Ramp

RFID: 101

WHITE PAPER

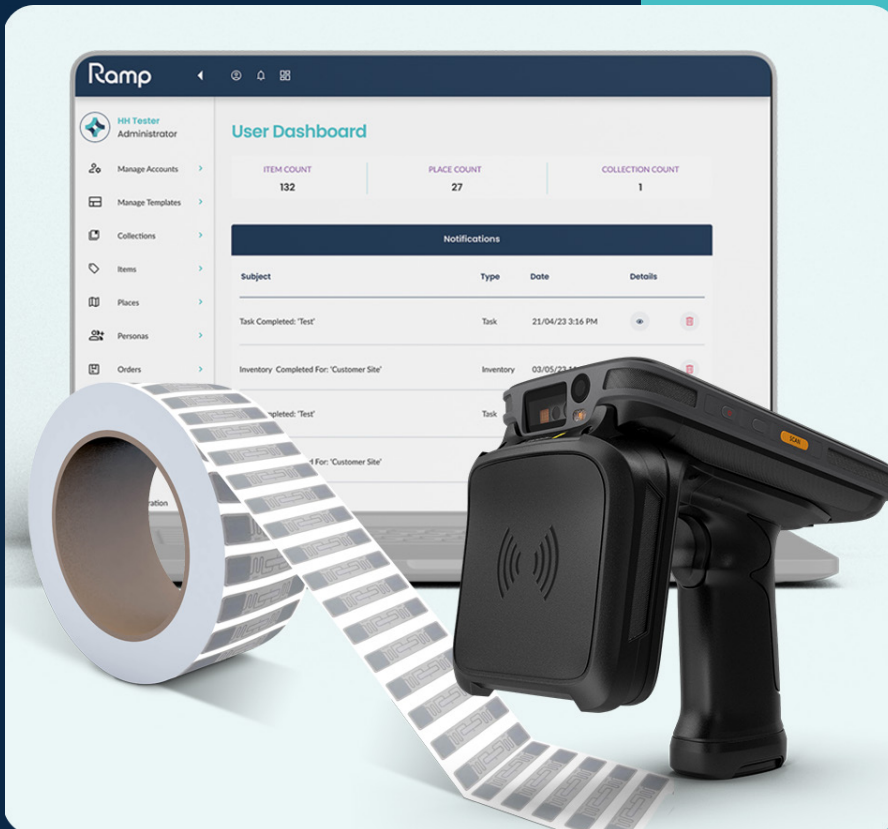## Ramp – The Value of Visibility

Understanding RFID, the building block for enhanced asset and inventory accuracy and efficiency.

www.ramp.com.au

About Us

Ramp is the pioneer of RFID-based asset and inventory management in Australia. Leveraging our extensive cross-industry experience, we deliver tailored solutions that harness the full potential of RFID technology to help businesses solve real problems.

Our more than 75 years of combined RFID experience enables us to offer an array of solutions - from tracking returnable and general assets to retail and inventory management, to automated vehicle identification (AVI). We tailor these solutions to suit your unique business needs.

98+%
Accuracy

RFID removes a lot of human error, and our clients consistently see over 98% accuracy. This accuracy is what powers the streamlining of other processes and the resulting business benefits.

Introduction

RFID stands for Radio Frequency Identification. And like a barcode or magnetic strip on a credit card, an RFID tag provides a unique identifier for an object. RFID technology uses radio waves to communicate between a device (such as a tag or a card) and a reader. The device, often called an RFID tag or label, contains a microchip and an antenna, and you can attach it to, or embed them, in an object.

The reader, also called an RFID scanner, sends out a radio frequency signal that "powers" the tag and enables it to send back its stored data. You can then scan items that have an RFID tag or label attached to them. Once you have items tagged and scanned you can use software to retrieve stored information.
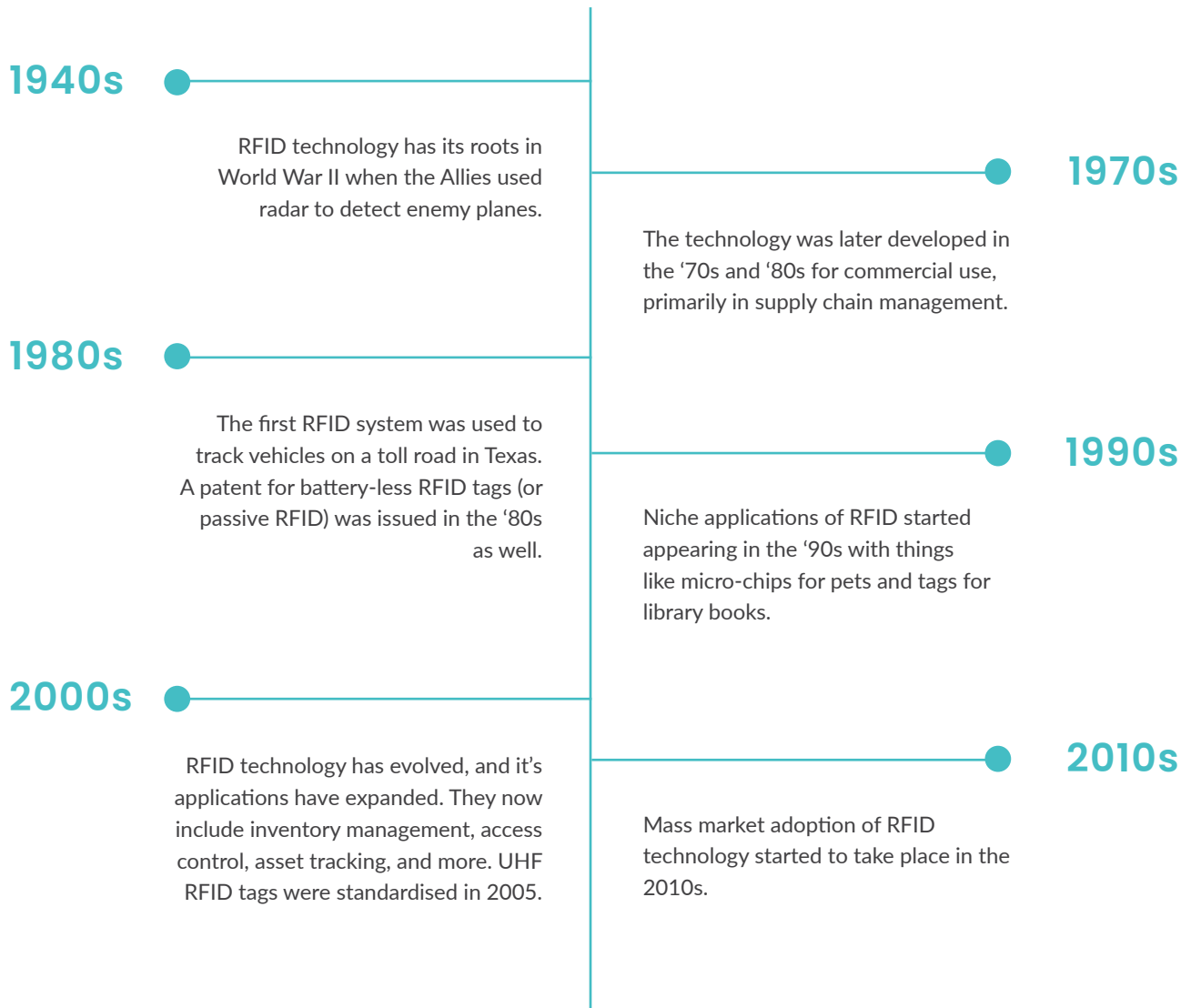
RFID

98+% Our clients consistently see 98%+ accuracy once they have implemented their tailored RIFD solution. The accuracy of an RFID system brings reliability, efficiency, and strategic advantages that can have a profound impact on your businesses bottom line.

90+% Our research shows that 90.82% of your time can be saved when performing asset tracking with RFID technology compared to traditional barcodes. This time saving leads to more efficient, cost-effective, and agile business operations, positioning your company for enhanced growth and customer service.

- **Programmable Data:** RFID tags come with the ability to store and alter data, offering flexible usage.

- **Multiple Memory Blocks:** RFID tags have several memory sections, allowing storage and segregation of different types of information.

- **High-Speed Reading:** RFID readers can capture data from the tags at remarkable speeds, enhancing operational efficiency.

- **Bulk Reading:** RFID technology supports simultaneous reading of multiple tags, reducing manual effort and time.

- **Non-Line-of-Sight:** RFID tags can be read without a direct line of sight, including through packaging.

- **Anti-Collision:** RFID tags incorporate anti-collision algorithms, allowing multiple tags to be read simultaneously without interference.

- **Long Read Range:** RFID tags can be read from a significant distance, extending the possibilities for tracking and managing assets.

- **Customisable:** RFID tags can be tailored to fit a variety of form factors and applications, ensuring optimal integration into your operations.

A History of RFID

1940s

RFID technology has its roots in World War II when the Allies used radar to detect enemy planes.

1970s

The technology was later developed in the '70s and '80s for commercial use, primarily in supply chain management.

1980s

The first RFID system was used to track vehicles on a toll road in Texas. A patent for battery-less RFID tags (or passive RFID) was issued in the '80s as well.

1990s

Niche applications of RFID started appearing in the '90s with things like micro-chips for pets and tags for library books.

2000s

RFID technology has evolved, and it's applications have expanded. They now include inventory management, access control, asset tracking, and more. UHF RFID tags were standardised in 2005.

2010s

Mass market adoption of RFID technology started to take place in the 2010s.

Today, you can use RFID in various industries, including retail, healthcare, transport and many more. RFID is all around us now.

Types of RFID Tags

There are two main types of RFID tags: passive and active.

You can use both types of RFID tags in a variety of applications such as inventory management, tracking, and access control. The choice of which type to use depends on the specific requirements of the application such as read range, cost, and lifespan.

There are hundreds of tag options available, and it usually takes someone with detailed knowledge of the technology and use case to determine the right tag.

Selecting the appropriate tag is essential for a successful and efficient RFID solution.

Passive RFID tags do not have a power source of their own. They rely on the radio frequency energy emitted by the reader to power the tag and send back its stored data. These tags are smaller, cost less, and have a longer lifespan than active tags. But they do have a shorter read range.

Active RFID tags have their own power source, usually battery, and can send a signal to the reader without needing to be in the same vicinity. They have a longer read range and transmit more data than a passive tag. However, they are larger, more expensive, and have a shorter lifespan.

Types of RFID

You can breakdown RFID by the frequency band in which they operate:

- Low Frequency (LF), used for things like micro-chips in domestic pets.
- High Frequency (HF), used for things like tap and go credit cards.
- Ultra High Frequency (UHF), this is the type of RFID we use for asset and inventory tracking.
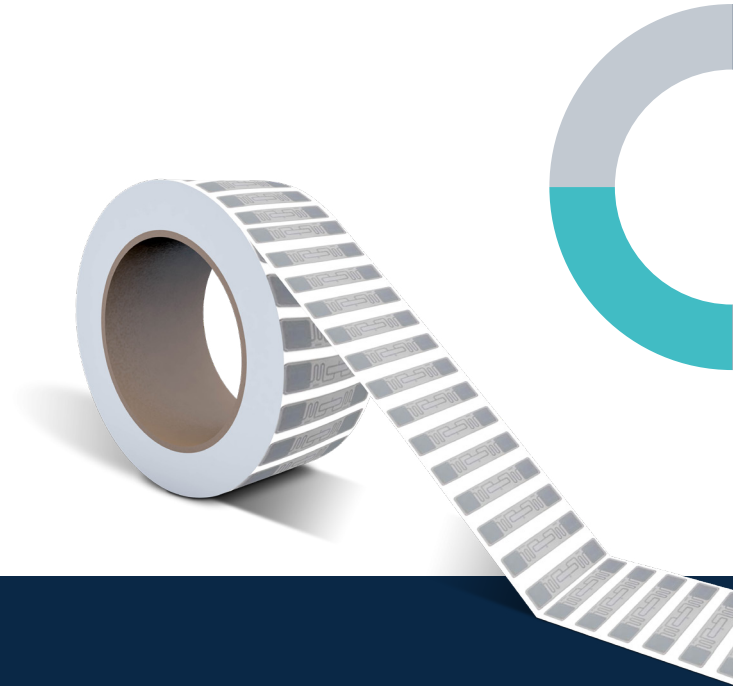
FEATURE	PASSIVE TAGS	ACTIVE TAGS
Power Source	The RFID reader's electromagnetic field	Built-in battery
Read Range	Up to a few metres	Up to 100 metres or more
Tag Size	Smaller and more flexible	Typically larger
Data Storage	Lower	Higher
Sensor	Identification data	Can include sensors
Cost per Tag	Less expensive	More expensive
Lifespan	10 years or more	Typically 3 - 5 years
Use Cases	Inventory management, supply chain tracking	Remote monitoring

How RFID Works

ITEMS   TAGS   READERS   SOFTWARE

Modulated Backscatter

It sounds very complicated, but you can think of it like an echo.

The RFID reader shouts out a message and then listens for a quiet echo. The tag then collects energy from the "shout", reflecting energy modulated to send the digital memory stored on the tag.

Operation Range

Operation, or communication range, is the distance a reader can be from the tag and still pick up the information. It's the minimum of the forward and reverse range. It depends on both the reader power and sensitivity, as well as the tag power consumption and backscatter efficiency.

You can control the size of the RFID reading zone by adjusting the power of the reader. If you want to read a single tagged object that's close by, you use a low reader power. If you want to read all tagged objects in a large area, you use the highest reader power.

If you want to be confident you are reading the right tag, you should use a printed barcode or QR code on the tag as well. You can still use the same reader to read these items. Combining the technology gives you the best of both worlds. RFID is fast and accurate for quantities, but barcodes or QR codes can give you individual item accuracy.

Constructive & Destructive Interference

The laws of physics dictate what RFID can and cannot read, and interference can disrupt the process.

Constructive interference enhances signal strength when multiple RFID readers send signals at the same frequency and in phase.

However, destructive interference weakens the signal when the readers transmit signals at different frequencies or out of phase.

To prevent this, use RFID readers and tags that operate at different frequencies or synchronise radio waves to transmit signals in phase for better system performance.

Our experts can help you configure all the appropriate settings required for your environment so you can ensure you are getting the maximum read rate from your RFID solution.

RF Reflections

Radio frequency hot and cold spots can be created by reflections, particularly in environments with a lot of metal surfaces.

This can lead to destructive interference or out-of-phase frequencies, causing issues with RFID reading. Delivery vans are a common example of this.

However, movement can help overcome interference. Moving RFID-tagged items within the RF field can allow them to transition from a cold spot to a hot spot.

Alternatively, the RFID reader can be moved, particularly with a handheld reader, but it is important to move steadily in a W shape to achieve optimal results without moving too quickly.

RFID & Barcodes

The Differences

You can think of the difference between RFID and barcodes like fishing. Using barcodes is like fishing with a rod, where you catch one fish at a time. RFID, on the other hand, is like scooping all the fish up in a net.

The decision between using RFID and barcodes isn't always an either-or-situation. In fact there are many scenarios where a combination of both can provide the most effective solution. Barcodes are simple and many industries have reliable systems built around their use. However, they do need a direct line of sight. RFID excels where bulk reading, non-line-of-sight capabilities, or real time tracking are required.
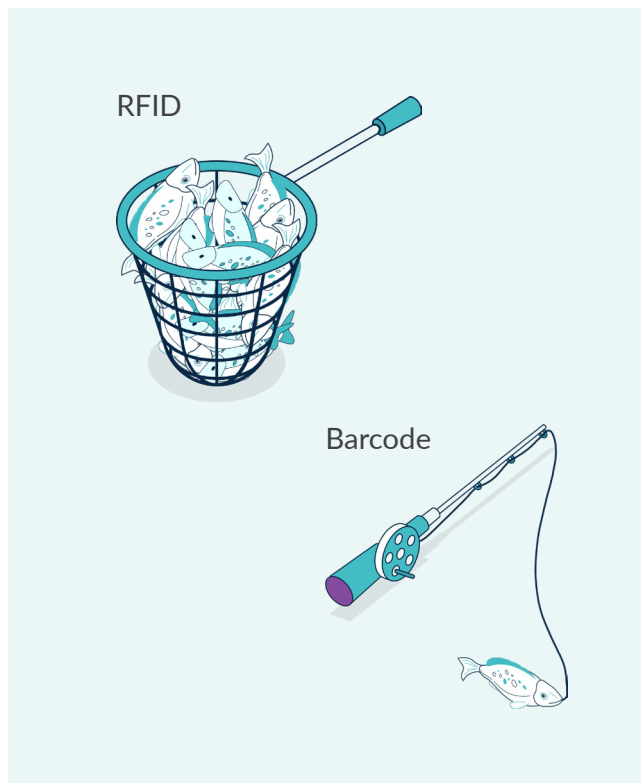
RFID

Barcode

RFID	Barcode
Multiple tags can be read simultaneously	Tags can only be read one at a time.
Item will scan as soon as it's in reading range.	Item needs to be scanned with line of sight.
System is complete automated.	Staff must physically scan each tag.
Capable of reading, writing, modifying and updating.	Capable of reading only.
Highly durable.	Can be damaged, removed or difficult to read.
Very secure, difficult to counterfeit.	Relatively easy to counterfeit.
Can trigger events such as alarm activation and door opening.	Cannot trigger other events.

Why Use RFID?

Operational Efficiency	RFID technology automates the asset tracking process, significantly reducing manual effort and speeding up operations.
Visibility	Get accurate, up-to-date insights into your asset location and status, enabling quicker and more accurate decision-making.
Accuracy	RFID delivers near-perfect inventory accuracy, minimising discrepancies and reducing the risk of stockouts or overstocks.
Customer Experience	Accurate data enables better customer service, avoiding out-of-stock situations and accurately promising delivery times.
Reduced Labour	Automated tracking with RFID means less time spent on manual checks, lowering labour costs and freeing up your team.
Asset Utilisation	RFID provides that data you need to use your assets more effectively, from reducing equipment downtime to optimising asset allocation.
Increased Security	RFID can help prevent theft and loss, improving security for valuable assets and sensitive items.
Traceability	RFID delivers comprehensive asset visibility, recording every movement. This no only minimises loss but improves supply chain integrity and recall management.
Compliance	RFID can make it easier to comply with regulartory requirements, and simplify reporting by providing a reliable, automated record of asset movements.
Competitive Advantage	Embracing RFID technology can give your business a significant edge over competitors still relying on slower, less accurate, and more labour-intensive methods.
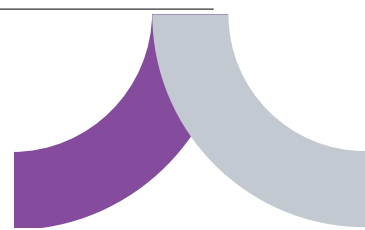
Looking for expert advice on RFID implementation. Talk to our team today.

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