industrial  
Logistics and Asset Management



# Delivering Accurate and Automated Inventory Tracking

## Speed warehouse throughput with the Intel® RFID Sensor Platform

“We challenged Intel to provide 100 percent quality in process flow. Otherwise, the application would have zero chance of succeeding in a high-standard logistic environment as ours. And this is what they achieved, opening the gateway to limitless development and implementation.”

—Ruud de Groot, site manager,  
DHL Supply Chain, Benelux

The speed of commerce today means that logistics and shipping companies must respond with faster throughput times while lowering costs to squeeze more from already narrow profit margins. Inventory registration and management in warehouse operations is one area that's ripe for improvement, due to the highly labor-intensive nature of the tasks and the need for real-time updates, accuracy, and security. While warehouse management technologies account for more than USD 2.7B in global spending,<sup>1</sup> most inventory registration, validation, and booking procedures (91 percent) are still performed manually.<sup>2</sup>

Recently, global shipping and logistics company DHL tested an Intel®-based RFID inventory input and tracking solution, the Intel® RFID Sensor Platform (Intel® RSP), at one of its major warehouse facilities, achieving more than 99 percent accuracy and the following results:

- High inventory registration and visibility
- Low capital and operating costs
- Ability to scale with changing needs
- Easy-to-deploy components with minimal staff training

### A solution for warehouse operations

For shipping and logistics companies, many tasks are still performed by human operators. Inventory registration, used in warehouses, distribution centers, or storage facilities, refers to when a product tag is validated against the actual physical item to determine its presence and location. Registration can happen at several points within a facility. For example, when a warehouse receives a shipment, registration occurs when each item is logged manually into the inventory management system. Workers also visually inspect product quality and quantity and then place the products in a staging area for the next process. Errors associated with human-assisted tasks related to registration can account for up to 5 percent of inventory inaccuracy downstream of the process, resulting in wasted hours of reconciliation.

Although DHL's existing inventory management system was already operating well with a high level of efficiency and accuracy, the company pilot tested the Intel®-based solution to optimize operations in several areas:

- **Warehouse management.** Derive greater value from IT-assisted inventory registration and booking for inbound and outbound procedures.
- **Quality improvement.** Reduce human error throughout the supply chain, both in inventory volumes and parts recognition.
- **Availability.** Improve dock-to-stock performance with always-on, always-ready automated processes.

## INTEL® RFID SENSOR PLATFORM (INTEL® RSP)

### Hardware:

- Intel® RSP Sensors (version 9003-1-02)
- Aruba 2920 24G Power-over-Ethernet (POE) switch
- Intel® edge compute device in mini desktop form factor
- Mobile/Wi-Fi routers to assist with connectivity without needing to tap into the warehouse network

### Software:

- Intel® edge compute device and sensor firmware 2.2
- Intel® RSP Software Toolkit
- Custom-built user interface (for pilot purposes only)

## Pilot study description

The pilot study was conducted at the 120,000-square-meter DHL Supply Chain facility in Beringe, Netherlands, a part of the Benelux region. In this region, DHL Supply Chain has 20 facilities serving more than a hundred major clients in a variety of sectors, including automotive, healthcare, chemical, and technology. The Beringe Campus is a major hub for EMEA returns, warranties, and order fulfillment.

DHL Supply Chain and Intel partnered to pilot the Intel RSP, focusing on one specific warehouse return-flow process. The technology was implemented to provide automation while meeting accuracy requirements and capturing inventory movements across the entire process, from receiving to put-away.

The pilot study tracked the movement of inventory ranging from small (6 x 3 x 3 in.) to large (24 x 12 x 12 in.) boxes from the receiving dock to the put-away station. The flow process is described in the following photos.



**Station 1. Receiving and quality control** – Inventory is offloaded from inbound trucks and staged in a large open-floor area. DHL warehouse workers determine inventory condition by inspecting items one by one.



**Station 2. Inventory repackaging** – At this stage, an RFID tag is applied to the exterior of each box. Inventory is then placed on mobile shelves for temporary storage. *Intel® RSP Sensors detect the presence of tags.*



**Station 3. Inventory control** – Inventory is logged into the system and offloaded into large totes. An internal PO is created to track the tote. *Intel® RSP Sensors detect the presence of each tag as the item is placed into the tote.*



**Station 4. Staging** – Full totes are staged and await movement to the final process step. *Intel® RSP Sensors detect the presence of tags in the tote.*



**Station 5. Put-away station** – Totes are moved into this area, and inventory is taken out and an invoice against the PO is generated. Lastly, inventory is placed on conveyor belts for final storage. *Intel® RSP Sensors detect the presence of tags as items are offloaded from the tote.*

Stations 1 through 4 were located at one end of the warehouse, while Station 5 was located in a separate but connected facility about 300 meters away.

The pilot study ran for a week with a team of five project members. During the study, the team performed nine end-to-end runs processing approximately 950 boxes from Station 2 to Station 5. The team also used the output data from the Intel RSP Sensors to autogenerate the internal PO to match DHL's current process and run side by side with the existing system.

The pilot study tested how Intel RSP would perform in two major areas:

- **Read accuracy.** High inventory visibility is possible through product-tracking read accuracy. However, getting a proper read with RFID technology can be challenging because of high amounts of signal interference from sources such as metal, liquids, humans, and other obstacles in warehouses that block line-of-sight visibility. The read accuracy goal for the pilot study was 98 percent of all tags read at each station.
- **Timely event capture.** As tagged inventory was grouped together for Stations 3 through 5, it was crucial that the data be read and processed in a timely manner in order to adequately integrate with existing software. Thus, the goal was for zero downtime and 100 percent network connectivity.

## How the solution works

The solution is modular with plug-and-play equipment, consisting of one sensor at Station 2; two sensors at Station 3; one sensor at Station 5; and an edge compute device, POE switch, and mobile router in each facility (total of two). It took the DHL and Intel team about a week to set up, test, and configure the network cable drops; install and configure hardware and software; and mount the overhead sensors and position them for optimal reads. Before starting the pilot, the team conducted two end-to-end trial runs. The pilot study setup did not require modifications to the existing system or business processes. DHL supervisors and staff were trained on the minimal operational changes, such as tag placement.

### Key components of the Intel RSP:

- **Intel® RSP Sensor:** A low-cost and low-power sensor enables data ingestion from numerous sources in the warehouse in a simple, cost-effective manner. The sensor features an integrated RFID reader and antenna, which is designed to work in highly dense environments by providing up to 300 square feet of coverage per sensor at more than 600 tag reads per second.

- **Intel® edge compute device:** The edge compute device finds, configures, controls, and interacts with Intel RSP Sensors over Ethernet without third-party middleware. Based on Intel® Core™ i7 or Intel® Xeon® processors, the device connects to the cloud via the internet using a wired network, wireless, or 3G/LTE cellular network. Inventory location information can be processed by the device with the capacity for scalable data ingestion from multiple sensors, data compression and filtering, and near-real-time analytics at the edge. Limiting the amount of data transmitted to the cloud also helps reduce latency and costs.
- **Edge applications:** These applications assist with data ingestion from edge devices to the cloud, enabling rich analytics and remote management.

## Study results

Nine hundred fifty-four boxes were processed with a 99.2 percent read accuracy at Stations 2 and 3. Inventory at this part of the process was primarily static, located either on a workstation or mobile shelf. Station 5 processed 710 boxes at a 99.9 percent read accuracy. Inventory at this stage was mostly in motion and network connectivity was consistent throughout, even in a metal-heavy environment.

The accuracy results obtained from the pilot met DHL's quality expectations and validated the technology's expected value in a warehouse environment. With the Intel RSP, DHL can drive business process and system-level actions based on RFID detection. Further, the pilot proved how DHL can achieve higher operational efficiencies and process automation. And finally, the combination of high inventory accuracy and process automation from the Intel RSP enables DHL to continue delivering cutting-edge technology and improved services to their customers worldwide.

Based on these promising results, DHL is looking to use the Intel RSP in other areas of its Beringe Campus and in other warehouse locations.

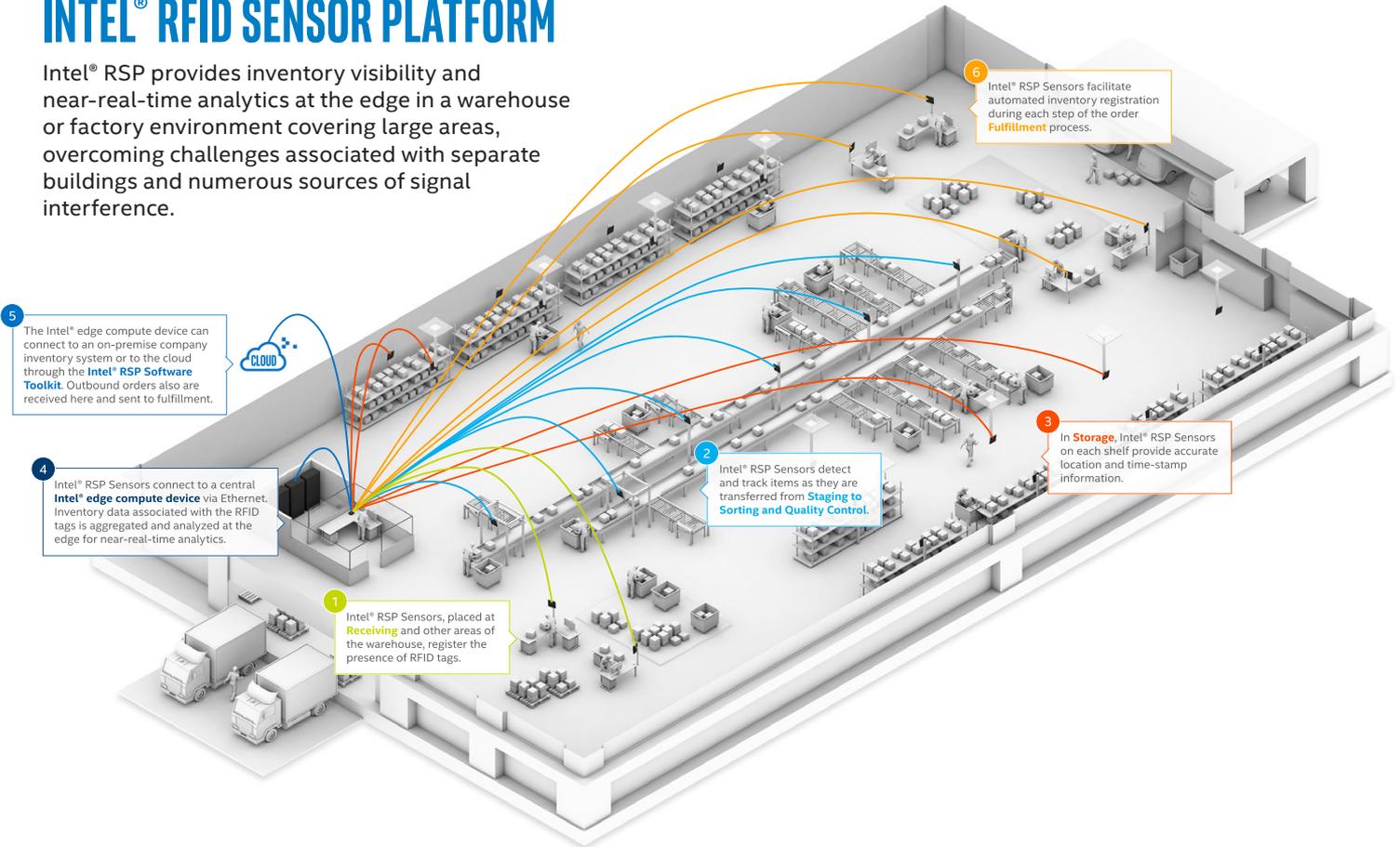
## Driving innovation together

Through their current work together on the Intel RSP, Intel and DHL are continuing a mutually beneficial partnership as part of a Vested Collaboration Agreement. Through this agreement, both partners are fostering innovation through state-of-the-art logistics solutions.



# INTEL® RFID SENSOR PLATFORM

Intel® RSP provides inventory visibility and near-real-time analytics at the edge in a warehouse or factory environment covering large areas, overcoming challenges associated with separate buildings and numerous sources of signal interference.



**Wide coverage:**  
Each Intel® RSP Sensor captures data within a range of up to 15 m<sup>2</sup> (160 ft<sup>2</sup>), tracking multiple items at one time.

**Timely event capture:**  
The Intel® RSP Sensors record how long an item remained at each station, providing useful data for process optimization or improved service-level agreements.

**Automation:**  
Actionable insights from the Intel® RSP Sensors decrease throughput time by eliminating manual inventory registration throughout the process flow.

**High read accuracy:**  
Intel® RSP Sensors are able to capture RFID data with > 99% accuracy.

## Learn more

To learn more about the Intel® RFID Sensor Platform, contact [SupplyChainIoT@intel.com](mailto:SupplyChainIoT@intel.com) or visit [intel.com/supplychainiot](http://intel.com/supplychainiot).

## About DHL Supply Chain

DHL Supply Chain is the leading global brand in the logistics industry and is part of Deutsche Post DHL Group, which generated more than €57 billion in revenue in 2016. The DHL family of divisions offers an unrivalled portfolio of logistics services ranging from national and international parcel delivery, e-commerce shipping and fulfillment solutions, international express, road, air and ocean transport, and industrial supply chain management. With about 350,000 employees in more than 220 countries and territories worldwide, DHL connects people and businesses securely and reliably, enabling global trade flows. DHL is decisively positioned as “The logistics company for the world.”



1. “Urban Logistics Opportunities—Last-Mile Innovation,” Frost & Sullivan, 2017, [store.frost.com/urban-logistics-opportunities-last-mile-innovation.html](http://store.frost.com/urban-logistics-opportunities-last-mile-innovation.html).  
2. “Building the Smarter Warehouse: Warehousing 2020,” Zebra, 2016, [zebra.com/content/dam/zebra\\_new\\_ia/en-us/campaigns/warehouse-visibility-campaign/research/warehouse-survey-2020-apac-en-gb.pdf](http://zebra.com/content/dam/zebra_new_ia/en-us/campaigns/warehouse-visibility-campaign/research/warehouse-survey-2020-apac-en-gb.pdf).

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