Near Field UHF RFID vs HF for Item Level Tagging

Everyone agrees that item level tagging is going to be the biggest market for RFID in terms of both spend and number of tags sold. Everyone agrees that item level tagging has its own, special requirements making it different from other categories of RFID such as the tagging of people, animals, pallets, cases and vehicles or RFID in passports, tickets and smart cards. Most people feel there is no going back on the choice of leading retailers and the US Military of UHF on pallets and cases, on the IATA specification of October 2005 requiring UHF on air baggage and the pan-industry collaboration that has led to UHF being chosen for tyre tagging in 2006. But there the agreement ends.

Needs of item level RFID
Potentially, the highest volume item level RFID will involve such things as books, consumer packaged goods and drugs from manufacture to recall and postal packages, including letters. Many of these items are small. Water and metal are frequently in, on or near these items. Smart shelves, often made of metal, need to distinguish one from another, however small they are, and yet groups of these items may also need to be read together, distinguishing them using robust multi-tag reading capability. Exceptionally accurate reading and lack of false reads is required with drugs, medical parts, aircraft parts and jewellery, for example.

Fuzzy boundary
The transition from case to item level is far from distinct. For example, a single bicycle in a case may even be larger than a case of 200 tins of sardines and involve even more metal. Indeed, Robert Ulrich of Wal-Mart has pointed out that 15% of his general merchandise is “case pack one-of-one”. Some retailers may therefore view with distress the preference of leading drug companies for HF RFID when UHF is standard for their pallets and cases. For example, for US deliveries, Pfizer has been tagging all Viagra and GlaxoSmithKline has placed orders to tag US deliveries of Trizivir both at HF. AstraZeneca will be next. However, in May 2006, we interviewed Pfizer and were told that it is not firmly committed to HF. It will see how it plays out.
This frequency is chosen because the tags are small enough for the smallest packs of drugs and they work well when bent around an item. They are tolerant of the metal in shelving and handling equipment and the water in medicines.

**HF is long established for item level**

These drug manufacturers were only following long established practice with items such as books in libraries (50 million items yearly), rented textiles/laundry and other items tagged at HF.

Figure 1.1 shows the TAGSYS HF tag that is fitted to Viagra items. It is the size of a postage stamp in order to give longer range than other, even smaller HF tags.

**Fig. 1.1 The HF tag that is fitted to Viagra**

Perhaps 20 million drug items will be delivered with HF tags in 2006 and 10 million with UHF. Exceptionally high percentages of successful reads and exceptionally low percentages of false reads seem to have been factors in the choice of HF. Conventional UHF was often found wanting in these respects although it is not a unanimous view in the pharmaceutical industry. Indeed, by Spring 2006, over two million drug items had been delivered to Wal-Mart under its mandate requiring the UHF RFID tagging of Type 2 drugs and some drug companies have said that they have yet to decide if UHF or HF is best for them.

Figure 1.2 shows, at bottom, a conventional Far Field (E Field) UHF label of about 2.5 centimeters square that has been trialled on drugs by Symbol Technologies (Matrics acquisition) compared with a much larger early dual antenna pallet/case tag using the same frequency and interface.
Near Field UHF RFID vs HF for Item Level Tagging

Fig. 1.2 Early pallet/case tag at top compared with item level tag at bottom, both being Far Field UHF constructions

Enter NF UHF

ODIN Technologies and, separately, IBM have recently tested FF UHF (transmitting a beam) and HF (flooding a controlled volume) for drug items and found HF to be best but the debate has moved on. Today, there is a rapidly declining number of suppliers recommending conventional FF UHF tagging of most items if only because most of the UHF proponents have switched to recommending what they see as a “best of both worlds” hybrid called Near Field UHF “NF UHF”. Instead of the antennas of tag and reader communicating by a propagating electromagnetic wave, commonly described as far field, they are designed to communicate by near E Field (electric capacitive) or by near H Field (magnetic) in just the same way that an HF antenna communicates.

Capacitive (near field electric) coupling is used by Cypak for smart medical packages and Motorola Bistatix™ licensees such as Power Paper, Dai Nippon Printing and Toppan Printing but at non-standard low frequencies (1MHz and a few kHz respectively). Technically, NF UHF means that the standard UHF Gen 2 chip is used but instead of the antennas of tag and reader communicating by Far Field (electric E field), they are designed to communicate by Near Field, including in just the same way that an HF antenna communicates (magnetic H field). This calls for a different antenna on and interrogator and usually on the tag as well if its performance is to be optimised, but the tag chip and reader electronics can be the same as those used for pallet and case tagging for example.
Most UHF far field tag designs will also work to a lesser or greater extent in the near field. FF antennas vary in size and design to allow them to work efficiently on a wide variety of products that are larger than most items: some, like the Avery Dennison AD420, include compensating technology allowing the antenna to adapt to the product allowing it to be used on a wide range of case materials and contents. The most common size for a UHF tag is ~100mm x 8mm, which is just over a quarter wavelength, and this gives similar efficiency to larger half wavelength designs, but smaller designs can still give ranges of a few meters, in a range of different form factors to suit the application.

**Not a new concept**

Ian Forster, Technical Director RFID, Avery Dennison, points out that NF UHF is not a new idea. Only the intention to use it in mass markets is new. He says, "Nobody should be surprised by this, as we use near field couplers in our production systems to allow us to test tags in roll format adjacent to each other, and RFID printers use a near field coupler to read and program RFID labels."

He also says: "We have been using UHF near field technology for at least three years, and I think it has a lot to offer in comparison to the HF technology, and will offer a viable alternative for item level applications; I think one factor which may concern people at the moment is that UHF readers are more expensive, but I think this is going to change very rapidly, making the reader infrastructure for item level highly competitive to HF."

**Impressive demonstrations**

Recent demonstrations of NF UHF were impressive. Impinj was reading 100 NF UHF tags in tiny floating balls in near proximity through five centimeters of water. The figure shows this with the reader antenna in the black base at the bottom. They also read over 200 items including foil blister packs, dry medicines and syringes thrown into a plastic box within a second. They read every one despite the orientation. See figure 1.3.
Appendix 2

IDTechEx Publications
Appendix 2: IDTechEx Publications

RFID and Smart Label Reports

Updated June 2006
RFID Forecasts, Players and Opportunities 2006-2016
Using new, unique information researched globally by IDTechEx technical experts, we analyse the RFID market in many different ways, with over 120 tables and figures. They include detailed ten year projections for EPC vs non-EPC, high value niche markets, active vs passive, readers, markets by frequency, markets by geographical region, label vs non label, chip vs chipless, markets by application, tag format and tag location. Cumulative sales of RFID are analyzed as are the major players and unmet opportunities. It covers the emergence of new products, legal and demand pressures and impediments for the years to come.

Updated June 2006
Real Time Locating Systems (RTLS) 2006-2016
This unique report covers the technology and market for what will be a multi-billion dollar market by 2013. It includes active RFID devices based on WiFi, etc, and over 30 case studies!

New in June 2006
How to Make Money out of RFID
There is a great need for profit optimization and careful product positioning and repositioning in the frenetic but unforgiving RFID market that is increasing ten times to become a $26 billion business in 2016. RFID is entering most sectors of corporate, public and private life so understanding how to create enduring profit from such a choice of designs and applications, software, hardware and services, calls for great care and modern management tools.

Updated June 2006
Active RFID 2006-2016
Active RFID is little reported, but its use is growing rapidly. Several applications have been above $100 million. It is responsible for over 20% of all spend on RFID. Learn how to use it and how to sell it. Forecasts to 2016
Near Field UHF RFID vs HF for Item Level Tagging

New in February 2006
Chipless RFID Forecasts, Technologies & Players 2006-2016
This report analyzes the prospects of the end game of RFID - ultra low cost tags that do not include a silicon chip. We assess the technologies that are available and emerging, players, challenges, the opportunity and give ten year forecasts.

Updated May 2006
Item Level RFID
This report details the business benefits of the “tag everything” scenario and explains the imminent transformation of postal, military, healthcare and other operations.

Short Range Wireless
Learn the unique benefits of Dynamic Short Range Communications, ZigBee, Bluetooth, WiFi, RFID and Near Field Communication, and explore how they can be used together to great effect.

The IDTechEx RFID Encyclopedia
This comprehensive handbook explains the magnitude of technology choices, applications and terms of radio frequency identification RFID.

Near Field UHF RFID vs HF for Item Level Tagging
Everyone agrees that item level tagging is going to be the biggest market for RFID in terms of both spend and number of tags sold. Everyone agrees that item level tagging has its own, special requirements making it different from other categories of RFID such as the tagging of people, animals, pallets, cases and vehicles or RFID in passports, tickets and smart cards. But there the agreement ends...

Printed Electronics Reports
Organic Electronics Forecasts, Players, Opportunities 2006-2025
This report brings you new, unique information researched globally by IDTechEx. 20 year forecasts are given for the full range of organic electronics – including logic, displays, memory, power, electrostatic and RF shielding and sensors.

Printed Electronics – updated April 2006
Printed electronics is a term that encompasses much more than the long awaited commercialisation of thin film transistor circuits TFTCs and organic light emitting diode displays. Both will have greatest potential when we can print them on common packaging material. TFTCs will be more robust and lower in cost than silicon chips so they will appear everywhere from singing gift cards to smart medical packaging and moving colour pictures in electronic books. However, those devices are only a part of what is going on.
The A to Z of Printed and Disposable Electronics
This is the first comprehensive handbook to cover the full range of terms associated with this
exciting, fast moving topic
Also available FREE with the Organics Electronics Forecasts, Players, Opportunities 2006-2025
report.

Application Specific Reports

Updated June 2006
RFID in Healthcare 2006-2016
The RFID business is growing so fast that few applicational sectors can beat that scorching rate
of growth. Healthcare is one of them thanks to the new tagging of drugs, real time location of
staff and patients and other developments including automated error prevention. This unique
report gives a full technical and market analysis illustrated by 63 case studies. It is a vital
resource for the healthcare profession and all who wish to support it.

RFID in Airports and Airlines 2006-2016
RFID is an extremely powerful enabling technology in airports and aircraft, serving to improve
security against criminal attack, safety against general hazards, efficiency, error prevention and
data capture and to remove tedious tasks. It can even create new earning streams where it
makes tolling feasible without causing congestion and where new airport “touch and go” cards
offer new paid services without delays.

Updated April 2006
RFID for Postal and Courier Services 2006-2016
Detailed ten year forecasts are given plus a full explanation of the technologies. In detail, there
are 30 new case studies of RFID in action in the postal and courier service in North America,
Europe, the Middle East and East Asia. The major breakthroughs that will provide future success
are discussed. Postal services ignoring this accelerating change will become uncompetitive and
suppliers missing out will regret it.

Updated June 2006
Food and Livestock Traceability – Forecasts, Needs, Best Practices
Strict new legislation on food traceability is largely driven by recent outbreaks of diseases such
as mad-cow disease, foot-and-mouth disease and avian flu and accidental contamination.
However, consumers also demand more information, as do the police and customs. This report
analyses the use of DNA, RFID and other technologies, with a profusion of case studies from
across the world.

Thirty RFID Case Studies in Retail
This covers retail and the Consumer Packaged Goods (CPG) supply chain. Introduction. Thirty
detailed studies from across the world. Jargon buster appendix

Thirty RFID Case Studies in Logistics
This has an introduction and thirty detailed case studies on RFID in the logistics industry, e.g.
freight tagging, driver access, condition monitoring, tachometer card. Jargon buster appendix
Near Field UHF RFID vs HF for Item Level Tagging

RFID Food and Livestock Case Studies
A major new report from IDTechEx provides, for the first time, no less than forty detailed case studies of RFID in action in food and livestock.

Food and Livestock Traceability Encyclopedia
It is tough to learn one’s way into the subject of food and livestock traceability nowadays. It has expanded to include the disciplines of medicine, biology, chemistry, electronics, computer science and more. We have therefore prepared this encyclopedia to give an unusually broad introduction to the acronyms and terms.

IDTechEx Subscription Services

RFID Case Studies Knowledgebase
Over 1,900 case studies, over 2100 organisations, 71 countries and growing rapidly. The variety of case studies in this Knowledgebase is a salutary reminder that, although the supply chain is seen as ultimately the biggest application for RFID, the less hyped applications such as Libraries & Archiving, Passenger & Personal Transportation, and Healthcare, are moving ahead extremely rapidly. This is a searchable electronic database, with many links and slide presentations, by far the largest available.

Smart Labels Analyst
Get news and analysis on emerging RFID and Smart Label technologies from this leading independent journal. Smart Labels Analyst is the first to concentrate exclusively on responsive labels, whether electronic or non-electronic. The biggest opportunity for these is radio frequency identification (RFID) but we also cover anti-theft tags, disposable timers and other labels for brand enhancement and diagnostics.

Smart Packaging Reports

Smart Packaging
Introductory report on the whole subject. Needs, applications and technologies for smart packaging whether consumer, postal, military, healthcare or other. 350 organisations are covered.

Electronic Smart Packaging
This report is an in-depth study of electronic smart packaging, the hottest sector. Forecasts to 2015. Already over 50 billion packages have been fitted with electronic smart packaging devices - and now the market is really taking off. This report exclusively analyses this extraordinary situation based on the imminent commercialization of the toolkit of technologies which will open up the industry.

Consumer Smart Packaging
Smart packaging brings additional useful and valuable benefits to the consumer. This book focuses on documenting, understanding and describing how unmet consumer needs can be satisfied by smarter consumer packaging, with specific chapters of the food, beverage, household products and health, beauty and personal care market sectors.