

# ***Pallet Technologies***

## ***RFID Overview***

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# **RFID Overview**

RFID (Radio Frequency Identification) - At its most basic level, it identifies unique objects, processes, transactions or events. RFID does this by using a burst of radio waves to move information, much like carrier pigeons were used to move information from point to point centuries ago.

# **RFID Overview**

It is a surprisingly simple communications architecture since only two basic building blocks are needed - A Tag and a Reader.

Of course, they are configured in sophisticated ways to create large networks capable of staggering data flows.

Like any story there are a number of supporting cast of characters such as: Antennas, Computer Systems, etc.

## Tags

...RFID systems include electronic devices called transponders or tags which may be simplified to being a microchip, memory and an antenna. Microchips are the brains for the Tag. Information which is sent or received from the radio waves is then stored or recalled from the memory. The antenna has only one task to do;

## Tags

RFID tags come in a wide variety of size, shapes and forms but have common attributes, such as: low-energy transmit and receive antennas, data storage and operating circuitry. Tags come with and without batteries; they can be read only or read/write.

## Antennas

The Antenna handles communication from either the Tag to the Reader or from the Reader to the Tag. Think of the antenna as a language translator converting digital data into radio wave energy or vice-versa.

## Antennas

A Tag physically attaches to something thereby allowing its location, condition or status to be tracked via information sent using radio waves. Decoding of a Tag occurs when it enters the antennas read zone. By definition, we define a read zone as the sweet spot of the antenna where radio waves may be sent and received in such a way that reliable communications take place between the Tag and the Reader.

## Readers

Reader electronics are stationary or handheld similar to bar code scanners. They are linked to other software systems that control the flow of data. In passive RFID systems, the reader must power, engage, download and retransmit data to the tag they encounter..

## *Technologies Active RFID System*

Active RFID and Passive RFID technologies, while often considered and evaluated together, are fundamentally distinct technologies with substantially different capabilities.

## *Technical Characteristics of Active and Passive RFID*

Although they both fall under the “RFID” moniker and are often discussed interchangeably, Active RFID and Passive RFID are fundamentally different technologies. While both use radio frequency energy to communicate between a tag and a reader, the method of powering the tags is different.

## **Technical Characteristics of Active and Passive RFID**

Active RFID uses an internal power source (battery) within the tag to continuously power the tag and its RF communication circuitry, whereas Passive RFID relies on RF energy transferred from the reader to the tag to power the tag.

While this distinction may seem minor on the surface, its impact on the functionality of the system is significant. Passive RFID either 1) reflects energy from the reader or 2) absorbs and temporarily stores a very small amount of energy from the reader's signal to generate its own quick response.

## **Technical Characteristics of Active and Passive RFID**

In either case, Passive RFID operation requires very strong signals from the reader, and the signal strength returned from the tag is constrained to very low levels by the limited energy.

On the other hand, Active RFID allows very low-level signals to be received by the tag (because the reader does not need to power the tag), and the tag can generate high-level signals back to the reader, driven from its internal power source.

## *Technical Characteristics of Active and Passive RFID*

Additionally, the Active RFID tag is continuously powered, whether in the reader field or not. As discussed in the next section, these differences impact communication range, multi-tag collection capability, ability to add sensors and data logging, and many other functional parameters.

## *Passive RFID*

For Passive RFID, the communication range is limited by two factors:

- 1) the need for very strong signals to be received by the tag to power the tag, limiting the reader to tag range, and...
- 2) the small amount of power available for a tag to respond to the reader, limiting the tag to reader range. These factors typically constrain Passive RFID operation to 3 meters or less. Depending on the vendor and frequency of operation, the range may be as short as a few centimeters.

## **Functional Capabilities of Active and Passive RFID**

As a direct result of the limited communication range of Passive RFID, collecting multiple collocated tags within a dynamic operation is difficult and often unreliable. An example scenario is a forklift carrying a pallet with multiple tagged items through a dock door. Identifying multiple tags requires a substantial amount of communication between the reader and tags, typically a multi-step process with the reader communicating individually with each tag.

## **Functional Capabilities of Active and Passive RFID**

Each interaction takes time, and the potential for interference increases with the number of tags, further increasing the overall duration of the operation. Because the entire collection operation must be completed while the tags are still within the range of the reader, Passive RFID is constrained in this aspect. For example, one popular Passive RFID systems available today requires more than 3 seconds to identify 20 tags. With a communication range of 3 meters, this limits the speed of the tagged items to less than 3 miles per hour.

## **Functional Capabilities of Active and Passive RFID**

Active RFID has neither constraint on power and can provide communication ranges of a quarter mile. Active RFID is able to collect thousands of tags from a single reader. Additionally, tags can be in motion at more than 100 mph and still be accurately and reliably collected. One functional area of great relevance of the Active RFID system to many supply chain applications is the ability to monitor environmental or status parameters using an RFID tag with built-in sensor capabilities. Parameters of interest may include temperature, humidity, and shock, as well as security and tamper detection.

## **Functional Capabilities of Active and Passive RFID**

Because Passive RFID tags are only powered while in close proximity to a reader, these tags are unable to continuously monitor the status of a sensor. Instead, they are limited to reporting the current status when they reach a reader.

Active RFID tags are constantly powered, whether in range of a reader or not, and are therefore able to continuously monitor and record sensor status, particularly valuable in measuring temperature limits and container seal status. Additionally, Active RFID tags can power an internal real-time clock and apply an accurate time/date stamp to each recorded sensor value or event.

## *Functional Capabilities of Active and Passive RFID*

Both Active and Passive RFID technologies are available that can dynamically store data within the tag. However, because of power limitations, Passive RFID typically only provides a small amount of read/write data storage, on the order of 128 bytes (1000 bits) or less, with no search capability or other data manipulation features.

## **Functional Capabilities of Active and Passive RFID**

Larger data storage and sophisticated data access capabilities require the tag to be powered for longer periods of time and are impractical with Passive RFID. Active RFID has the flexibility to remain powered for access and search of larger data spaces, as well as the ability to transmit longer data packets for simplified data retrieval. Active RFID tags are in common use with 128K bytes (1 million bits) of dynamically searchable read/write data storage.

## **Applicability of Active and Passive RFID to Supply Chain Asset Management**

Based on the functionality provided by each technology, Active and Passive RFID address different, but often complementary, aspects of supply chain visibility. Passive RFID is most appropriate where the movement of tagged assets is highly consistent and controlled, and little or no security or sensing capability or data storage is required.

## *Applicability of Active and Passive RFID to Supply Chain Asset Management*

Active RFID is best suited where business processes are dynamic or unconstrained, movement of tagged assets is variable, and more sophisticated security, sensing, and/or data storage capabilities are required.

The following are benefits of the Active RFID System.....

## Area Monitoring

In many applications, there is a need to continuously or periodically monitor the presence and status of tagged assets and items over a large area.

### Examples include:

- Collecting real-time inventory information within a warehouse
- Monitoring the location of empty and loaded air cargo containers across an air terminal or tarmac
- Monitoring the security of ocean containers or trailers stored in a yard or terminal
- Because of the necessity for long-range communication, area monitoring is only available with Active RFID.

## **Speed, Multi-Tag Portal Capability**

Portals of various sizes, shapes, and uses are common throughout supply chains.

Essentially, any sort of gate, doorway, or other opening through which items move fits this category, including:

Dock doors at a distribution center

Entry/exit gates at an intermodal terminal

Conveyor checkpoints within a parcel sorting operation

Identifying multiple tagged items moving through a portal requires two capabilities:

- 1) highspeed multi-tag collection, and
- 2) the ability to locate all tags within the portal

(and none

in adjacent areas).

For large portal applications, such as roadside monitoring of an eight-lane highway, only Active RFID provides the necessary communication range to cover the portal.

## **Cargo Security**

RFID-based electronic seals are an effective means of securing all forms of cargo – ocean, air, land, and rail. Both Passive and Active RFID can be used for electronic seals, but each provides different capabilities and levels of security.

Passive RFID security solutions are good for applications where simple tamper detection is sufficient, the exact time of a tampering event is not important, and concern about sophisticated thieves attempting to “spoof” the seal are minimal. Because Passive RFID tags cannot be powered while the cargo is in transit, they cannot continuously monitor the presence and status of the cargo seal. They can only report if the seal appears intact at the next read point.

## Cargo Security

Active RFID, on the other hand, can continuously monitor the seal status, detecting minute variations in the seal position or integrity and implementing sophisticated anti-spoofing techniques. Immediately upon detection of a problem, the date and time and event code can be logged in the tag's memory, providing a complete audit trail of all events during the shipment.

## **Electronic Manifest**

For supply chain applications where there is a need to store an electronic manifest within the tag, such as customs inspection, only Active RFID is an appropriate option. Passive RFID does not provide sufficient data storage or data search capabilities.

A key consideration in any implementation of RFID is the impact on business processes. Clearly, the objective is to minimize these impacts, but they are virtually impossible to eliminate completely.

## **Electronic Manifest**

As a general rule, Active RFID requires significantly fewer changes to existing business processes than Passive RFID.

There are several reasons for this:

1) Passive RFID has a very limited read range, requiring tagged assets and items to move along well-defined paths and past specific read points, 2) Passive RFID has limited multi-tag collection capabilities, requiring large groupings of tagged items to be dispersed before passing a read point, and 3) Passive RFID is unable to read tags moving at high speed. The result is that Passive RFID may require substantial process re-design and worker training to be effectively implemented. The costs associated with business process re-engineering must be considered, along with the costs of software, tags, and readers, when assessing the total cost of implementation and ownership of an RFID system.

## Data Logging

The data has the advantage of being transmitted and received through a large number of mediums whether that be GPS, cellular, radio, Satellite and a host of other options. Our proprietary system allows you to do with one application which previously you would have had to do with several specialized applications. This makes it not only the most cost effective option but also the most versatile. With our software you can have access to your data all the time.

## Data Logging

The system collects information and enables action.

Today the dependence on information is more significant, the better informed you are, the more effective your decisions are, making you more competitive in today's market.

Our proprietary industrial software that allows you to monitor and control your assets from nearly anywhere in the world from any internet ready device.

## **Data Logging**

Using state of the art mapping, assets can be monitored down to street number level world wide where available and geo fenced giving a complete visual picture. Assets can be measured in a multitude of ways, optimized and controlled.

Our proprietary system gives the user complete freedom for the type of reporting deemed necessary. Reports are fully customizable in what content is displayed, in what format and how it is displayed. Reports can be scheduled and customized for different groups of users. Live Iris gives you the choice, so that you have complete and relevant information.

## Data Logging

Our software can contact a data logger or a data logger can make contact without software. The software securely and quickly pulls the data from a data logger. The software can submit user instructions to a data logger for management of an asset.

The software can connect to a data logger thru cellular modems, satellite modems, point to point radios and the Internet (3G, GPRS & CDMA).

## What can you do with our software?

### You can monitor the following:

- Acceleration
- Air temperature
- Alarms
- Altitude
- Audio
- Auxiliary motors
- Batteries
- Bearings
- Brakes
- Cylinder pressure
- Dallas 1 wire
- Direction
- Distance
- Door open/close
- Driver fatigue
- Engine hours
- Engine RPM
- Entry/Exits
- Exhaust emissions
- Event times
- Flow rates
- Fuel levels
- Gear changes
- Geo fence
- G Forces
- Gas levels
- Gas pressures
- GPS
- Hydraulics
- Inclination
- Induction temperatures
- Ignition
- Instruments
- Levels
- Lights
- Light variation
- Load cells
- Location
- Metal fatigue
- Metal in oil
- Movement
- Oil pressure
- Oil temperature
- Panic switch
- Real time tracking
- RFIDs
- Run time
- RS232 & RS485
- Set point temperature
- Speed
- Stops
- Supply temperature
- Suspension travel
- Sweeper arms
- System temperature
- Throttle position
- Turbo pressure
- Tyre pressure
- Tyre wear
- Vibration
- Video
- Voltage
- Water pressure
- Weather
- Weight

## What can you do with our software?

- Immobilization
- Open/close valves
- Sound alarms
- Switch on/off lights
- Send SMS messages
- Send E-mails
- Open/close doors
- Activate video surveillance
- Turn on/off engines
- Control motors

## **Recommendations**

Active RFID and Passive RFID are fundamentally different technologies.

Active RFID and Passive RFID have different functional capabilities, and therefore address different areas of supply chain visibility.

Passive RFID is most appropriate where the movement of tagged assets is highly consistent and controlled, and little or no security or sensing capability or data storage is required.

Active RFID is best suited where business processes are dynamic or unconstrained, movement of tagged assets is variable, and more sophisticated security, sensing, and/or data storage capabilities are required.

# A Reality Check...

- RFID is NOT the right solution for every problem
- RFID is NOT a cure for bad business practices
- RFID is NOT all things to all businesses
- RFID does NOT always have an ROI

# However...

- RFID IS a highly capable technology when implemented carefully
- RFID IS an enabling technology
- RFID IS a technology that challenges current business practices
- RFID IS proven and able to deliver a measurable ROI in most cases

# RFID “Hotspots”

## ● **Manufacturing**

- Leaner production and better inventory management, raw materials planning

## ● **Packaging / labeling**

- “Integrating” RFID tags in labels and packages

## ● **Transportation / Distribution / Logistics**

- Track and manage inventory, increased visibility, more data

## ● **Security**

- Product authentication and anti-theft
- goods and company assets

## ● **Retail**

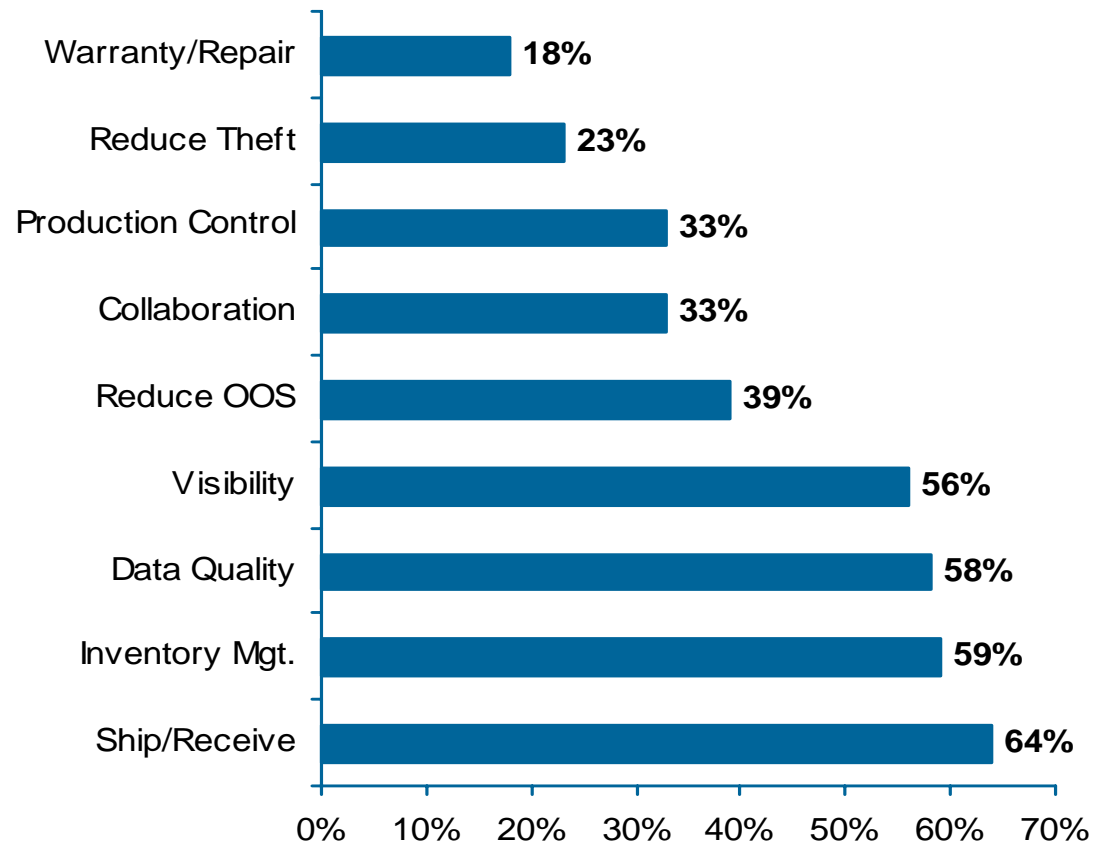
- Last 50 meters may be most important piece of retail supply chain

## ● **Payment / Loyalty systems**

- Strong 3-level value proposition

# What are the problems?

**“What are the key business problems you are currently, or would like to help solve utilizing RFID solutions?”  
(Multiple Responses)**



# Burning Issues That Drive Adoption...

- Continued high Out-of-Stock rates
  - Costs retailers \$7Bn-\$12Bn/Year
  - 7% walkouts
- Massive theft rates:
  - Manufacturer theft reaching 1% of sales
  - Retailer theft reaching 2% of revenues
  - Write-offs of \$33Bn annually in the US

# More Burning Drivers...

## ● **Expensive manual processes**

- Labor costs reaching 89% of DC costs
- Over 30% of labor tied up in receiving alone due to manual order processing
- 60% of receiving still done with note pads

## ● **Transportation costs continue to rise**

- Labor rates and labor costs escalating 10% per year
- Fuel prices high and supply critical

# Focus: Transportation and Logistics

Facing new challenges...

- Shorter Delivery Times
- Demand for better information on location of goods in transit
- Higher levels of shipping security needed
  - Increased shrinkage
  - Product diversion/gray market goods
  - Homeland security

# But Where's the ROI?

- The Areas of Opportunity
  - Asset utilization
  - Operational Efficiency
- Opportunities for Benefit
  - Better QC and customer service
  - Better financial management
  - Improved profitability through cost reduction

# ROI in Asset Utilization

- Tagging at the case and pallet level will allow:
  - Each case and pallet to be uniquely identified
  - Greater visibility
  - Better shipment consolidation
- Leading to:
  - Adjustments to fleet size to maximize vehicle and container utilization, while still maintaining delivery service levels
  - Adjustments to container consolidation utilization over time
  - Assets not being fully utilized can be re-deployed where needed or sold and removed from inventory

# ROI in Asset Tracking

- Tagging all containers to track their position and movement in supply chain
  - Small cardboard trays to large airline freight containers
- Purchase of new expensive containers due to loss or damage or can't locate
- By monitoring this information over the entire delivery network, a carrier would be able to:
  - Reduce their inventory of containers by up to 10%
  - Evaluate alternate equipment financing methods to meet increased demand during peak seasons
  - Potentially identify millions of dollars of annual capital investment that could be more closely managed

# Accenture Case Study – Medium-sized carrier

## **What they implemented:**

*A real time location system (RTLS) using active RFID tags to monitor their tractors and trailers within their freight terminal yards*

## **This allowed them to:**

*Postpone the purchase of new equipment*

*Sell off a portion of their current assets*

*Increase their usage of leased equipment to handle peak volume needs*

*Turned their capital investment into a fully deductible expense*

## **Which lead to:**

*Selling 2% of existing tractors, 7% of trailers (\$8.2 million in assets)*

*Better visibility of assets*

*Which reduced shrinkage of assets*

*Which led to a reduction in replacement of asset inventory*

# Savings From RFID

<b>Capacity Utilization</b>	<i>Reduction of existing assets for re-sale (fleet and trailer)</i>	<i>\$8,200,000</i>
	<i>Reduction of annual new asset purchases</i>	<i>\$3,300,000</i>
<b>Asset Tracking</b>	<i>Reduction of shrinkage of assets</i>	<i>\$150,000</i>
	<i>Reduction of replacements due to damage</i>	<i>\$172,025</i>
<b>Total Savings</b>		<b>\$11,822,025</b>

# ROI in Operational Efficiencies

Tagging the packages allows...

- Volume planning before shipments arrive at the depot or DC
- Personnel / labor loading planning
- Redundant labor can be reduced
- Auto-sortation, less touches
- Customs brokerage, manual and labor intensive
- Reduce time and resources required to manage mis-shipments
- More efficient paperless

# Identifying Your Requirements

- **Determine if RFID meets the needs and if implementation is economically viable**
  - **Can it help improve efficiency?**
  - **Can it help improve productivity?**
  - **Can it reduce operating costs?**
  - **Can it reduce labor costs?**
  - **What is the infrastructure installation cost?**
  - **What are the recurring costs associated with the solution?**
  - **Do the investment and variable costs of the solution advance your business model?**

# The Final Question?

You have to answer it yourself for your business...

Where's the ROI?

# Smart Pallet Example



Smart Pallet arrives at warehouse with items

Items Passive RFID tagged on pallet



Active RFID tag embedded in pallet

Software interactive with process



sends to system owner

*Thank You for Your Interest in Pallet  
Technologies RFID Solutions!*

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