



## 17 - Radio Frequency Identity Tags

*The monitoring of an individual item's manufacture, distribution, retail sale and eventual collection for recycling using a microprocessor will be enabled through Radio Frequency Identity Tags (RFID) that will cost less than eight cents to produce and will have a profound impact on daily life.*

Radio Frequency Identity Tags (RFIDs) are microprocessors that respond to radio frequency signals and can provide data regarding not only the RFID itself but also information stored on the microchip. This technology will not have an immediate and direct impact on the Shared Technology industries but it will result in changes to the way that work processes are undertaken in the future.

RFIDs work in a similar way to a printed bar-code but provide for much more information to be transmitted. A bar code is printed with a number that only identifies the manufacturer and the product. As it is included in the label, there is very little cost to the manufacturer and it is a "dumb" number that is not able to identify anything else. A item-specific bar-code is able to be attached to the item that would be able to provide for a unique reference to a database.

One major difference between an RFID and a bar code is that the RFID does not need to be visible for the data to be communicated to the reader. As the RFID works on a radio frequency, an RFID reader sends a radio frequency out to the tag which responds and sends a signal back with the stored data. This data may be a unique number that is matched to a data base or it can send data that is only stored on the RFID.

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This technology is not new but does have the ability to transform work processes. It has been included in this part of the report as an enabling technology as it will allow individuals to process more data more quickly. It will also allow technicians to quickly interrogate parts or components to determine age, batch numbers, shipping date, order processing, warehouse receipt and even location. The future applications of this technology are very broad.

## **Introduction**

The use of radio transponders was made during the Second World War to allow the Allies to identify friend-from-foe for incoming aircraft.<sup>1</sup> Since that time, RFIDs have been developed that allow for a range of products to be developed that facilitate a number of activities. While the technology is not new, the main interest is that the manufacturing costs of these devices is likely to be substantially reduced thus allowing their use to be more wide spread.

RFIDs are currently used to provide a data sequence to a reader in situations such as security access, public transport fare collection and motor vehicle tollway collections. These tags are also injected into livestock to allow for commercial tracking and unique identification or into pet animals for a similar purpose. RFIDs are used to automate custom manufacturing processes by identifying the planned component combination through this tagging. The most prolific application is expected to be in tracking the movement of products through the distribution process.<sup>2</sup>

The cost of producing RFIDs varies upon the features to be included. If the tag is designed to only carry a unique number, minimal componentry is required. If the device needs to send a signal some distance, a battery will need to be included. Further, if the tag is to store additional data the microchip will need to include memory. The cost of current RFIDs can range from between \$0.50 for low-power, low-data write-only tags<sup>3</sup> through to \$160 for the battery-powered, high-end re-writeable tags.<sup>4</sup>

The cost of manufacture for low-end RFIDs is set to fall dramatically. A Californian company, Alien Technologies,<sup>5</sup> is working on the development of a AU\$0.09 tag. This will be manufactured using a chemical process rather than the standard lithographic process used for most microchips. The very small chip will be "printed" on to a roll for labelling on to the product and will be common by 2006.<sup>6</sup> In order to support this, an infrastructure will need to be developed that will include international standards, hardware, software and changes in work processes.

It is estimated that in 2002 over 220 million RFID tags were sold. This is expected to grow to 1.6 billion tags in 2007. This technology is expected to have more than \$1.8 billion spent on infrastructure in the next five years.<sup>7</sup>

## **Technology overview**

The main function of the RFID is to provide a record of the data contained on the microchip. Contained within a radio signal is a small but useable amount of energy. When this radio signal hits the RFID it responds with the stream of data. This process is known as induction.

The frequencies used for RFIDs can be between 50KHz through to 2.5GHz. At the higher end of this range is the Industrial Scientific Medical (ISM) frequency and the use of tag readers at this frequency can interfere with many of the wireless technologies also planned and in use. Additionally it is unlikely that all manufacturers will use the same frequency so a range of readers may need to be available for various industries.

### Types of RFIDs

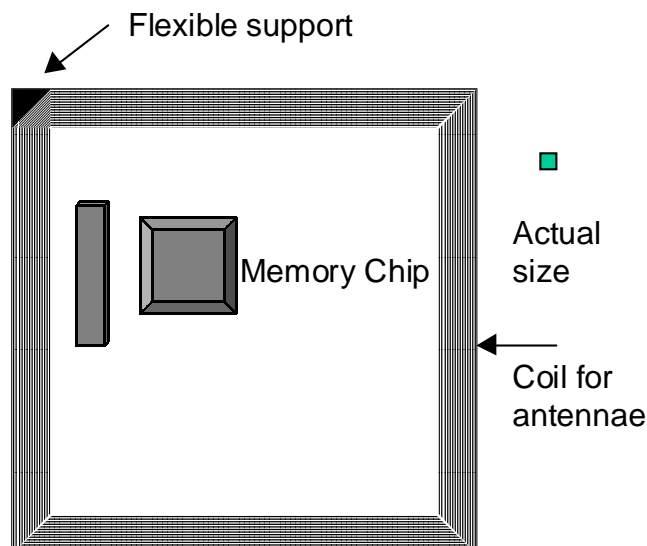
There are two types of RFIDs that are available – passive and active. The first, a passive tag, uses the power in the reader's signal to return the data stream and this requires the reader to be closer. Additionally, the data rate from these devices is slow by comparison but these cost less to manufacture. There is no maintenance required and are designed to be expendable. Data storage can be as low as 20b.

The other type is an active tag and this type usually includes a battery in the system. As a result, the active tag is able to send the radio signal further, faster and with more data than the passive tag. These tags can store more than 32kb of information and can be up to 1MB. This type of tag can be loaded with information in a read-write operation.<sup>8</sup>

### Microchip design

The design of the RFID comprises a microchip with a copper antenna “wound” around the centre similar to an electric coil on a hot plate. This assembly uses a plastic base to allow it to be applied to a surface.

Figure 17.1 – Simplified Design of an RFID



### Standards Development

As this technology is expected to be utilised in increasing applications, a number of manufacturers and other organisations have collaborated to form the Auto-ID Centre that is situated at the Massachusetts Institute of Technology (MIT). This

centre has over 100 members including the University of Adelaide and is proposing an identification numbering system called the electronic product code (ePC).

This electronic product code would be a 96 bit number split into four sections that will allow for separate identification of the RFID type, the manufacturer of the product, the product type and the actual individual item itself. This system can provide for 268 million manufacturers, 16 million product lines for each manufacturer and 68 billion individual products.<sup>9</sup>

The International Organization for Standardization (ISO) has a number of standards being developed to cover the short term but is working on a more the comprehensive standard, ISO 18000, to deal with the issues more completely. This standard will define common protocols, data structure and the frequency to be used.<sup>10</sup>

### **Future Applications**

The possible applications in which RFIDs may be used are very broad. These devices will be used to identify a single item, monitor the status of an item or determine the location an item. For the Shared Technology Industries, this can mean the ability to quickly identify the specific individual part that requires replacement. As these devices can be read without being visible, individuals can check to see if all the items for a maintenance plan are contained in a shipment of parts prior to setting off to the site.

Much of the activity for RFIDs will be in the monitoring of retail products. This will include applications in shoplifting prevention, proof of purchase and use-by dates for food products. For example, an RFID included within the a garment will signal an alarm if it is stolen (but not discovered) from the store without being paid for. Additionally if it is removed and presented for refund, the system will signal that the particular garment was never sold.

### **Privacy Concerns**

In a world connected by recording devices it is possible to imagine the collation of data bases that will provide for a detailed analysis of the behaviour of individuals. For example, if an empty drink container is found at a crime scene, the RFID data may be able to tracked to the exact time at which the product was purchased. If a bank-linked transaction card is used, the purchaser may be able to be identified.

This scenario outlined above is just one of a number of illusions George Orwell's novel *1984* privacy invasions and are being promoted as a result of this new technology. The printed bar-code with the Universal Product Code (UPC) was also imagined to be able to accomplish similar privacy infringements. But when a technology offers power, simplicity, flexibility and affordability, consumer acceptance tends to catch up.<sup>11</sup>

### **Summary**

The RFID technology is expected to be commonplace by 2007<sup>12</sup> with around 30 per cent of all retail products using this technology in 2010.<sup>13</sup> The major manufacturers will be making billions of passive tags by 2006.<sup>14</sup>

## IMPLICATIONS FOR THE SHARED TECHNOLOGY INDUSTRIES

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### *Automotive*

This technology is already in use in manufacturing to define the range of components to be included in the vehicle as well as in automated tollway collection. The use of this technology in parts management and order confirmation will have significant benefits in reducing cost of warehousing and inventory management. Further applications not mentioned here are expected.

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### *Building and Construction*

This technology will assist in asset management where the details regarding a particular device will be available through a reader/display device that is linked wirelessly to the network.

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### *Electrical*

Limited application in the activities within this industry. Obviously devices that are installed will be able to be interrogated with a reader/display to provide for historical records regarding the composition of the device and the installation/maintenance history.

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### *Electronics*

Further development of this technology will see the integration of other microprocessors. New applications will continued to be developed that utilise this identity system.

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### *Engineering*

The application of this technology in process and manufacturing automation will require the coordination of the product with the identification tag. The collection of this data will be critical for the distribution stream and marketing functions.

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### *Information Technology*

The data collected through the use of this technology will need to be managed. The data will also be required by various other enterprises for product improvement and customer relationship management. These applications will involve expansion of database applications and web services.

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### *Telecommunications*

This technology will assist in asset management where the details regarding a particular device will be available through a reader/display

device that is linked wirelessly to the network. Other applications will be developed.

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- <sup>1</sup> Fildes, J. (2002). Chips with everything. *New Scientist*, 19 October, 2002, p. 45-47.
  - <sup>2</sup> Magrassi, P., & Berg, T. (2002). *A world of smart objects: The role of auto-identification technologies*. Gartner Dataquest. Reference Number: R-17-2243.
  - <sup>3</sup> Margrassi, P. (2002). *An introduction to e-tagging*. Gartner Dataquest. Reference Number: T-15-0102.
  - <sup>4</sup> Miller, M. (2002). Received wisdom. *CommVerge*, 1 November, 2002. Available: <http://www.e-insite.net/commvergemag/index.asp?layout=article&articleid=CA253104&pubdate=11/1/2002> Accessed: 21 April, 2003.
  - <sup>5</sup> See Alien Technologies <http://www.alientechnology.com>
  - <sup>6</sup> Magrassi, P., & Berg, T. (2002). *A world of smart objects: The role of auto-identification technologies*. Gartner Dataquest. Reference Number: R-17-2243.
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  - <sup>8</sup> Premier Solutions. (2002). *RFID white paper*. Indianapolis, IN: Author. Available: <http://www.premiersi.com/technology/rfid.htm> Accessed: 21 April, 2003.
  - <sup>9</sup> Fildes, J. (2002). Chips with everything. *New Scientist*, 19 October, 2002, p. 45-47.
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  - <sup>12</sup> Magrassi, P. (2002). *Why a universal RFID infrastructure may never exist*. Gartner Dataquest. Reference Number: SPA-16-0061.
  - <sup>13</sup> Magrassi, P., & Berg, T. (2002). *A world of smart objects: The role of auto-identification technologies*. Gartner Dataquest. Reference Number: R-17-2243.
  - <sup>14</sup> The Economist. (2003). The best thing since the bar code. *The Economist*, 6 February, 2003. Available: [http://www.economist.com/globalExecutive/thinking/displayStory.cfm?story\\_id=1576067](http://www.economist.com/globalExecutive/thinking/displayStory.cfm?story_id=1576067) Accessed: 21 April, 2003.