Intelligent Packaging with RAIN RFID

RAIN RFID Alliance
White Paper

V.1.0

May 2019

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Summary

Packaging with RAIN RFID tags embedded or attached, provides value to all categories of packaged goods throughout the supply chain.

In many applications, inventory management is the key driver for a Return on Investment (ROI). RAIN RFID's suitability for fast and/or automated inventory-taking helps avoid out-of-stock situations which can significantly improve the revenue in retail operations. In addition, the same system can reduce over-stocking, and ensure that older stock is consumed based on its sell-by-date, thus improving the bottom line.

Almost all companies shipping physical goods can benefit from RAIN RFID in their shipping/receiving process. An automated process cuts shipping errors, saves time, and reduces labour costs. The enabling RAIN RFID attribute is that it can penetrate stacks of cases, so identification can be conducted on pallets without opening-on-transfer during shipping. Similarly, it enables identification of items in boxes.

Other sources of ROI from Intelligent Packaging are, for example, authentication of goods, automated Point-Of-Sale (POS), unmanned retail, and Electronic Article Surveillance (EAS) – all can be implemented within the same system.

Strong development of the RFID industry during recent years has brought the technology to where benefits are far greater than costs. This means there is no reason to postpone implementations. RAIN RFID technology is mature and well standardized – this ensures the current investments can be leveraged far into the future.

Introduction

This white paper is an introduction to the topic of Intelligent Packaging. It covers the terminologies, most important applications, and expected future developments.

RAIN RFID

RAIN RFID is a highly evolved, globally deployed, wireless technology that connects billions of everyday items to the internet, enabling businesses and consumers to **identify**, **locate**, **authenticate,** and **engage** each item. An RFID system has three primary components – a tag associated with an item, a reader, and communications software on a computer that collects the information and makes it accessible locally or through the internet.

RAIN RFID Tags

- Are either attached to, or embedded in, items
- Tagged items store and send information
- Thousands can be identified simultaneously and do not have to be visible

RAIN RFID Readers

- Have antenna(s) for either short- or long-range communication
- Can be small and portable, or larger and installed, or embedded in other devices

RAIN RFID Software applications

- ***Identify* – *Locate* – *Authenticate* – *Engage***
- Use the tags and readers to create, collect, and use the item's data – locally, or on a server, or on a cloud
- Authentication starts with determining an item is genuine
- Engage can involve sensors, or other means of interacting with the item

For a more complete explanation please access the *What is RAIN?* E-Book that can be downloaded from the RAIN RFID Alliance webpage.

RFID and Packaging

Packaging provides five functions throughout its life, from filling to disposal:

1. Containment: Essential for powders, liquids, loose parts, sets, small packages …
2. Protection: Preventing damage from shock, wetting, humidity, light, heat …
3. Information: Names, SKUs, codes, use-by-dates, ingredients, instructions …
4. Utility: Designed for filling, pouring, counting, moving, storing, handling …
5. Promotion: Brand identification and advertising …

Modern packaging has evolved, so for nearly all these functions, there are affordable constructions, designs, and printing options that support a package through its supply chain and total life. And there is ongoing development in all areas to: improve performance, lower cost without performance loss, and increase value.

But two remaining problematic areas in the supply chain can be very costly:

- Losses and delays from being unable to identify or locate needed or saleable items.
- Perishable materials being spoiled or exceeding their safe life.

Avoiding the costly problems in the supply chain requires constant monitoring with exception handling, or frequent manual counting (itself not error-proof), which without RAIN RFID are affordable for only markets of extremely high value. RAIN RFID, by providing automated identification, is the only current practical and affordable solution.

Intelligent Packaging

Smart Packaging and Intelligent Packaging are often used interchangeably to describe RFID enabled packages. However, in this white paper we use more accurate terminology, where Smart Packaging includes both Intelligent Packaging and Active Packaging.

- Intelligent Packaging enhances the communication function of packaging by utilizing optical codes or RFID
- Active Packaging enhances the protection function of packaging by utilizing advanced materials and chemistry
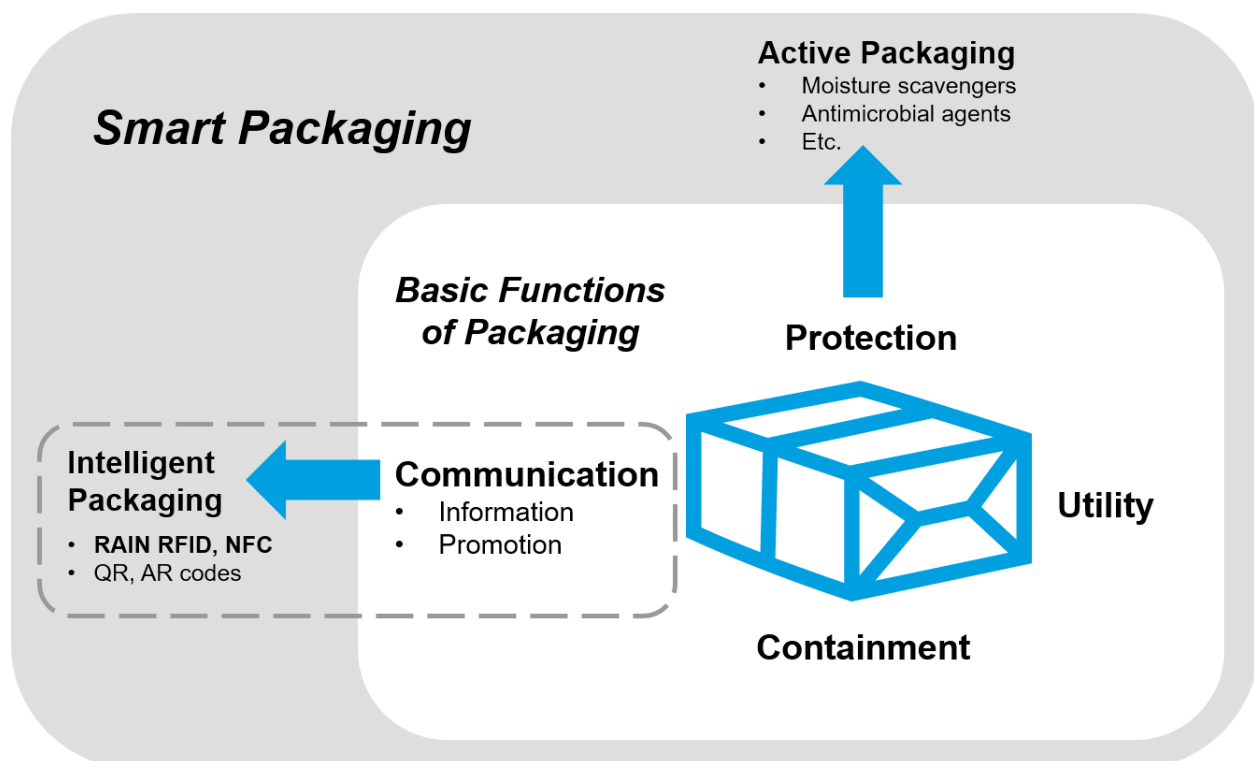
Intelligent Packaging electronically communicates information--including identification, batch number, shelf-life, or status, that can be carried by or in the package.

This comes in two forms:

Optical codes (such as bar and QR codes) which although capable of large quantities of data, can be read only optically (visually or by camera) so the item must be visible and located. These are extremely valuable, and greatly improve economy but only when items are going to be handled individually, such as on the retail shelf or through checkout. Optical codes are also easy to copy by printing.

RFID tags, which answer requests sent by a RFID reader sending back identity, status, temperature, or other data. They may be passive, functioning only on request, or powered and able to accumulate information.

Again, there are two varieties for packaging:

NFC RFID functions for single objects when the reader is within centimetres of the item, so its location is obvious. Consumers can query NFC via cell phones; hence it has value for consumer engagement and authentication.

RAIN RFID functions over distances of up to 20 metres without line of sight, through most packaging materials and with a speed of hundreds of items per second. Due to its unique properties, RAIN RFID has exceptional value in most use-cases requiring a high-level of automation and speed.

Advantages of RAIN RFID vs. NFC and Optical Codes

	RAIN RFID	NFC	Barcode/QR
Reading without line of sight	✓ (metres)	✓ (centimetres)	X
Embeddable into/inside package	✓	✓	X
Read speed in production line	✓ hundreds per sec	1 item at a time	1 item at a time
Read/write capability	✓	✓	X
Tamper detection	✓	✓	X
Security	✓	✓	X
Connection to sensors and LEDs	✓	✓	X

Intelligent Packaging Use-Cases

Imagination is the limit for Intelligent Packaging applications. Most products are transported in packaged form, and many parts of the supply chain can benefit from automated and individual identification of the products. Often implementations combine various use-cases because once an investment in infrastructure and tags has been made, it requires relatively low additional cost to deploy further use-cases.

> **RAIN RFID**
>
> The only practical and affordable intelligent packaging solution.

Use-case 1: More frequent inventorying leading to less out-of-stocks and higher sales revenue

A well proven use-case in global retail environment is using RFID to perform more frequent inventory taking of products in the shop floor. Increased visibility into inventory drives improved replenishment of products available for customers, which again improves sales significantly. The system can be extended to include RAIN RFID operated self-checkout and Electronic Article Surveillance (EAS) functionalities. Furthermore, improved visibility is a pre-requisite for omni-channel retail where each store can also act as delivery point for online purchases (a process which can be further optimized with RAIN RFID system). This use-case is also valid for packaged goods, such as under- garments, cosmetics and accessories.

Public examples: Decathlon Group, Marks & Spencer, Nespresso (self-checkout), XXL (omni-channel)

Use-case 2: Shipment/receiving process automation leading to reduced errors and higher efficiency

Almost all companies shipping physical goods can benefit from RAIN RFID in their shipping/receiving process. An automated process cuts shipping errors, saves time, and reduces labour costs. As previously stated, RAIN RFID can penetrate stacks of cases, so identification of the contents of a pallet does not require opening boxes on transfer during shipping. Granularity of the system can be easily increased by adding reading points also within manufacturing or warehousing operations.

Public examples: Toshiba, XXL, US Defense Logistics Agency (DLA), Hanmi Pharmaceutical

Use-case 3: A device authenticating consumables and adjusting process accordingly

Many equipment manufacturers have business models where majority of the revenue and profitability comes from consumables rather than the equipment itself. RAIN RFID can elevate this solution as equipment with an embedded RFID reader can automatically identify and authenticate RFID tagged consumables and adjust equipment parameters based on the identification number (including SKU information).

Public examples: Coca-Cola (Freestyle soda dispenser / tagged syrup packages), Keurig (coffee machine / tagged pods), Hewlett-Packard (Ink-jet printers/ tagged ink cartridges)

Use-case 4: Automated real-time inventorying and optimized replenishment via Intelligent VMI

A Vendor-Managed Inventory (VMI) solution can be automated and have real-time information by tagging the packages of the items in VMI storage and equipping the storage space with RFID reading capability and network connection. Such a model provides many benefits both for the end-user and the product provider. The end-user does not need to handle or carry inventory, or worry about over/under stocking, The product provider will increase customer loyalty and can fully optimize the replenishment process. This model is becoming especially successful in hospitals and laboratories, and it can also be deployed very successfully in factories and warehouses.

Public examples: Health Consortium of Anoia, Medacta USA, Paul & Co.

Future

RAIN RFID technology keeps evolving and new applications and related new business models will emerge and make an impact to various industries. In addition to new applications, also technological improvements will be made, and sustainability will become more and more important.

New Applications

One such emerging new application with high potential is unmanned retail for packaged consumer goods such as snacks, drinks and food. This includes RAIN RFID operated supermarkets, kiosks and fridges. Payment is typically implemented via mobile payment applications. This application improves the availability of a retailer's offering by being open 24/7 and being very flexible with placement to various locations such as office buildings, petrol stations, shopping malls etc. A

dramatic increase in availability can increase both revenue and margin. Besides unmanned retail, RAIN RFID use-cases related to perishable food are expected to increase dramatically in the future. RAIN RFID provides unbeatable features for this end-use area, as it gives unique identity for each item and automates reading events. When combined, these features facilitate effective management and control of expiry dates. Possibilities for reducing food waste are enormous. Currently RAIN RFID is mainly used to give each object an individual identity and to communicate it wirelessly to a central database. In the future, various sensor technologies can be added to the same system via RFID sensor tags. There is already an existing customer need for recording sensored product data, via sensor tags attached to packaging. However, until now the cost level of tags capable of data logging has been preventing wide-scale use. As this obstacle is being removed, this application area will see significant growth assuming the sensor tag disposal/reuse after use will be sustainably arranged.

Customer shops unmanned convenience store in Wuhan, China

One of the currently biggest limitations of RAIN RFID is that consumers are not able to interact with it (like with NFC or QR codes). As the use of RAIN RFID keeps on increasing in consumer facing applications, this is expected to change. It is a matter of time before RAIN RFID reading capability will be implemented into mobile phones. When this happens, a RAIN RFID tagged package is a natural communication channel between the brand and the consumer.

Sustainability and Technology

Today, the largest end-use application for RAIN RFID is retail. As consumers globally expect more and more sustainability, retailers have almost unanimously started to emphasize environmental friendliness. This megatrend is therefore also influencing the RAIN RFID industry. Sustainability in RFID is relevant for the companies producing RFID consumables such as tags, labels and tagged packages. Sustainability includes the environmental influences of the product throughout its life-cycle. For RFID consumables this means that future products should be optimized not only for their materials and manufacturing processes, but also for the end-of-life processes whether it is incineration, composting, or recycling with paperboard waste.

It is expected that in the future, RFID tag materials will evolve from polyester towards fibre-based, non-fossil substrates and from epoxies to less harmful adhesives. Antenna processing methods will likely shift from chemical etching towards dry and additive methods such as printing or cutting. Microchips will get smaller, which means their environmental impact will reduce. Tags may become more integrated with the package, eventually leading into a process where the only additional materials applied onto the package are the antenna conductor and the IC. If this process is done onto the middle layer of the package wall structure, the tag will be embedded which can provide additional benefits such as protection, anti-tampering, and authentication. Today production processes for integrated or embedded RFID packages are not yet economically viable, so the label format-based production and application process still prevails.

How to get started

In summary, RAIN RFID provides unique capabilities for automated identification of packaged goods in multiple applications. Technology is now mature, standardized, and widely used. To learn more and get started, contact the RAIN RFID Alliance or its member companies.

ABOUT RAIN RFID ALLIANCE

The RAIN RFID Alliance is an organization supporting the universal adoption of RAIN UHF RFID technology. A wireless technology that connects billions of everyday items to the internet, enabling businesses and consumers to identify, locate, authenticate and engage each item. The technology is based on the EPC Gen2 UHF RFID specification, incorporated into the ISO/IEC 18000-63 standard. For more information, visit www.RAINRFID.org. The RAIN Alliance is part of AIM, Inc. AIM is the trusted worldwide industry association for the automatic identification industry, providing unbiased information, educational resources and standards for nearly half a century.

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