Gamma Solutions

WHITE PAPER

RFID – Radio Frequency Identification
October 2005

Objective
To provide a broad view of the current status of RFID technology.
Gamma will be pleased to provide more specific information.

Automatic Data Collection
There are many forms of ADC.

- Barcodes
- MICR. Magnetic Ink Character Recognition as on cheques
- Magnetic Stripe on credit cards
- Smart Cards: contain data and often this data is updatable.
- OCR: Optical Character Recognition using machine recognisable fonts.
- Bio Concepts: recognition of finger prints & faces.
- Visual Scanning: page scanners that read printed documents.
- Counters: automatic recording when a counter is activated.

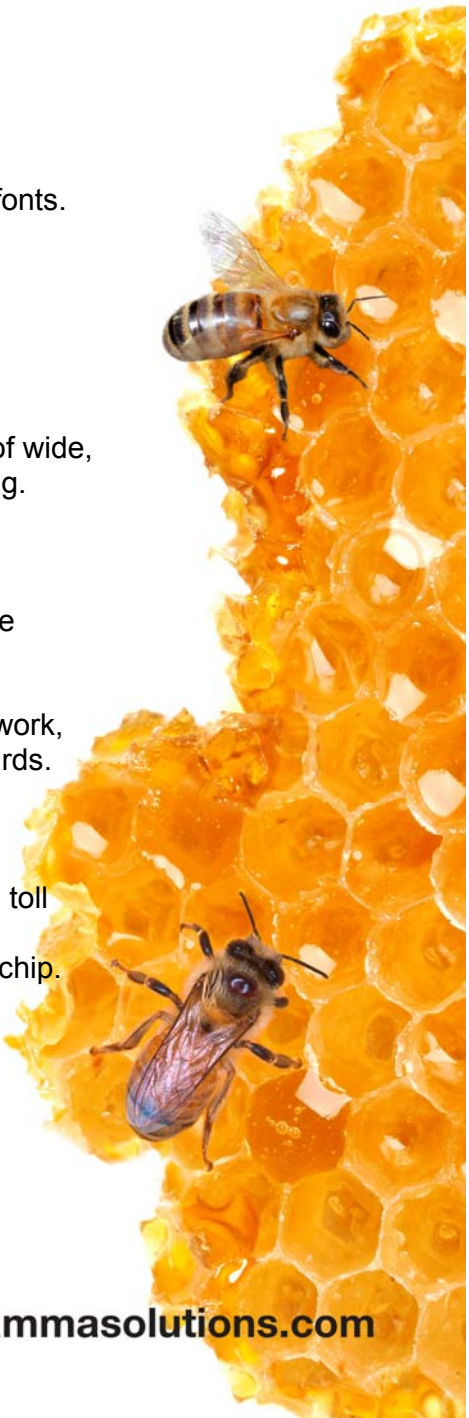
Plus others and the newest form is RFID.

Barcodes
Barcodes require line of sight to the reader. A barcode is a complex mix of wide, narrow stripes & spaces, a non read occurs if there is dirt, dust or creasing.

Radio Frequency Identification
RFID tags transmit a signal that can be read through dirt, dust and most material (metals being a problem), they do not require line of sight and are more tolerant regarding alignment.

RFID allows items to be identified in conditions where a barcode will not work, but has the disadvantage of higher cost and uncertainty regarding standards.

What Is a RFID Tag?
Active tags: these have a battery and can transmit distances of over a hundred metres. Typical example is an e-tag, which is used in automated toll collecting on certain highways.
Passive tags: passive tags consist of an antenna/coil, a capacitor and a chip. These are packaged into a range of outer options.
To generate a signal from the tag the reader “excites” the coil and this generates power.



mobile workforce

Passive Tags Continued…….

When sufficient power is stored in the capacitor it activates the chip and the chip sends out a radio signal, usually a serial number. This is virtually instantaneous.
Tags range in size from a centimetre, up to six centimetres (size relates mainly to coil size and thus read distance).

Options

- **Read only tags**: transmit a number and this acts as a "number plate".
  Like a car number plate they contain no meaningful data and applications need to be referred to a database to get any meaningful information.
- **Read Write tags**: have mega bytes of data. A typical use is army dog tags that contain blood type and known allergies. They are used when a database is not available and important data must travel with the product or person.
- **EAS** or Electronic Article Security. Tags set to activate an alarm.
  Eg: illegally taking items out of a warehouse/store. Another option is tags that will show evidence of tampering.
- **Anti Collision**: a feature allowing multiple tags to be read simultaneously.
  An essential feature when multiple tags are in the read area at the same time.
  Eg: to read all products in a super market trolley would require the anti collision feature in the tags.
- **Special applications**: are a range of special tags (eg minute tags that can be mixed with fluids and used to identify the source of oil or chemical spills). There are also tags that can be read when moving at high speed and others that are part of a printed label and can be encoded at the same time a label is printed.
- **Printed tags**: an ink developed to allow a printed image to act as an RFID tag and send out a radio signal when activated by a reader.

Standards.

Passive tags

There are a number of unique aspects of each tag currently on offer:-

- Chip brand
- Frequency
- Format

Manufacturers are promoting various configurations of the above.
Broadly speaking the tag brands are unique and readers will only read one brand. Historically, we have a similar situation to the early days of barcodes. When the current multitude of RFID standards is reduced, then multi tag readers will be produced (but equipment to handle the variable radio standards is more complex than equipment to handle different barcode concepts).

Standards Continued….

Overall the adoption of RFID is hampered by the lack of universal standards, however they are evolving and dramatic changes have occurred in 2005 and will continue into 2006.
The introduction of standards will have an impact on cost of tags and equipment.
Until then the multitude of standards is impeding the industry.

Gen2 Standard

GS1 (the new name for EAN) are the international body that controls the standards for barcodes used on grocery items and many other products.
They have recently released the specification for RFID tags. There is evidence, various industry bodies are adopting Gen2 standards. For example the tyre industry is changing to Gen2 standards. However many issues such, as read range, results in Gen2 not being suitable for certain applications. Also China has thrown a "cat amongst the pigeons" by saying they do not plan to adopt the Gen2 standard.
There is little doubt the "clout" of GS1 will make Gen2 the de-facto standard for many industries.

Other Standards

Each RFID tag manufacturer is promoting their concept. Some have patents that preclude others copying their tag. Flexible licence arrangements, or dropping of patents, will be needed for any proprietary tag to become popular.
Many companies are meeting under the umbrella of Intermec's Quick Start program to cover cross licensing between vendors.
Recently a number of legal cases involving patents were abandoned. Apart from the cost, there is recognition by the key manufacturers that infighting will hinder industry development. These moves by major players will have significant impact on the adoption of RFID technology.

Cost

A barcode replacement tag currently ranges from $0.50 to $1.00.
Longer range tags (to 1.5 metres) $2 to $5.
Active tags (battery driven and 100 plus metre read range) $50 to $350.

Packaging

The RFID components can be packaged into various forms, eg:-

- Stick on tags.
- Capsules embedded in items (including animal implants).
- Wrist bands, shoe clips etc.
- Waterproof and dry cleaning chemical proof.

Read Range

Barcode replacement tags	3 -10 centimetres
Longer range	to 1.5 metres
Active tags	100 metres plus.

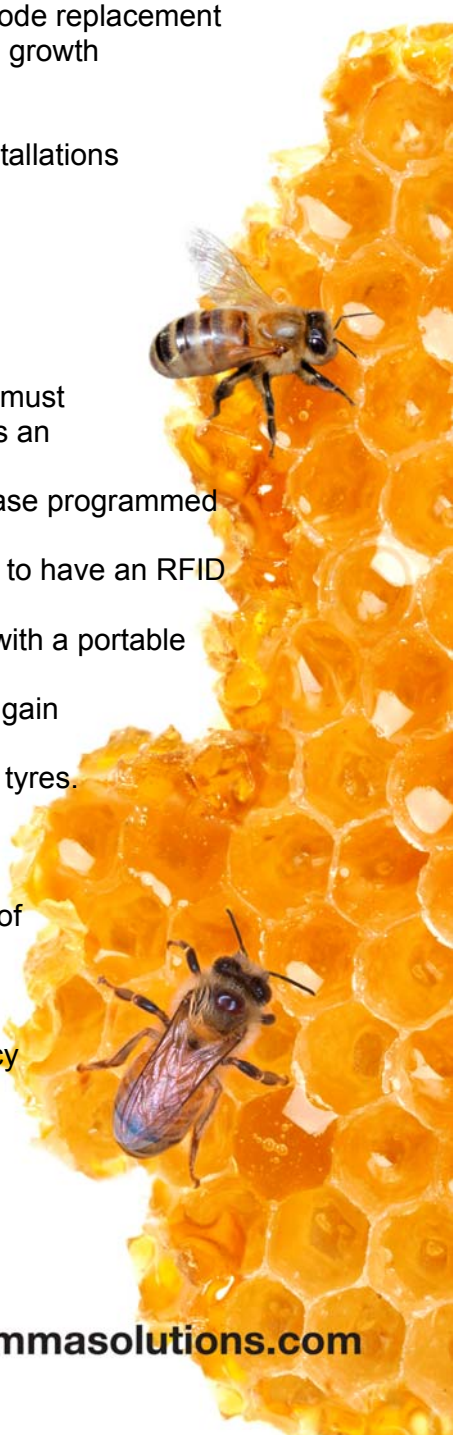
The Gen2 standard is a barcode replacement tag with a range of a few centimetres.

History and Projection of Commercial RFID

To Pre -2005	Many standards and concepts Most installations are closed loop Most installations "new" and not barcode replacement Many unfulfilled predictions of radical growth
2005	Standards emerging Many major "one off, closed loop" installations
2006	Standards consolidated More common use

Typical Application

Supply Chain: Wal-Mart have specified farm to shelf reusable containers must have RFID tags. Containers tags are read regardless of dirt and it replaces an application requiring a different barcode for each shipment.
Pallets: systems will be developed around tracking the pallet, via a database programmed to identify specific product on each pallet.
Pet Identification: several Australian municipalities require domestic pets to have an RFID tag embedded under their skin.
Security: an RFID tag attached to site premises can be read by a guard with a portable reader to prove attendance.
Access Control: personal tags waved in front of a reader allow people to gain access to areas of a building.
Tyres: tags can be used to check correct rotation and security of valuable tyres.
Asset ID: tools and assets have anti tamper tags. Memorabilia and art can have restricted access authenticity tags embedded to stop forgery.
Passports: photo or finger print details can be stored and used to speed up processing and add to tighter security. Australia is poised to issue one of the world's first e-passports and they will contain a photo embedded in a RFID tag.
Toll tags: active tags used as e tags on tollways.
Airline bag tags: experiments using RFID on bags has improved efficiency and lowered bag handling costs.



Laundry: used in applications where the items are cleaned in bulk & must be identified individually for return or billing. For example, uniforms, items from hire companies or hospital sheets.
Library: books can be read as they slide down a shoot, which eliminates the need for librarians to start each day by scanning returned books. Also, books in the wrong part of the library (common for students to place hard to get books in the wrong area and retrieve them when they next need them) can be identified by simply passing a scanner along the shelf.
Waste Collection: tags on waste bins allow applications that weigh and identify bins. This is the fore runner of "user pays" waste disposal and is already in use in certain municipalities. Systems can also ensure the sum of waste (especially fluids) are correctly disposed and are not collected and dumped down a local drain.
Cattle Ear Tags: in the 2005 Budget the Government allocated $20 million to expand the use of electronic ear tags on cattle. Animal location will be tracked, and in the event of a disease outbreak every animal in contact with a contaminated location will be identified.

Blue Sky

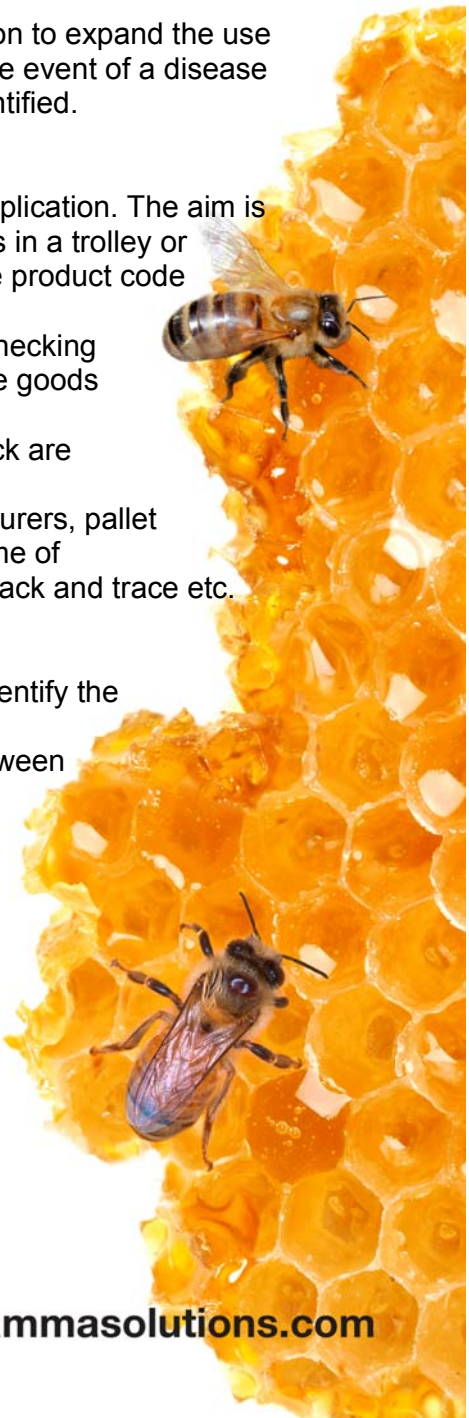
Supermarket Check Out: by far the biggest automatic data collection application. The aim is to have a tag that costs less than five cents (rising) and can read all items in a trolley or basket. Current problems are price and ensuring all items with the same product code are checked & recorded as individual items.
Options such as anti collision reading have been combined with weight checking as a solution. Eg: each product has its weight in a database, therefore the goods weighed must agree with the trolley weight.
Long Range Low Cost Tags: on warehouse dispatch, all items on a truck are recorded.
Products Produced with an ID: if furniture manufacturers, PC manufacturers, pallet manufacturers, baggage producers were to build in an RFID tag at the time of manufacture there would be many systems developed around security, track and trace etc.

Technical Data

This section is not intended to cover all the standards available but will identify the various components of a tag and the many variables to be considered.
Frequencies: Interface protocols cover the frequency in sending data between the tag and the reader.

ISO have established standards for various frequencies.

1800-1	135 KHz
1800-2	13.58 MHz
1800-3	2.4 GHz
1800-5	5.8 GHz
1800-6	860 -930 MHz
1800-7	433.92 MHz



Data Content
Formats and bit structure must be defined.
Various standards bodies and trade associations have specified data format. The standards are too numerous to cover but examples are:-
CEN/TC 23/SC 3/WG 3 for gas bottles
CEN TC 278 Traffic related tags
ISO standards
ANSI American National Standards Institute
EAN Gen 2 standard
UPO Universal Postal Union
Animal ID, airline bag tags, containers, health, cattle ear tags and access control all have standards.

Security and read conformation: how the data is checked and secured varies by manufacturer, including encryption where applicable.

Classes
Class 1: field programmable.
Class 2: number programmed at the time the chip is manufactured.

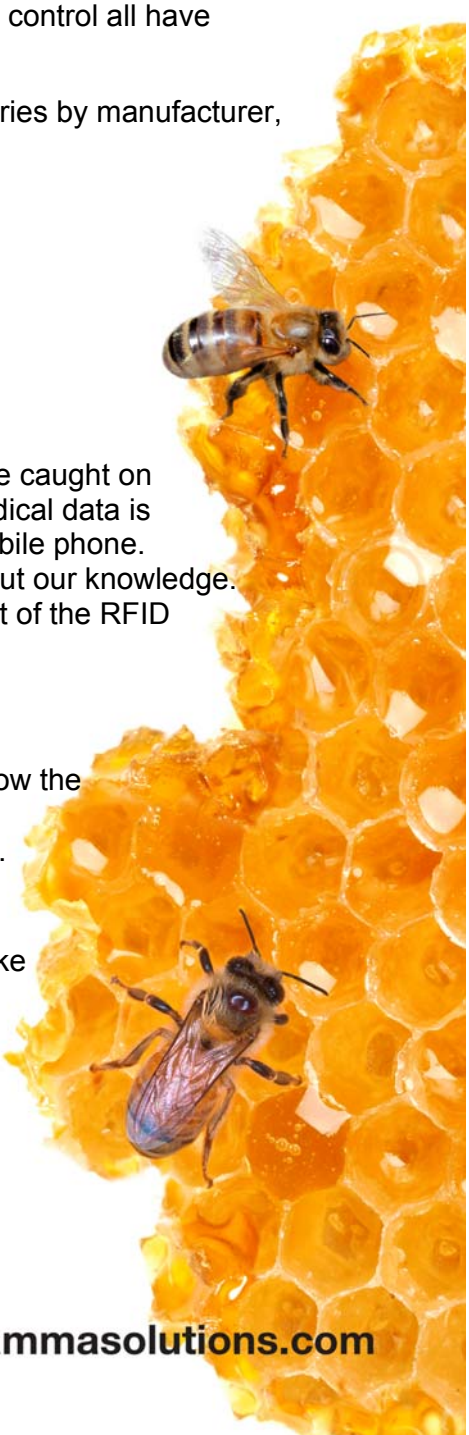
Power
Various wattages are used by readers.

Privacy

There is concern individual privacy is being eroded as our movements are caught on security camera, our purchases are recorded at the point of sale, our medical data is recorded and even our movements are tracked via the location of our mobile phone. With RFID tracking there are even more events that can be tracked without our knowledge. There is little doubt, the invasion of privacy arguments will emerge as part of the RFID development path.

Gamma Solutions Position

- Gamma Solutions has appointed an RFID Service Engineer to follow the technology.
- We are involved in Australian R&D for tags for unique applications.
- We have a range of options available to meet current needs.
- We have various options to meet future standards including Gen2.
- Our strategy is to be a major supplier in the RFID industry and make available the various options and up to date information to our customers.



Recommendation

RFID is in a formative stage and various technologies are fighting for dominance.
Gamma Solutions recommends the following direction:

1. Closed loop applications (in house and where no outside compatibility is required). These can be justified if the current technology (eg read range) is available.
2. For non closed loop, and non pressing applications, Gamma Solutions believes the best solution is to review the application in 2006 when standards become clearer.

Contact us directly on 1300 555 563 or utilise an internet search engine and key in RFID "Your Industry" to get updates.

If you have any questions regarding the information detailed in the White Paper, please feel free to contact our Sales Team on 1300 555 563.