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Smart Labels Analyst

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Inside this issue:

RFID in Banknotes

The little old lady went to the Post Office to get her Government pension. She took the banknote down the road to buy food. It was refused: it was a counterfeit. She took it back to the Post Office who refused to replace it, saying that she could not prove it came from them. As a consequence, she ate very little that week. Some years ago a newspaper report alleged that all that happened in the UK some years ago.

Secrecy

Official figures for banknote counterfeiting in the UK are kept secret. That was true in all countries of Europe except Germany, where the Bundesbank published alarmingly increasing figures up to the 1980's. Nowadays the European Central Bank has taken over and even the Germans are denied access to the counterfeiting figures.

Court Cases

Court cases give a glimpse of the continuing problem. Most countries have at least one such case every year.

Global Repertoire of Counterfeit

For example, in the UK last year a forger was jailed for seven and a half years. He helped to create £10 million ($16m) of counterfeit notes that fooled banks and were dispensed from cash machines. He took orders from underworld figures around the world and produced English, Northern Irish, Scottish, US, and Spanish currency. A fellow printer was also jailed. The operation was described as being skilled, very well equipped, meticulous and persistent. They became the first counterfeiters to successfully forge the Bank of England's new £20 note, which has a complex hologram.

Main Target – the Dollar

However, it is the US dollar that is widely accepted as the world's most defrauded and defraudable currency. Three men who took part in the largest counterfeit US dollars scam were jailed for a total of 19 years this month. The trio, which included a former KGB agent from Armenia were part of a European wide network which stretched to a leading IRA dissident and the Russian mafia. They were sentenced following a joint operation between the US secret service and British national crimesquad detectives to uncover the distribution of counterfeit $100 bills. Official estimates for the total distribution of so-called "super dollars" worldwide is over $27m. Is the true figure much higher? Many experts think it is.

Trouble for the Euro

The Euro makes things tougher for many reasons. It is more widely used so counterfeits are easier to unload. It has very high value notes, so vast amounts of money can be carried in a suitcase, counterfeit or otherwise. It is unfamiliar and uses very tired, old security printing features in the main,

so the national printers could minimise any costs of re-equipment .

Predictions Look Bad

"There is going to be an increase in forged money in circulation, and forged notes held in stock will be released," a German interior minister said last year, in the run up to the launch of the Euro. Police in Italy, where more fake notes are produced than in any other EU country, said gangs with piles of counterfeit lire that will soon be useless to them are likely to make a last attempt to introduce them to the market. In France, the big retailer Carrefour was also worried. Patrick Armand, director of finance, said the focus of anti-counterfeiting efforts on forgery of euro notes would create an opportunity for criminals to forge the notes of legacy currencies. The German minister said that criminals might also attempt to exchange forged D-Marks for euros in the large number of east European countries where the German currency is widely accepted. The Bundesbank said 15,000 fake notes were detected in the first six months of 2001, double the number in the same period in 2000. This has prompted the country's main retailers federation to launch an internet-based scheme to guard against forgeries being passed.

Stores will be able to contribute and access information on attempts to pass off forged D-Marks within seconds of incidents being logged. Retailers also fear a flood of fake euro banknotes as criminals try to exploit consumers and shop assistants unfamiliar with the new currency. So far the figures that are available show only a modest problem but this may be the calm before the storm. Within the eurozone, banknote forgeries fell by 93% in the first six months of use in 2002, according to the pan-European police agency, Europol. Europol had originally feared east European counterfeiters might flood the markets with false currency when the euro was introduced in January 2002, but now thought that the incidence of forgery was far less than anticipated. Only 211,965 forgeries were reported to Europol during the period to the end of June – 7% of the total reported in the first half of 2001. National police authorities arrested 116 people in connection with 400 separate counterfeit operations.

Tough Courts: Poor Products

All this adds up to strong action against counterfeiters across the world, but a more leisurely response in terms of redesign of banknotes to give them rapidly verifiable visual and electronic features that could embarrass the counterfeiter.

"We expect prices of chip RFID in banknotes to start at 10 cents or so and drop to four cents at lowest so they will probably only appear on notes worth at least $100"

That little old lady with her dud £20 ($32) bill is not receiving prime attention anyway. It is the high value notes used and abused by drug runners and, closely associated, the new terrorism that governments are energetically reviewing.

Action in Japan

The Bank of Japan has backed the world's smallest RFID chip – the Hitachi Mew Solutions product – specifically for high value notes and it is said that the first notes with the chip in will appear next year. We expect prices of chip RFID in banknotes to start at 10 cents or so and drop to four cents at lowest so they will probably only appear on notes worth at least $100 and therefore sell globally at no more than 10 billion yearly – still a good boost to RFID volumes. Also, we understand that a high value Euro banknote will be trialled with an RFID chip next year in The Netherlands, presumably with one of the new Philips ultra small chips, as we reported in SLA 14. It has been reported that chip makers, Philips and Infineon are both involved in this project backed by the European Central Bank (ECB) and targeted for full roll-out in 2005.

Hidden Agenda?

This is interesting because it would enable bank notes to be covertly tracked and counted. It would not just deter counterfeiters. Flying Null (FN) in the UK has a bank note security ribbon detectable a few centimetres away with digital encoding and no chip. The company says it could uniquely code every Euro for decades to come at a fraction of the cost of a chip. Others in Europe are about to announce ultra low cost chipless RFID in the form of printed ink detectable at a few centimetres (the FN product is made by a vacuum process. Inkode seems to have got some of its microwave RFID "Taggents" into the paper of some banknotes as has NHK in Japan with magnetic fibres, but neither of these processes are directly digitally encodeabel. Is the digitally-encoded, covertly monitored banknote about to arrive?

For further information:

Flying Null: www.flying-null.com
Hitachi Mu Solutions: r-imura@hdq.hitachis.co.jp
NHK: sugahara@nhkspg.co.jp
Philips: t.riener@grk.sc.philips.com

For more information on the Hitachi Meu chip, see the Hitachi Smart Labels USA 2002 conference lecture in this months downloads section: http://www.idtechex.com/journal/upload/sla19.html

New IDTechEx Associates

Adrian Becks, an academic member of the Auto ID Center and lecturer at Leicester university, Dr Robb Clarke, of Michigan State University and Andrew Howe, formerly of Sentec, have recently become IDTechEx Associates, and will write guest articles and aid our consultancy work. See www.idtechex.com for more details of our associates and consultancy.

A Focus on Philips

Interview with Katja Kienzl, marketing manager of RF tag and label IC's, Philips Semiconductors

Philips' expertise lies within making RFID IC's (integrated circuits) for contactless devices. Their position in the value chain is horizontal: they do not make complete labels themselves, this is done by their partners and resellers. This strategy has been clearly successful, with Philips IC's market share being over 50% for contactless smart cards. This also allows end users to second source smart labels based on the same chip, and means Philips hold a strong position in progressing universal standards.

Products

With the recent addition of a UHF IC (described below), Philips' portfolio now covers all the chip RFID frequencies. The I.Code chip is primarily for smart label use, , while hitag is typically used in robust tag applications and mifare for epurse and transport applications.

Kienzl said Philip's have now sold about 500 million RF IC's into three categories:

1. Vehicle immobilisers (car clickers)
2. Contactless smart card applications (mainly transport)
3. Tag/label IC's

Figure 1: Philips' technologies for tags and labels

Vehicle Immobilisers

The use of RFID for vehicle immobilisers was one of the early successes of RFID, since tag cost was not critical and this is a "closed" application. Despite 40 to 50 million new vehicles made yearly (not all with immobilisers), and Philips being not the only supplier of RF IC's for this application, this market has demanded a high number of tags since each vehicle typically has two keys (hence two tags) but more lucratively also requires a reader, for which Philips also sells the necessary silicon components. Katja told us Philips have sold 100 million transponders for car immobilisers to date. This area also differs from the two other RFID business units at Philips since it employs a vertical approach – they supply the complete car key transponder.

Smart cards

Transport has been a very successful application of RFID, more so than people realise, if you include the number of RF tags and cards sold for road tolling, combined transport and epurse cards, passports and so on. Earlier this year Philips announced they had sold 200 million RF chips for contactless smart cards – mainly transport. Philips see this as a growing market, once banks and others are sure that the contactless versions are as secure as their current contact ones, contactless cards could replace most contact ones meaning more convenience for users.

Figure 2: Philips' RFID roadmap

Tags and labels

Kienzl told us that one of the quickest growing businesses is now with tag and label IC's, especially for supply chain management. Sales of their tags have mainly been into closed applications, where standards are not required, and long trials are not necessary as ROI is now quickly achieved (and in many cases by 6 months). Because closed systems are generally typically relatively small in size, the infrastructure is often simpler and less complex than open systems which generally need to cope with many more tags and a much more complex, spread infrastructure.

One example of a closed application proving a fast ROI are rental systems where the RFID tags can be reused. The national library of Singapore, for instance, uses 6 million RFID tags (based on Philips IC's), which tag each library book to reduce the labour of stock counting and to help automate check in and check out of books. As the tag is used for the life of the book, tag price is not as critical had the tag needed to be disposable. This example parallels others such as Chep (UK/USA), Blockbuster (USA), Scottish Courage Brewing (UK) and Athelia (France), tagging crates, videos, beer kegs and gas cylinders respectively for improved rental control.

Philips have sold approximately 200 million IC's used as smart labels. Currently their IC price for the most basic chips (I.Code) start at under 20 cents per chip for one million, but their development of a scaleable production line means they expect to be able to produce billions of tags yearly when this volume is in demand, and, consistent with the Auto ID Centre, they say they can achieve 1 cent per IC once volume demand is high enough (tens of billions).

Progression with Standards

Philips, a member of the Auto ID Centre, are actively pursuing standards for use of smart labels in supply chain logistics applications. The GTAG approach is inline with their strategy, and they intend to be one of the first to market with an ePC compatible tag. Already they have released a tag compliant to the draft GTAG specification, the I.Code HSL (High frequency smart label chip – complying with the ISO 18000-6 and ISO 18000-4 draft standards), meaning their product range now covers all frequency bands for passive chip RFID.

Developing scaleable, high volume production methods

Philips have invested into Alien Technology, but have also recently announced their own IC connection technique, "I-Connect". This technique uses a flip chip method to bond the IC to a larger connector strap. The process works almost independent of IC size, and removes the need for customers to connect the RFID ICs in a clean room environment themselves. The connector area to the antenna from the package is larger than those directly from the chip, meaning antenna attachment is simpler and many different connection strategies to the antenna can be used, such as soldering, gluing, crimping etc. Flip chip processes are offered by other companies, but Philips' capabilities include high throughput (10,000 units per hour) and their large customer base means that their resellers can perform fewer and simpler steps to make the final RFID device, reducing their resellers costs.

Reducing the size of the IC is a necessary development to reach ultra low cost smart labels, since many more ICs will be fabricated for one silicon wafer if the IC's are smaller. Kienzl told us that on a chip size and functionality comparison, Philips now offer one of the "smallest IC's" - their current chip sizes are less than 1 square mm, but Philips will soon offer chips just a few tenths of a square mm in size. Currently, Hitachi have the world's smallest IC – the Meu chip – which measures 0.4mm, but with less functionality than some of the I.Code specifications.

Polymer Electronics

Philips demonstrated the first smart label based on polymer transistors back in 1999. Due to the poorer conductivity of polymers compared with silicon, the data transfer was slow, and the molecules broke down after several months. However, that was four years ago, and Kienzl explained that Philips have still been extensively

A Focus on Philips

working on development of polymer electronics, with promising results. However, she felt that certainly in the short to medium term polymer electronics does not pose a threat to silicon RFID because they believe that with advancements in silicon IC production processes they are developing they can achieve silicon IC prices very close to that of polymer IC prices. As a result, Kienzl feels that the better functionality of silicon will mean that chip RFID will still be the preferred option, and polymer electronics still has several significant milestones to reach before robust samples can even be demonstrated.

Other product developments within the next year include work on battery technology and eventually tags and labels incorporating sensors (which would require a battery powered label). Details of their road map are shown in Figure 2. For more information Philips will be presenting at Smart Labels 2002, 4-5 September, Churchill College, Cambridge University, or see www.semiconductors.philips.com. Katja Kienzl can be contacted at katja.kienzl@philips.com. Also see this months download section.

Progress with the World's Largest RFID Card Project

Is it 970 million adult Chinese that must hold the RFID (contactless) national smart card by 2010 or is the number 800 million? There is still some vagueness about this and other aspects of the project.

For a number of years, government officials have publicly discussed plans to replace the existing paper identity document with a more secure and durable chip card. The ID card project seems to be taking shape at last. The card will be a hard-wired 4-kilobyte memory card and not a higher-priced microprocessor card that can be loaded with additional features, says Pan Li-hua, a deputy director of a government chip card agency and secretary general of the Smart Card Society of China trade association.

Second Generation ID Card

He says the card, known in China as the 'second generation ID card' will only carry personal identifications. It will operate in contactless mode – that is by waving it within a few centimetres of readers to avoid wear and tear on cards and readers from repeated insertions. This ISO 'Proximity' mode is already the norm on mass transit systems using smartcards in China and elsewhere.

Many uses

Citizens will use the card to identify themselves in many settings, including when they make bank deposits, check into hotels and at airports, and when they trade stocks, Pan calls it, 'More than 100 areas' Pan says the government has chosen four Chinese smart card vendors to supply the card. China will not rely on foreign vendors for a project that is viewed as a national security priority, observers say.

Rollout This Year

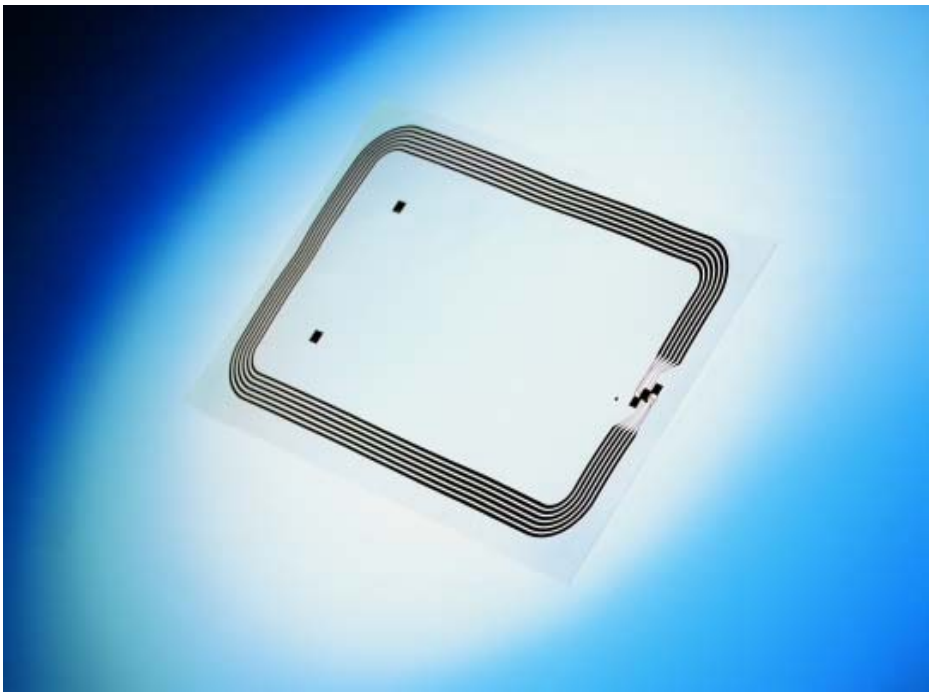
The government will issue the card later this year in Shanghai and a handful of other cities, Pan says. He says the government might issue 10 million chip cards this year, 70 million to 80 million cards in 2003 and more than 100 million per year after that. Within five years, he says, 800 million Chinese citizens will carry the chip-based IDs.

Doubts

Other Chinese smart card industry executives, however, remain sceptical that the programme will get under way this year. "you can never tell what the government will do." shrugs one. And Jacek Kowalski, president and CEO of French contactless smart and general RFID manufacturer Inside Contactless, recently visited China. He reports that Chinese vendors seem unsure what will happen. He feels that a rollout could still be two to three years away.

Card Technology magazine notes that, "Adding to the uncertainty is the expected retirement within the year of China's president, Jiang Zemin, who is likely to be replaced by Vice President Hu Jintao. The government may wait for the new chief to take over before moving forward with a program as sweeping as a new national ID card."

Smart Labels based on Philips' I.Code chip



News Snippets

Motorola using Chipless RFID to protect barcodes and other data carriers

Motorola are developing a chipless RFID tag which is aimed for track and trace applications. The tag could also be used as an alternative to EAS (one bit anti theft devices), but Motorola say they can extend this to several bits by "providing a PIN code like solution, i.e. protecting information carriers rather than carrying the information".

The read distance is up to 10 mm, and price is "very competitive with other solutions in the same class." It is between <$5 per 1000 labels for more the 1 billion (yearly) of labels and <$15 per 1000 labels for several millions of protected items. The readers price is dependent on the project size and are at the price range of less then $99 per unit.

Amos Redlich, of Motorola Israel, told us, "For trace and trace applications we intend to protect the information carriers - bar-codes in most cases. We strongly believe that this approach is much more cost effective than most of the RFID solutions, as customers may prefer to preserve previous investments in bar-code equipment, but will ask to protect their bar-codes against any unauthorized changes or counterfeiting. For this purposes we have developed a concept solution that demonstrate how a reader works in conjunction with hand held terminal. The two equipments communicate each other through Bluetooth communication protocol. The bar-code scans the label and the detector approves it. Our objectives is to integrate the two units into one terminal that reads an "approved bar-code". For more information see www.microtag-temed.com

The World's Thinnest Chipless tag

Flying Null, the Cambridge based inventor of magnetic tagging technologies, announced the release of what they believe is the thinnest, remotely readable, non-line of sight smart tagging system in the world. At only 3-micron thick and a millimetre wide the new FN Transfer Tag is 25 times thinner then a human hair. The hot foil stamped tags can be laminated, embedded, applied directly to the surface, over printed or even form part of the final packaging design.

Developed for brand protection or document security the transfer tags provide the same security levels of the existing Flying Null technologies. Once applied they provide each item with a permanent ID which can be read remotely using the Flying Null hand held reader.

Although thinner than Flying Null's other EMID® (Electromagnetic ID—a type of Chipless RFID) tags, the new Transfer Tags offer the same durability. They can survive a host of harsh environments varying from high temperatures at +200°C to very low temperature and many atmospheres of pressure. They can also withstand exposure to high levels of radiation, microwaves, and electrostatic and electromagnetic fields.
The tags can be supplied in various formats to cater for product authentication, batch control, warranty control or Track & Trace applications. Suitably positioned and applied the tags will also provide machine readable tamper evidence functionality. When used in tandem with other technologies FN Transfer Tags can add a covert machine-readable feature to security print features or optical technologies such as Holograms.

The new FN Transfer Tag is also being considered for recycling applications. The low metallic content and small size of the tags means that they introduce less then 0.3 parts per million into glass when recycled, also there is no danger of inclusions occurring.

For more information contact Rob Karsten: robk@flying-null.com or see www.flying-null.com

Marconi InfoChain

Marconi InfoChain, responsible for developing tags and antennas to work in typically unfriendly RF environments, such as metal and liquids, are sadly closing down after failing to find a buyer for the unit.

RFID tag monitors medication compliance

A new RFID tag has been developed, claiming to monitor medication usage with any standard blister packaging format. Developed by Canada's Information Mediary's Med-ic ECM, the RFID tag records the time when the contents of the blister pack are expelled from the blister, logging and following the patient' use of the medication.

The doctor and pharmacist can then at a later date download the information and make a judgement based on the patients compliance levels.

Information Mediary says the device can be incorporated into existing blister packs without needing specialized tooling or packaging design. Visual and auditory reminders could be added if required.

Non compliance with medication is estimated to add more than US $100 billion yearly to the US healthcare system and results in 125,000 deaths and 1 million hospitalizations.

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Background to The Internet of Things Part 2

Continued from last month (Smart Labels Analyst 18)

Internet and wireless network connectables

Three, almost unrelated trends have-been important in making the dream of the Internet of Things both realistic and necessary. We will look at each of these in detail. They are:

1. The beginning of thing-to-thing communication on the Internet.
2. The rapid adoption of wireless networks with a wide variety of connectables,
3. The sharpening need for total asset visibility.

Things electronically communicating on a small scale today

Today there are many examples of things communicating with things electronically. Some employ the Internet while others autodial down telephone lines with no computer involved. For instance, an unoccupied house may have various sensors to detect burglary or fire and even flooding. In the case of a problem being detected, the equipment may dial the number where the residents are on holiday and leave a synthesised voice message. There are many variants on this.

Linear systems

On the other hand video cameras in a chain of shops may send images to headquarters via the Internet for recording and late examination. What these have in common is that they are small scale and linear - one sensor to one destination in the main. They are not usually capable of forming ad hoc networks in the way people communicate in a crowd to find a lost child - lots of short-range messages achieve a long-range search. When the task is completed the network is dissolved forever. Even where various inputs are processed to send one simple message, as with the various burglar and fire alarms mentioned earlier, the processing is relatively unsophisticated.
Hard wiring, with all its limitations, is often used entirely or in part. Thus, the sensors can rarely be mobile or even easily reconfigured and the small number of inputs means the information gained is skimpy at best. The node that pools the inputs rarely has to coordinate with other nodes. It is all a long way from tracking fast moving consumer goods or even vehicles, yet these types of challenge are, as we shall see, central to the dream of the Internet of Things.

Wireless LANs and their new connectables

Let us now look at a different, though related industry, that of computer networking, and see where that is leading.

Hard-wired networks

Computer networking - connecting computers and computer-like equipment - is traditionally achieved with hard wiring, originally with copper wire but more recently with fibre optics and combinations of fibre optics and copper. It is done in order to save money and time and make new things possible, such as several small computers temporarily collaborating to perform a task previously only possible with a large computer.

Fibre optics

The fibre optic cable increasingly used in computer networking can cost more up-front but handle far more information far faster and thus make new things possible and saves money in the medium term. Fibre optics can be more secure against intrusion and electrical interference as well. Nonetheless, all wiring and cabling has the disadvantage of needing extensive installation and it is useless for mobile equipment. Indeed it is poor for equipment that has to be repositioned regularly. That is where wireless Local Area Networks (LANs) come in.

Wireless LANs

For example, in an airport, the cost of digging up a runway to connect to equipment on the other side can be enormous, particularly if the disruption is factored in as well. Connecting to mobile ground support equipment is totally impossible with hard wiring. In both cases, wireless LANs come to the rescue. These can be very simple. At Vienna International Airport, one aerial serves the wireless LAN over almost the whole campus. That does not replace the hard wiring: it enhances it. The two are connected. This is because wireless networks handle data more slowly - their capacity is limited. They are not always cheaper than hard wiring over life and there can be problems with crowding out the airwaves, particularly in locations like airports where safety is also involved. This is compounded by the fact that for very short ranges of a few metres or less there is a new and very popular global standard for wireless connection called Bluetooth. This will often eliminate the need for wiring between computers, printers, and other equipment in offices and make it much easier to reconfigure everything. However, it will further congest the airwaves.

New connectables

In all this evolution of computer networks, including a trend to so-called TCP/IP protocol which mimics the way the Internet works, comes another radical change. What is connected to the network is no longer mainly computers or computer terminals. A profusion of sensors, human interfaces, display devices, transaction systems and even vending machines are connected to an increasing number of computer networks and these networks are even subsuming telephone networks. Information Technology IT

Background to The Internet of Things

departments are increasingly being called Information and Communications Technology ICT departments to reflect this change and some are being converted from cost centres to profit centres.

The future

So what comes next? One trend is towards vastly more numerous, cheaper input devices to wireless computer networks. To take the airport example again, these ubiquitous, low-cost input devices will not replace the present "LAN connectables". In an airport these include intelligent video cameras that can recognise faces, the vending machines, payphones, flight display systems, card access terminals and automated ticket dispensers.

Connectables en masse

The cheaper, and therefore potentially more ubiquitous wireless input devices can include Radio Frequency Identification (RFID) tags on passengers, baggage, freight, trolleys, vehicles and much more. Indeed RFID tags are the archetypal ubiquitous wireless LAN connectable. At today's prices of 30 cents to $10 each they are beginning to be used in millions just in airports alone. At the lower prices (sub 5 cents) that will be possible in future, they will be used in billions in airports. Across all of society, it is possible to envisage RFID tags being used in trillions particularly if they can be reduced in cost below 1 cent. Orchestrating such a profusion of wireless LAN connectables is going to be radically different from the management of the few million wireless LAN connectables in use today. However, if it is achieved efficiently, totally new and amazing benefits to society will be achieved. This is another trend that is leading towards what we shall call the Internet of Things.

Total Asset Visibility

Coming from a third direction is another trend towards The Internet of Things. In the Gulf war, the US military had to open 30,000 containers just to find what was in them. The paper labels and manifests had been destroyed by sand and by handling. This was clearly a very serious and mission-critical failure of "asset visibility" and it is one of the things that has led the US military to become one of the most energetic pursuers of so called Total Asset Visibility, TAV, the dream being to know the location and status of everything in real time and at all times, right down to the cheapest, least-important consumable.

There are obvious potential benefits. They include less danger, greater effectiveness, and lower costs. Less manpower is needed and tasks can be deskilled. However, in many situations TAV, or some progress towards it, can make new things possible. For example a rapid response force may be effective in some distant land when it was previously impossible to mount an operation in the necessary timescale.

Manufacturing industry, the medical services and many other organisations are keenly interested in TAV for reasons that include competitive advantage, service improvement, and the need to survive on slashed budgets. We shall see that many of these organisations need to develop the concept of the Internet of Things to achieve these objectives. Indeed organisations such as Mars and Gillette in the fast moving consumer goods sector are already heavily involved.

Low cost RFID – "Smart Labels" – can make it possible

Potentially the most ubiquitous LAN connectable of all

One essential piece of the jigsaw that is needed if our three trends - things communicating with things, wireless LANs and TAV – are to progress further is a very low cost identification device, to ID individual items. Today, barcodes go someway in doing this, but have several serious limitations, line-of-sight, short read range, limited data and lack of robustness being just a few. Therefore the solution to this problem is seen to lie with Radio Frequency Identification. As the name implies, it may provide just identification to an electronic wireless interrogator. However, the name can be something of a misnomer because RFID can involve much more. Because RFID is so important to the subject of this report, we now look at it in some detail.

Definition

Radio Frequency Identification is the use of radio frequencies, or similar transmissions such as microwaves, to interrogate small portable objects known as RFID tags. These contain data. Anti-theft "EAS" tags in shops are not RFID because they do not contain data.

Big differences

In the last few years, the term "low cost RFID" has begun to be used and this may seem an artificial distinction at first sight. However, low cost RFID tags, typically taken as those costing less than one dollar each, are different from conventional tags in several important respects. These differences mean that low cost RFID tags can be applied in very different, new applications and interest very different groups of suppliers and end users. Most importantly, they are usually cheap enough to be disposable and thin enough to go in new locations, even inside sheets of paper in some cases, so they are usually called smart labels. They also create new markets. For example, over 200 million RFID tags have been used in car immobilisers ("clickers") and 30 million in a Hasbro Space Wars toy, neither of which replace anything. Over 20% of all RFID tags sold in the world today do new tasks, replacing nothing.

Uses of smart labels

The applications of RFID are very wide but most consist of one or more of the following:

Background to The Internet of Things

· Security, such as secure access cards that work at a distance.
· Safety, such as controlling dangerous medical disposables.
· Traceability, including product recall.
· Anti-counterfeiting, banknotes being an example.
Product handshaking – making sure the right things are together. One could auto reject counterfeit aircraft parts for example.
· Logistics eg. postal service.
· Carrying information from one place to another, such as warranty and repair history in a copier.
· Transactions, such as contactless financial cards.
· Positioning and locating, eg. lost animals, children, prisoners, the elderly.
· Entertainment – a feature of a toy robot for example.
· Fast track eg. of frequent flyers at an airport. Doors open and details are recorded without action on the part of the passenger.

Industry sectors addressed

Industry sectors using, or likely to use low cost RFID tags include:
· Military
· Retail – particularly supermarkets
· Industrial/commercial
· Life Sciences – human and animal
· Logistics – production lines, postal etc.
· Financial

However, so far, Military and Life Sciences applications tend to be some of the most sophisticated and therefore expensive, examples being tags that can:

· Hold alterable and unalterable data and sense position, even communicate with each other.
· Sense parameters such as glucose level while implanted in living tissue.

Nonetheless, even in these sectors there is a great interest in TAV even for high volume, low-cost items. By contrast, RFID is not commonly used in general retailing, libraries and garden centres yet but six billion 2 to 6 cent EAS anti-theft devices are consumed yearly in these sectors. Some companies are beginning to combine RFID and anti-theft in one label, preferably fitted on manufacture ('source tagging') and success with these will transform the situation.

Horizontal applications

The reason why RFID is seen as the most desirable identification device for The Internet of Things is because of its huge number of applications, which result in multiple paybacks and savings and its often low price. Some applications cross most industry sectors, asset tracking being one, where theft is detected and provable, stolen goods can be returned to the rightful owners and even the right location in their premises if it is electronically recorded on the tag. The tag or in the network may also permit inventory to be counted and identified easily for accounting purposes, often without approaching the product.

Features and benefits of smart labels

RFID tags help in these areas by providing benefits such as some or all of these:

· Lower system cost over life (eg. vs barcode, manual or forensic systems)
· Greater reliability and accuracy
· Faster action
· Tougher for criminals to crack
· More tolerant of obstructions or misorientation
· Will work under environmental extremes
· Can gather data during use and perform several tasks ('multi-functional')
· Does not deface product: can be covert
· Can provide something new, such as being the amusing feature of a toy

Detailed benefits

Let us now look in more detail at RFID benefits. Today, where RFID beats security printing, barcodes, conventional (rubbed) magnetic stripes or visible writing on products and labels it is usually because it has many of the following capabilities:

· Not limited to contact or line of sight.
· Reads faster – typically in 0.1 seconds – and many can be read at the same time or in a very short space of time (anti-collision).

· Is capable of being put in awkward places, even buried in many products during manufacture.

· Virtually maintenance free. Readers and tags are more robust. Most tags do not need a battery and have virtually unlimited life.

· Reads almost 100 per cent accurately (almost no false reads or failure to read).

· Reads through ice, dirt, paint, steam, water, wood and other non-metals including humans and sometimes through or round metal obstructions.

· Tough to counterfeit or emulate (mimic) particularly if designed specially for security.

· Tag is capable of doing calculations in some cases such as scrambling and unscrambling messages.

· Capable of carrying more data than barcodes, handwriting etc.

· Sometimes read-write remotely i.e. can capture data repeatedly, have data removed and replaced at a distance. If required can contain both alterable and unalterable data.

· Can have a lower system cost over life. For instance, readers that rub magnetic stripes wear them out, need regular cleaning and have fairly short life. Portable barcode readers often have moving parts and break when dropped. RFID readers and read-writers are usually cheaper to buy and last longer, with less maintenance. None have moving parts.

Business cases for RFID are usually based on efficiency, productivity, safety, security or improved customer

Background to The Internet of Things

satisfaction (eg. higher sales, lower return of product). Creating new forms of income can also give a pay-back such as making road tolling practicable or selling advertisements on a contactless smart card, a form of RFID.

New capabilities

In some ways RFID can be seen as a modern form of security printing, the hand-written or conventional printed label, the barcode or the conventional magnetic stripe but, being more expensive up front (though often lower total life cost), they do not always replace these directly. Rather, they solve previously insoluble problems such as:

· Batch details travelling on a car part through spray and bake.

· Locating lost animals automatically.

· Data and automated anti-counterfeiting features in or on very small items.

· Instantly sensing which sheet of paper has been removed from an archive of millions, and at what time.

· Proof of ownership of goods without defacing them.

· Preventing the copying and shredding of secure documents and alerting when one is taken out of a room.

Range

RFID now encompasses tags that work at anything from 20 micrometres to four kilometres. This is because a wide variety of problems are tackled, and having too long a range can be a waste of cost on tag and interrogatory electronics, mean unnecessarily high power consumption by the interrogatory electronics (perhaps ac mains needed instead of a button battery) or a problem with the tag being too big. It is also because the various inventions have different limitations in terms of range. Inventions with limited range may be in demand because of other unique features such as high security or 'seeing' through thick metal. Some of the potential applications replace bar-codes by doing more functions, in harsher conditions and without defacing the product.

A Gross Simplification of the Ranges Needed by Typical Applications—see table 1

Many technology choices

The many inventions in low cost RFID split into tags that either do or do not contain a microchip. There are radical differences in cost and performance between these two categories even to the extent that they should rarely compete with each other. Chip tags cost more and do more with data. Roughly speaking, chip tags are not usually available below 30 cents if ordered in quantities of less than one million but chipless tags are usually 1 to 20 cents even for orders of as few as 100,000 or less. Some chipless tags are already available for as little as 1 cent but it is difficult to see how complete, protected chip tags can get much below 10 cents in the near future or below 5 cents in 5 years.

Low cost chip tags

Low cost tags are below $1 for 1m range and below $5 for greater ranges. Low cost chip tags sometimes have the longest range of the low cost options (eg. 30 metres) and some can be re-written at a distance and store fairly large amounts of data. Large companies offer low cost chip tag systems and they have created the open standards necessary for most of the big applications. It is easy to make every chip tag have a different identification code and to interrogate groups of them simultaneously. However, they are the most expensive and often the largest

Table 1

Anti-counterfeiting features buried in banknotes and cheques Anti-counterfeiting and tamper detection features in packaging	20µm or more
Dog licence implant Asset management – indoors eg computers	Few mm or more
Mass transit and venue ticketing Anti-counterfeiting – documents, jewellery etc.	1-3 cm
Counting genuine products without unpacking sets Asset management – outdoors eg vehicles Wheely bin and pallet tracking Air baggage and freight processing	10cm – 1 metre
Road vehicle non-stop tolling and parking	3-10 metres
Locating animals, stolen goods, lost children, elderly, freight, and cattle management	50m-4km

Background to The Internet of Things

(because of the antenna) and thickest and most delicate (because of the chip).

Low cost chipless tags

By contrast, low cost RFID tags that do not contain a microchip are those that rely on magnetic materials or transistorless thin film circuits to store the data. These are the cheapest and thinnest, sometimes even to the extent of being invisibly buried in cardboard packaging or a banknote. Some types are only one micron thick and some can be printed directly on a product, using a special ink. However, most only work below 0.5 metres and most are read-only - or rewriteable only by contact methods. There are no open standards for mainstream ie. digitally-recordable chipless tags, partly because it is only in the last two years that big companies have entered the field.

Chip vs chipless low cost tags

The relevance of the relative benefits of chip vs chipless low cost tags can be summarised in this way:

There are two types of application for low cost RFID.

1. Where data handling is the primary challenge, chip tags are usually best.

2. Where certain physical properties are vital and/or tag price is extremely critical as with very high volumes and disposable tags on very cheap products. Here chipless tags are often best.

The opportunities being tackled by the proponents of chip vs chipless today look rather random. However, the above fundamentals, and the price differential, will lead to a polarisation where they compete less with each other : they will be applied where they are most appropriate. Both types of RFID could be appropriate for The Internet of Things : chipless is the best on price, a true contender for replacing the barcode, but chip offer greater data handling capabilities, and strong backing, with promises of reduced prices.

Table 2

Primary Challenge	**Data**	**Physical**
Examples of demands	· Large memory · Long range · Rewriteable · Every tag has different ID · Need to read many tags simultaneously. · Battery boosted	· -100°C to +250°C working. · Can be embedded in paper. · Needs to see through metal. · Can be brutally treated · Not damaged by radiation or other sterilisation processes.
Best solution is often	Chip tags	Chipless tags
Examples of actual and potential applications	· Pallet status · Parts in manufacture · Road tolling · Smart cards · Animal implants · Car immobilisers · Library books	· Brand protection · Bank passbooks · Banknotes · Medical disposables · Pharmaceuticals · FMCG logistics

Many data carriers

The Internet of Things does not and will not depend solely on one type of data carrier. Ubiquitous tagging will involve more than just smart labels. Perhaps there may be some optical (barcode) readers linked by Wireless interrogators and the Internet. Other technologies such as Global Positioning System (GPS), Bluetooth, wireless LANS and even biometrics, including finger prints and chemical/DNA taggants, may be used, most likely by networks within networks, allowing complete asset visibility and tracking. Barcodes, for example, still win over smart labels in some circumstances, because:

· Barcodes cost almost nothing to make, compared to the current price of smart labels.

· 2-D optical barcodes can store data at a higher bit density than some RFID.

· There are no worries about radio regulations.

· Readings are unaffected by adjacent metal.

However, for item and pallet level tracking, low cost RFID including smart labels will take most of the market, due to the advantages of the technology aforementioned. This could equate to a demand for trillions of smart labels yearly, but only if the price is right.

The Internet of Things will employ many types of connectable

Cleverer RFID and GSM and GPS-

Background to The Internet of Things

based devices

Although cleverer and more expensive forms of transponder will not be used in the highest volumes in The Internet of Things, they will have a place. Some battery-driven (ie. active tags) no bigger than a credit card can be located to an accuracy of 20 metres at 4 kilometres using UHF beams and they are used to monitor cattle and vehicle movements. A cow not moving for 24 hours may be unwell for example. Appropriate disposable batteries costing 2 cents and rechargeable ones costing 20 cents are already available.

Adding positioning techniques based on satellites (GPS) or radiotelephone transmitters (GSM) permits more accurate location in real time, over longer ranges (there is currently no hope of having real time location with trillions of one cent tags because their short range would require an intolerably large number of interrogators to be positioned so they are never out of range).

One company in the US even claims to have developed a $10 disposable paper radiotelephone, so GSM-based low-cost identification devices may be on the horizon that can be located at 10 kilometres. However, this is unlikely to be a product costing cents. If anything, it will be a modest-volume part of the jigsaw.

Sensor input and other devices

Also expensive, but having a place in The Internet of Things, are tags that monitor variables such as history of temperature, time, shock, radiation sterilisation, bacteria, and gaseous environment. Some are already implanted in humans to monitor blood chemistry etc. and, because this is done without human intervention at the time, wireless networking of these also comes within the definition of The Internet of Things. Already firemen have tags that monitor heart rate, position etc. in real time, radioing back the data.

Sensor tags in machinery, buildings etc. can monitor danger, theft, tampering, identify the operator and so on. For example, every airside vehicle at an airport can be signalling its battery state, driver identification, direction, speed etc. in real time. SITA and IBM are working on just this.

The Internet of Things is more than just a clever connectable

Further to just the tag itself, is the infrastructure of the "back-end" of the system; the way data is handled, the driving software, and so on. This will all require an initial upfront cost usually far outweighing the cost of the tags themselves (maybe from a half to nine-tenths of the total system cost), and requires discussions of standards, methods of data handling, privacy concerns and implementation issues.

Further details about The Internet of Things can be found in the IDTechEx publication: The Internet of Things, www.idtechex.com/books.html

Intelligent & Smart Packaging Conference, Miami, January 2003

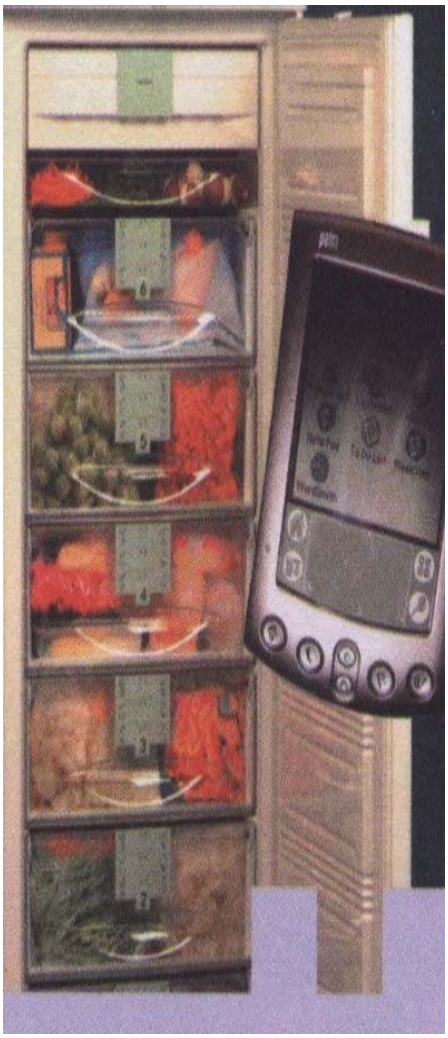
IDTechEx and Pira International will jointly host a conference on intelligent and smart packaging. The conference aims to provide some good case study applications of smart and intelligent packaging being used today, together with technical review papers of the latest technologies and some blue sky glimpses at what the future will bring. If you are interested in speaking or attending this event then please email: info@idtechex.com

IDTechEx will also be hosting the annual Smart Labels USA 2003 conference in Cambridge, MA, USA in late March, and a one day smart labels in Healthcare conference in London in April 2003. Keep an eye on www.idtechex.com for details of all these events.

Case Study: Liebherer's Smart Freezer

Cambridge Consultants has been working with Liebherer to help them develop an 'intelligent freezer'. The system is based around fitting smart tags to frozen food. A reader device identifies the freezer drawer the food is stored in, the date the food item was placed in the freezer and its storage life. A list management system enables the householder to keep a record of minimum stocks and a current shopping list. Data management options such as menu planning and automatic re-ordering of shopping via a modem link could also be included as future system enhancements.

For more information contact Nicola Millar at Cambridge Consultants on: Niola.millar@cambridgeconsultants.com



Smart Labels Analyst • **Issue 19** • **August 2002**

The monitoring and control of chemical inputs to arable farming systems

Guest Commentary from Adrian Watts, Professor PCH Miller (Silsoe Research Institute), Professor RJ Godwin (Cranfield University at Silsoe)

Abstract

Growers are currently under increasing pressure to manage and record more information. This has been influenced by enhanced consumer awareness, as well as added environmental and employee legislation. There are currently a number of schemes and advisory groups, which promote and inform the grower of what to record, and how to record it. These are all based on manual entry systems, which are totally reliant on the grower and or operator.

This project is investigating the best ways in which the record creation process could be automated. This would result in records which are more complete, created on the appropriate date, and above all correct. Automation would mean giving the tractor/sprayer combination knowledge of the products in use. This has benefits, such as interlock operation to stop non approved chemicals being used, ensuring the operator is certified, and allowing automatic conformance to LERAPS and COSHH legislation.

The first year was concerned with identifying suitable technology with the ability to store and transmit data about chemical products, from container to applicator. The major criteria were for the technology was that it must not influence product price, must be easily integrated into the packaging of the chemical product and that storage device must not require a power supply. Two technologies emerged. These are 2D barcodes and Passive RFID (Radio Frequency IDentification)

These two technologies have problems. To successfully read a barcode, the code itself must be in good condition, and the reader must be clean and free from damage. A 12 month experiment involving 30 sprayers/spreaders is currently ongoing to determine how much dirt and damage is likely to be encountered. RFID tags are still expensive in comparison to barcodes (10p-£1 depending on volume). Other problems include greater regulation on radio emissions, and less defined standards, although this is less so with ISO 15693 being released in September 2001.

In order to gauge possible uptake of new technology by growers, and to source data with respect to their current practices a questionnaire has been compiled. Results from a small trial sample of 20 growers and contractors have yielded some interesting results. Examples include inadequate COSSH assessment completion, different chemical storage practices and different input recording methods. A revised questionnaire will be sent to a much larger sample shortly.

Future work will concentrate on developing an RFID based system, including interface between reader and tractor computer, a proposal for the architecture of the system, guidelines for positioning of the necessary electronic equipment, and expansion of the system to other operations.

For further information, please contact:
Adrian Watts
Tel: 01525 860000
Email: Adrian.watts@bbsrc.ac.uk

Jewellery Tag Counters Phone Theft

A jewellery student in the UK has combined fashion with technology in a bid to solve the problem of mobile phone theft – and his work has already attracted the attention of New York based fashion house Donna Karan and others.

Billy Greenhalgh has just completed a degree in metalwork and jewellery at Sheffield Hallam University. He has developed jewellery which features tagging technology borrowed from contactless smartcards. A mobile phone is modified so that it will only make outgoing calls when it is within 60cm of the RF tag, worn in a necklace or ring.

The work has been shortlisted for the final round of a Design Against Crime competition co-sponsored by the UK Home Office and the Design Council of the UK. The competition aims to encourage manufacturers to include crime prevention and crime reduction in their design processes.

Greenhalgh was assisted by the Digital Technology Research Centre at Sheffield Hallam to develop the jewellery. Siemens of Germany provided a handset for use in concept demonstrations.

Smart Labels 2002

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Delegates from 22 countries registered at time of print, at least 200 are expected again this year.

4-5 September 2002 (Optional Workshops 6 September)
Churchill College, Cambridge University, UK

Smart Labels 2002 will be the third IDTechEx UK conference, with at least 200 delegates expected again following last year's 218 from 20 countries. The conference programme is now full with **28 speakers over two days**.

From left to right: Kings College chapel (built 1481), Cambridge University
Kings College Chapel in grounds: Kings College is the venue for the "Meet the Experts" dinner to be attended by all conference delegates.
Churchill college auditorium (external view, with a tiered lecture hall with the conference and exhibition will take place).
Churchill college conference centre at night.

Day One: Big Issues, Big Potential Users [Wednesday 4 September 2002]

Chairman's Introduction - Smart Labels in the Year 2010: **Dr Peter Harrop, Chairman, IDTechEx, UK**

"RFID Tagging within a Global Courier Express Network": **Trevor Peirce, Manager, DHL, GERMANY**

"Electrolux Master Cyber & Assistant Fridge: The gastronomic solution in food logistic and food care":
Udo Baumann, Vice President, Dipl. Engineer, Head of Professional Innovation Centre Electrolux, GERMANY

"Tracking Gap Clothing Using Smart Labels": **Neco Can, Director, Project Management, The Gap, USA**

"Measuring Car Park Utilisation": **Mark Percival, Head of Systems and Integration National Car Parks (NCP), UK**

"Diamond and Gemset Jewellery: Need for Anti-fraud Tagging and Secure Archiving":
Mr Julian Boles, Director General, British Gemmological Institute, UK

"Find Out How The UK 's Biggest Brewer Has Been Using RFID Over The Last Four Years": **Graham DN Miller, Project Director, Scottish Courage Brewing Limited, UK**

"The World's Most Advanced Passports Thanks To Smart Labels": **Charles Yap, Iris Technologies, MALAYSIA**

"E.Val : The Contactless Ticket In Exploitation": **Michel Barjansky, Paris Transport System, RATP, FRANCE**

"Making It Real: The Internet of Things": **Helen Duce, Associate Director Europe Auto-ID Center, EUROPE**

"RFID Use in Japan": **Masamitsu Miyake, Chief Executive, & Paul Groves Miyake, JAPAN**

"Coordinated RFID Tagging Across The Netherlands": **Martin Damen, Rigo, THE NETHERLANDS**

"Healthcare, Theme Parks and Other Applications": **Trevor Crotch-Harvey, Managing Director—DataLabel, Innovision Research & Technology Plc., UK**

"Convergent Retail Technologies": **Phil Lazo - RFID Development Director, Sensormatic, USA**

Continued >>

Day Two: New Announcements and Innovative Technologies [Thursday 5 September 2002]

Chairlady's Introduction - Implementing RFID in the Post Office:
Jean Cooper-Moran, Consignia (The British Post Office), UK

"Smart Label Solutions Now and in the Future":
Katja Kienzel, Marketing Manager for Tags and Labels, Philips Semiconductors, AUSTRIA

"Ecotag Pushes The Range Boundaries In UHF Passive Tags - 9 Meters In Isocard Format Low Cost Passive Tags":
Mike Marsh, Chief Executive, Trolley Scan, Pty Ltd, SOUTH AFRICA

"Applications of RFID in Singapore": Lim Peck Hui, Chief Executive, Tunity Pte Ltd, SINGAPORE

"Readers for RFID Smart Labels - Breaking The Mould Of Traditional Proprietary Thinking":
Clifford Horwitz, Chairman and CEO, Samsys, CANADA

"The Next Generation of RFID Tag Readers": Tom Grant, Chairman, ThingMagic LLC, USA

"Migration Route – EAS To Chipless To Chip":
Douglas Karp, Senior Director, Operations and Strategic Marketing Checkpoint Systems Inc, USA

"Movement Powered Tags": Chris Richardson, Principal Consultant, Radio Devices, Siemens Roke Manor Research, UK

"Multi-Bit Chipless LC Tags: Design and Applications": Richard Fletcher, Researcher, MIT Media Labs, USA

"Ultra-thin Low Cost RFID Tags": James R Sheats, PhD, VP of Research & Development and CEO Rolltronics Corporation, USA

"Inks Beyond Contrast: Applying Graphic Arts Processes for a Printed Future":
Dan Lawrence, Project Manager RFID, FlintInk, USA

"Smart Labels beyond EAS and RFID": **Andrew Jackson, Applications Marketing Manager Sherwood Technology Ltd, UK**

"Commercial Application of De-classified Technology in RFID Systems":
Christopher Coomber, Director QinetiQ Metal Printing, UK

Exhibitors at time of print include:

- ADT Fire & Security (Sensormatic), **USA**
- activeRF, **UK**
- Asset Tracker , **South Africa**
- IDTechEx, **UK**
- Innovision, **UK**
- Miyake, **Japan**
- Plastic Logic, **UK**
- QinetiQ Metal Printing, **UK**
- QuantumTag, **South Africa**
- Tunity Solutions, **Singapore**
- Sygade, **South Africa**
- PIRA International, **UK**

For full programme information, and to see who is already attending, please go to:

www.idtechex.com

Plus: Two optional workshops will be held on 6 September 2002

Session 1: morning workshop: **RFID Smart Labels**
by Richard Fletcher, MIT Media Lab and Raghu Das, IDTechEx

- Pros & cons of chip and chipless tag technologies and their applications
- Market forecasts and trends
- Examples of RFID being used, how many have been sold, and into which markets
- New potential applications and advice on entry to market
- The Internet of Things: challenges, product design and opportunities
- Hear about new inventions not covered in the conference, and examine many different tag samples
- Workshop materials include over 80 slides and some samples to take away

Session 2: afternoon workshop: **Smart Labels Beyond RFID and EAS**
by Stuart Evans, Plastic Logic, Andrew Jackson, Sherwood Technologies, Reuben Fuchs, PowerPaper and Dr Peter Harrop, IDTechEx. Slides and samples to take away.

- "Magic" inks, non electronic & electronic laminates for brand enhancement & diagnostics
- The significance of transparent polymer electronics
- The exploding market for indicating food doneness, temperature humidity, risk of sunburn and many other excursions
- Intelligent packaging
- Future trends with disposable timers, voice chips, electronic medical patches, radios, cellphones and others

IDTechEx Publications

Full details of these publications (including a contents list) can be found at www.idtechex.com

The IDTechEx Web Journal

Smart Labels Analyst and Smart Packaging Journal—NEW

These web journals are the first to concentrate primarily on low-cost RFID and other responsive devices, colloquially known as smart labels and smart packaging. We try to give a balanced view of the subject. To this end we do not accept paid advertising or sponsorship. Our text is not therefore advertising by another name. Further, we seek to provide original useful material, not available elsewhere. For example, we attend many of the conferences you may miss and we analyse their content. We visit faraway places where interesting work is being done and give you the news first. We interpret future trends and regularly have guest columnists giving insights from their expertise.

Almost all articles are written by our own technical graduates as they travel the world, visiting the start-ups, the conferences and so on. However, to broaden the viewpoint we also commission experts from around the world to give their own input on important topics. Above all, we wish to tune these journals to what you need. The Journals are an ideal way to remain updated with the latest industry developments.

The Complete Introductory Report in low-cost RFID and beyond

The Smart Label Revolution

Mid 2002 New

By Dr Peter Harrop and Raghu Das, IDTechEx

Totally new mid 2002 • International case histories and company profiles • Technologies evaluated • 252 pages • Over 90 detailed tables and figures • Forecasts by technology etc to 2010 • Sales leads

The one stop guide to chip and chipless technologies, markets, standards, statistics, trends, lessons of success and failures, future opportunities, and the RFID movers, makers and shakers. Your business needs this knowledge to get ahead, whether you wish to make, install, or use these revolutionary devices. This 252 page report is illustrated with over 90 detailed tables and diagrams.

Over 60 international case histories and company profiles from: Australia, China, Japan, Eastern Europe, Singapore, South Africa, USA and Western Europe

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In Depth on Chipless

The Future of Chipless Smart Labels: Markets, Players and Forecasts

Mid 2002 New

By Dr Peter Harrop and Raghu Das, IDTechEx

Totally new mid 2002 • Forecasts by technology etc to 2010 • Latest new products and inventions • 271 pages • Over 105 detailed tables and figures • Extensive sales leads

This report expands on The Smart Label Revolution, by looking in far more detail at chipless tags, including a much wider range of technologies. These have enormous market potential. They are usually ultra low-cost from 0.1 to 10 cents each, even in modest quantities. This second report also analyses how the silicon chip and even batteries in conventional RFID will become printed, to lower cost and improve ruggedness so eventually most forms of low cost RFID become “chipless”.

In Depth on Chip

Chip Smart Labels: The Intelligent RFID

By Raghu Das and Dr Peter Harrop, IDTechEx

This report completes the series by looking in far more detail at chip tags. Disposable chip smart labels have a huge potential. At present there is a wide variety of technologies, including a diversity of frequencies and ranges, and this is complicated further by the evolution of standards. This report provides a comprehensive explanation of the technologies and standards involved, as well as analysing the potential of this industry, including new and conventional markets. Whether you wish to make, install or use chip smart labels , or consider the business case of these revolutionary devices, this report enables you to gain the knowledge to get ahead. The standards chapter is written by Professor Anthony Furness.

IDTechEx Publications

Full details of these publications (including a contents list) can be found at www.idtechex.com

Smart Transport: Smart labels, tickets and cards in land, air and water transport

By Dr Peter Harrop, IDTechEx

Now only £500 for SLA or SPJ readers

Transport is today's killer application for RFID, with enormous growth potential remaining. In the past, buses, trains, private road transport, water and air transport were very separate industries. Their tagging and ticketing was supplied by unrelated companies using different technologies and standards were few and far between. Now stored-value cards, remotely-sensed tickets and other advances are starting to share the same or similar technologies. Standards are evolving and interoperability is being energetically pursued.

This takes the form of intermodal transport passes in a city such as one stored-value card that gets you on any bus, train or ferry, as in Hong Kong, or interoperable bus cards across a country. These smart card and ticket technologies can be packaged into different shapes or electronically reconfigured. Then they are useful for a wide range of non-ticketing uses in transport. These include airport gold cards and frequent-flyer cards, and radio tags on taxis, buses, trains, baggage, freight, even people and airport ground support equipment.

These tags, often supplied by the same manufacturers, provide an enormous range of benefits from new earning streams to cost-reduction, improved facilitation and enhanced security. Users are increasingly doing one-stop shopping for smart cards, tickets and labels. This report analyses all these opportunities and trends. It is your reference

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The World's First Independent Report on…

The Internet of Things:

By Raghu Das and Dr Peter Harrop, IDTechEx

This report gives the reality, the dream and the emerging technology of The Internet of Things. Ultra low-cost smart labels, tickets and cards will play a huge part in it. In addition, RFID is linked, without human intervention, to Global Positioning Systems (GPS), GSM radio location, Bluetooth™ and other services. Virtual super-computing will make cost-effective the necessary large and rapid computations, as will cheaper data storage.

The Internet of Things will enable:

- Automated control of assets and people anywhere, anytime.
- Eliminating queues, tampering, theft and counterfeits.
- Large new markets for position-related services.
- Fast-moving consumer business transformed.
- Virtual supercomputing and other enabling technologies.
- Trillions of one cent RFID smart labels sold each year.
- Tens of billions of 5 cent RFID smart labels sold each year.

Publications	Net Price (GB£)	Net Price (US$)	Quantity	Total Price (£/$)
Web Journal : Smart Labels Analyst 12 month subscription	£399/Yr* (£468.83 inc VAT)	$640/Yr* ($752 inc VAT)		
Smart Packaging Journal: 18 month subscription (bi-monthly)	£299* (£351.33 inc. VAT)	$479* $562.83 inc. VAT)	€499*(€586.33 inc. VAT)	
The Smart Label Revolution (Introductory Report)	£600	$950		
The Future of Chipless Smart Labels : Markets, Players and Forecasts (In depth on chipless)	£600	$950		
Chip Smart Labels (In depth on chip)	£600	$950		
The Internet of Things	£1250	$2000		
Smart Transport **Discount**	£500	$800		
Electronic copy of any of the above (only when bought at the same time, or if already purchased). Per report.	£199* (£233.83 inc VAT)	$320* ($376 inc VAT)		
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