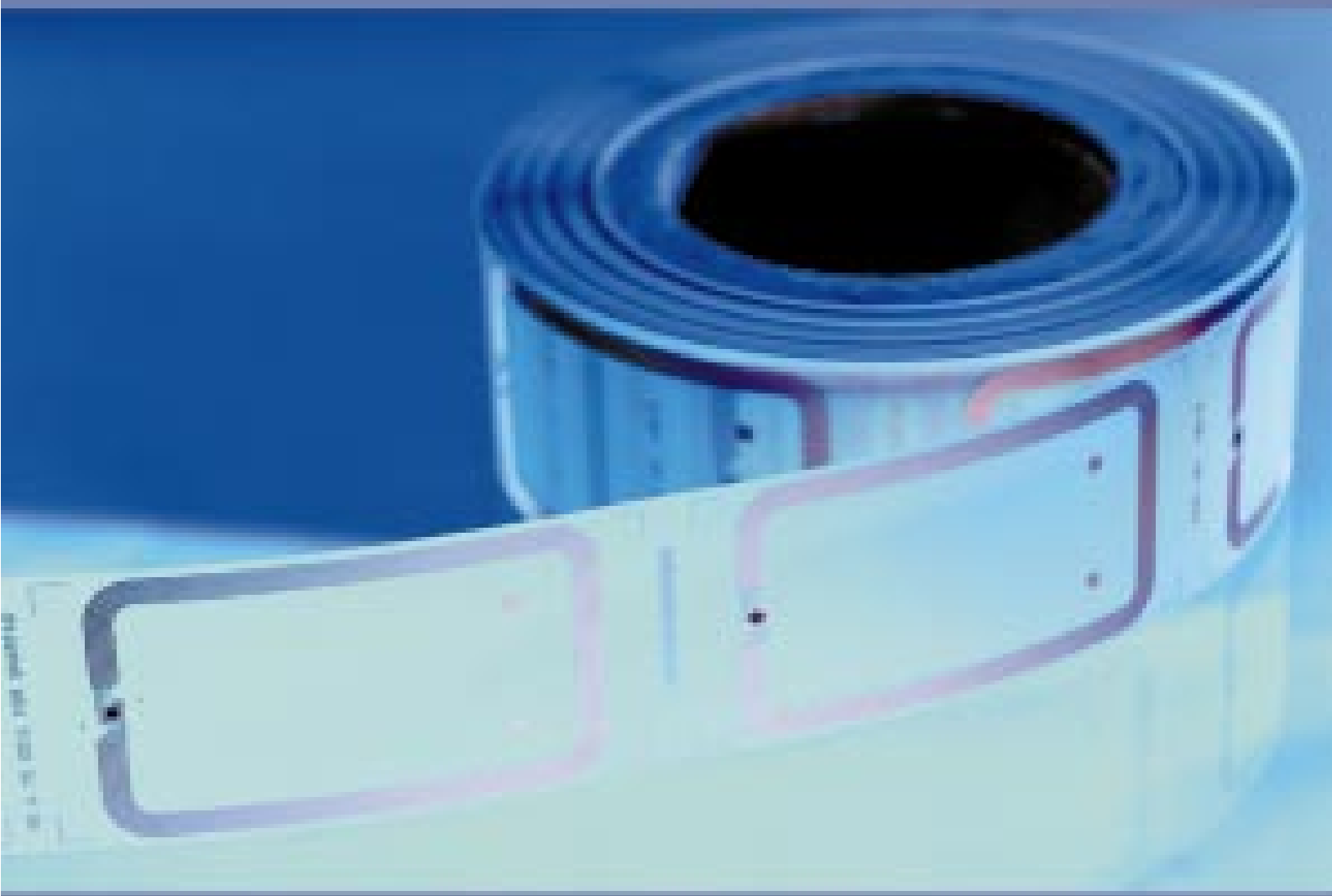
Global Commerce Initiative EPC Roadmap



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About the Global Commerce Initiative (GCI)

The Global Commerce Initiative is a voluntary body created in October 1999 to improve the performance of the international supply chain for consumer goods through the collaborative development and endorsement of recommended standards and key business processes. GCI operates through an executive board composed of senior representatives of more than 45 companies drawn equally from manufacturing and retailing that do business across continents or via global supply chains. It operates under the sponsorship of eight existing organisations representing the interests of one million businesses, large and small. For more information on the Global Commerce Initiative and the GCI EPC Working Group, please visit www.gci-net.org or contact:

Sabine Ritter
Global Commerce Initiative
+49 221 94714 423
sabine.ritter@gci-net.org

Dr. Gerd Wolfram
METRO Group
+49 211 969 2100
wolfram@mgi.de

Patrick J. Rizzotto
Johnson & Johnson
+1 908 904 3567
prizzot@cscus.jnj.com

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Sachin Shah
IBM Business Consulting Services
+44 207 021 9444
sachin.shah@uk.ibm.com

Sean Campbell
IBM Business Consulting Services
+1 646 598 4071
sean.campbell@us.ibm.com

Bernd Bueker
IBM Business Consulting Services
+49 211 476 1690
bernd_bueker@de.ibm.com

Kathryn Gramling
IBM Business Consulting Services
+33 683 830 294
kathryn.gramling@us.ibm.com

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1. Introduction to the EPC Roadmap

1.1 Foreword

Radio frequency identification (RFID) is a technology that has been around for more than half a century. In the last few years, however, its tremendous potential has begun to be harnessed to deliver new century solutions to the way manufacturers and retailers do business in the food and consumer packaged goods industry. In particular, the benefits to end consumers are also being realised by enabling improved on-shelf availability and providing the capability to enhance the shopping experience.

Enormous progress is being made on the commercial applications of this technology that make the entire industry supply chain visible, efficient, and collaborative. However, some challenges and barriers to a broad implementation of RFID still exist. Some companies are leading the way with the technology applications and pilot testing of RFID tags attached to items, cases, and pallets. The lessons learned from these early adopters acknowledge these challenges and barriers, but they also point to benefits already proven in these piloted tests and to those benefits alluded to by the tremendous promise of this initiative.

This roadmap outlines both the technology and process initiatives that have the power to revolutionise our industry. It details the status of standards and reveals the results of early trials and their areas of concentration. By putting all the issues surrounding RFID and their implications to companies and to the industry into one report, we hope to encourage your company to consider adoption of a standards-compliant implementation of RFID.

Why EPC Roadmap and not RFID Roadmap? The Global Commerce Initiative (GCI) Executive Board strongly recommends the implementation of RFID technology based on open, global standards. The Auto-ID Center worked for several years on a concept for RFID and the Electronic Product Code or EPC, which is the key identifier and content of the RFID tag. The establishment of a new organisation, EPCglobal™, was approved in September 2003 as a joint venture of EAN International and the Uniform Code Council to support the industry with open, voluntary standards for this new initiative. GCI wants to promote the practical application of the Electronic Product Code, and, therefore, we have named this roadmap accordingly.

The roadmap seeks to answer five key questions at a high level:

1. What is the EPC, and what is the vision behind it?
2. What current progress is being made with EPC development, and what are the issues we need to act upon to make the EPC vision a reality?
3. What are the key application scenarios, and what are the compelling reasons to act now?
4. What does a company implementation roadmap look like?
5. What can the industry jointly do to remove the barriers for a broad industry adoption?

The full implementation of the EPC vision will take some time. If we do not get the groundwork right and implement the standards across the industry now, we will hinder wider implementation efforts before they have even begun. This also will prevent companies from gaining the full benefits the EPC can bring.

GCI is convinced that both manufacturers and retailers will benefit from the adoption of global voluntary EPC standards aimed at transforming and streamlining the industry supply chain. We do not want to repeat the mistakes of the past. We therefore encourage you and your company to support the emerging standards and the work being driven through EPCglobal™.

Let's make it work!

Antony Burgmans
Unilever

Zygmunt Mierdorf
METRO Group

Co-Chairmen of the Global Commerce Initiative

November 2003

1.2 Executive Summary

The radio frequency identification (RFID) technology was born midway through the last century and more or less forgotten for decades.

In the last years of the 1990s, however, new interest was sparked for this "new" technology that promises to streamline and speed up inventories, supply chains, and payment processes. It also promises in the long run to change the way we do business irrevocably.

Much has been written of late about how RFID is bringing a wealth of new technologies — and their resulting new business processes — into this first decade of the 21st century.

And it's not all media hype. Little doubt exists in the minds of most industry leaders that harnessing this technology and using the resulting applications and processes will have an impact even more revolutionary and far-reaching than the introduction of the Universal Product Code (U.P.C.) and retail scanning a quarter of a century ago.

It is because of this immense scope and the equally immense potential of this initiative that it was decided that the Auto-ID Center, which had spearheaded the industry project since its inception in 1999, would be succeeded by two organisations — the Auto-ID Labs and EPCglobal™.

The Auto-ID Labs began in the autumn of 2003 to carry on the technical and research aspects of the initiative. Six labs comprise the Auto-ID Labs group and are located in the US, Great Britain, Australia, Japan, Switzerland and China.

EPCglobal™ was created in the autumn of 2003 as a joint venture of EAN International and the Uniform Code Council (UCC). The launch of this organisation signals a redoubled drive toward a worldwide, multi-industry adoption of the key identification aspect of RFID — the Electronic Product Code or EPC — and its network of links to Internet technologies. The new organisation is charged with setting the EPC vision — a vision of companies having complete visibility in their standards-based, integrated supply chains at any time in any country in the world.

EPCglobal™ will spearhead efforts to support open, voluntary global standards for this new initiative and to promote the adoption of the EPC. It will also assist companies by providing the latest information on implementation, applications, pilots and field tests and more.

What Is an EPC?

The Electronic Product Code (EPC) has been called the "next generation bar code," but it is much more than that. The EPC basically is a coding scheme developed by the Auto-ID Center that uniquely can identify an individual item — whether that object is a consumer item, case, pallet, logistics asset, or virtually anything else. Instead of being printed on a paper label as with today's bar-coding system, this number is inserted into an electronic tag that can be detected with radio waves. This provides the ability to locate or track products through the supply chain, and to "read" these EPCs at a distance and out of direct-line-of-sight.

Electronic Product Code (EPC) 1

An EPC Roadmap

Thus, the roadmap for RFID implementation in the industry is being termed an EPC roadmap. This report joins the recent discussions on how this technology should be developed in the food and consumer packaged goods industry. In order for the RFID technology to be applied in this industry sector, however, there is a need for voluntary open standards to form the basis of all applications.

Several events have occurred recently that, when combined, suggest that this technology is now ready for wider adoption:

- Agreement of a common numbering standard — the EPC to identify objects uniquely.
- Transition of previous research and development efforts (largely done through the Auto-ID Center initiative) into a new organisation, EPCglobal™, which will now commercialise and administer this network of numbers and continue the development of open and voluntary standards.
- Field trials and pilots are increasing in number, and substantial increases are expected over the next two years. Most of the early trials are following the approach of learning first from pallet, case, and logistics asset-level tagging.
- Results from trials of item level tagging show that the benefits are considerable. However, a number of issues still need to be resolved before mass adoption at this tagging level.

What Is Radio Frequency Identification?

Radio frequency identification or RFID is a method of identifying unique items using radio waves. The big advantage over bar code technology is that lasers must see a bar code to read it. Radio waves do not require line-of-sight and can pass through materials, such as cardboard or plastic.

Key Study Conclusions

The key conclusions from this study are:

- A critical mass of manufacturers and retailers have conducted trials with this technology and are now preparing for wider adoption.
- Each company should consider adopting the EPC vision now. A growing degree of enthusiasm is taking place in the industry worldwide as would-be practitioners are seeing the successful results of the trials and pilots. The significant value of the trials has also convinced early adopters to continue their EPC journey.
- Competitor activity and requests from important trading partners are expected to accelerate the implementation of the EPC vision across the globe. Thus, it is essential to understand the implications for your business as early as possible.
  - The adoption of an EPC network plan/pilot between trading partners offers the opportunity to achieve supply chain convergence between suppliers and retailers.
  - Inevitably, the progress achieved so far has been driven by large multi-national organisations. However, an important aspect of the EPC vision is that the technology will eventually be available in every local independent store or small supplier, much as bar codes and scanners are today.
- The main benefits to a company and to the industry are through process change. The technology is simply an enabler. Significant benefits exist from applying the EPC vision within an organisational structure of an individual company. However, there are significantly higher benefits from end-to-end supply chain collaboration between trading partners across the entire industry.
- Today enough of the critical enablers are in place to test the EPC network now. Also in place are the open voluntary global standards, market-ready technology, and a willingness to move adoption forward across the industry.
- EPC implementation should be thought of as a step-by-step process — not a big-bang approach.

- Technology (tags and readers plus early versions of the integration technology) is considered to be nearly ready for wider adoption at market-acceptable prices.
- Expected convergence of radio frequency and power regulations will allow cost-effective usage of this technology.

This paper will focus on the following:

- The EPC network — an overview of the components.
- The critical issues that need to be addressed before the EPC vision can become a reality.
- The steps an individual company should consider when developing implementation strategy.
- A set of critical actions that the industry should consider undertaking collectively to enable this vision.

1.3 Acknowledgments

The Global Commerce Initiative (GCI) and IBM Business Consulting Services, which conducted the research and writing of this report, wish to thank the GCI EPC Steering Group for providing support, guidance and invaluable input to this report.

In particular, we would like to thank:
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In order to make the roadmap as practical and applicable to as many different countries as possible, study analysts had conversations with a number of industry representatives from around the globe. We wish to thank these companies for their willingness to share their insights:

Alien Technology™ Corporation
Auto-ID Center
Carrefour
CHEP™
The Coca-Cola Company
Dairy Farmers
Dixons Group PLC
EAN International
Eastman Kodak Company
EPCglobal™
The Gillette Company
Goodman Fielder Limited
Integrated Product Intelligence Ltd.
Johnson & Johnson
Kirin Brewery of America
Kimberly-Clark Corporation
Kraft Foods International
Lawson Inc.
LION Corporation
Loblaw Companies Ltd.
L'Oréal
Matrics, Inc.
Marks and Spencer
METRO Group
Nestlé SA
Philips
The Procter & Gamble Company
Royal Ahold
Sara Lee Corporation
Target
Tesco
Uniform Code Council, Inc. (UCC)
Unilever Best Foods
Wal-Mart Stores, Inc.
Woolworths (Australia)

2. The EPC Network

2.1 RFID Introduction & Background

In general terms, radio frequency identification (RFID) is a means of identifying an object using a radio frequency transmission. In a typical RFID system, transponders — or RFID tags — are attached to objects. Passive or semi-passive radio tags will 'identify' themselves when detecting a signal from a compatible device, which is known as a reader or interrogator, by emitting a radio frequency transmission.

Each RFID tag can carry an impressive array of information on it, such as a serial number, model number, colour, place of assembly, etc. When these tags pass through a Radio Frequency (RF) field generated by a compatible reader, they transmit this information back to the reader, thereby identifying and giving details on the object to which they are attached.

The technology behind RFID is not new. RFID is a descendent of wireless technology used during World War II for aircraft identification. Recently, however, the technology has received great attention due to a confluence of events, including technology advancement, heightened security concerns and a greater business emphasis on cost control.

Today, RFID already is revolutionising various aspects of businesses and public practices around the world. Cars speed through toll booths without stopping to pay using RFID. The technology also is being used to guard masterpieces in museums, to keep track of logistics for the US military and airline baggage. It serves as an alternative to credit cards and controls access to buildings. DHL Worldwide Express will soon launch a system of global RFID tracking for its estimated 160 million packages annually. Forty-five cities in China already use RFID payment systems in public transportation, and citizens of Singapore and elsewhere use the technology for check out/anti-theft in their public libraries.

RFID capabilities and applications are wide and varied, but basically for the purpose of this roadmap, all the RFID systems have three principle components:

1. The RFID tag with its own data, functions and physical characteristics.
2. The reader (fixed or portable) with its own functions and physical characteristics.
3. The computer with its own hardware, functions and predefined tasks.

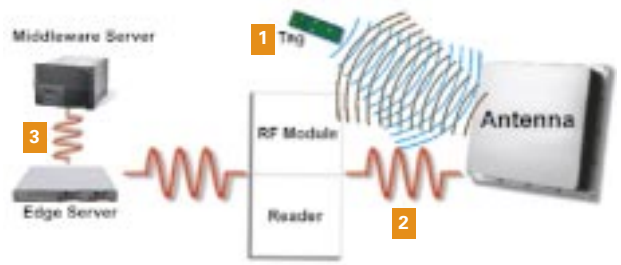
RFID technology uses radio waves to write data and to read from radio tags. RFID readers are devices that emit radio waves and listen for tags to respond back with their data. This technology is similar to AM or FM radio, but the components have been greatly miniaturised and placed onto tiny computer chips. The reader transmits radio waves, and tiny radio tags use the energy from those waves to echo back the unique ID of the product to which they are attached.

The combined development of microchips and software has created commercial applications. However, these new commercial initiatives often require representative bodies to drive adoption forward.

"The use of RFID technologies and a common EPC support our move towards the realisation of 'radio bar codes'. These barcodes help us improve the overall productivity of our supply chain and help us improve the availability of products for our customers."

John F. Clarke
Director, Group Technology and Architecture, Tesco

RFID Technology Components 2



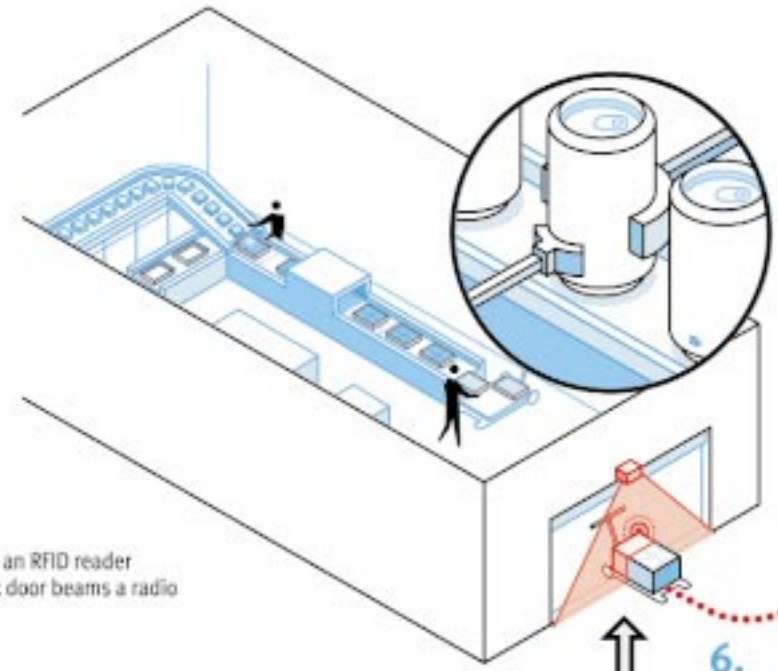
Source: QED Systems

2.2 The EPC Vision

Imagine a world in which every object can be sensed as it moves, can trigger a response that can be interpreted and acted on without human intervention. Now apply this vision to the real world

How the EPC Network Will Automate the Supply Chain

With the new EPC™ Network, computers will be able to "see" physical objects, allowing manufacturers to track and trace items automatically throughout the supply chain. This technology will revolutionize the way we manufacture, sell and buy products. Here's how it works:

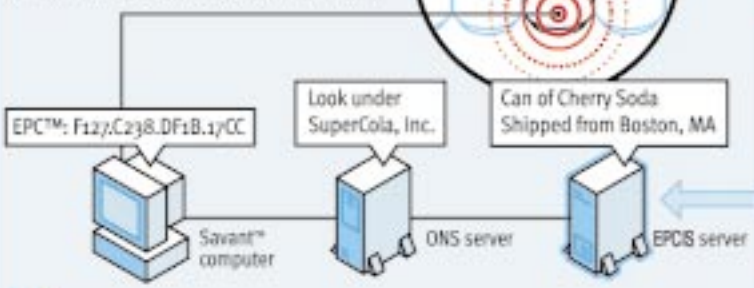


1.
Each item contains a tiny microchip which includes a radio antenna and a unique identifier, called an Electronic Product Code (EPC™). This Radio Frequency Identification (RFID) tag costs about five cents to make.

2.
The item can now be automatically and cost-effectively identified, counted and tracked. Cases and pallets can also carry their own unique tags.

3.
As pallets leave the manufacturer, an RFID reader positioned above the loading dock door beams a radio wave that "wakes up" the tags.

4A.
The tags broadcast their individual EPCs™ to the reader, which rapidly switches them on and off in sequence, until all are read.



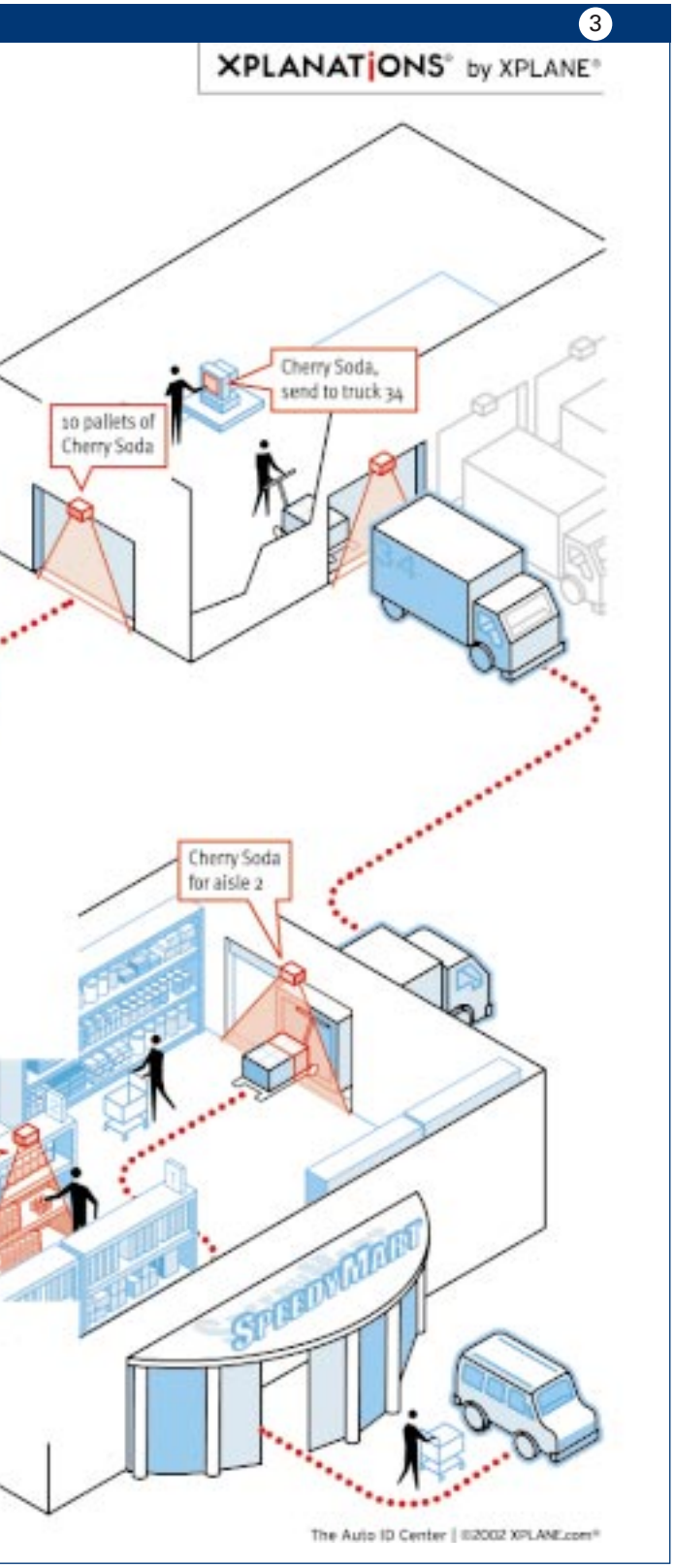
4B.
The reader sends the EPCs™ to a computer running software called Savant™. Savant™ sends the EPC™ over the internet to an Object Name Service (ONS) database, which produces an address. The ONS matches the EPC™ to another server, which has comprehensive information about the product.

4C.
This server uses PML (Physical Markup Language) to store data about manufacturers' products. Because it knows the location of the reader sending the query, it knows where the product was made. If an incident involving a defect or tampering arises, the source of the problem can be tracked and the products can be recalled.

5.
If the unloading area contains an RFID reader, there's no need to open packages and examine their contents. Savant™ provides a cargo list, and the pallet is quickly routed to the appropriate truck.

6.
SpeedyMart tracks the shipment through its own Savant™ connection. As soon as it arrives, retail systems are updated to include every item. In this way stores can locate their entire inventory automatically, accurately and at low cost.

7.
Reader-enabled "smart shelves" can automatically order more product from the back room or the manufacturer. With such a system, the need to maintain costly "safety volumes" in remote warehouses is eliminated.



and imagine an environment in which every object in the consumer products supply chain can be tracked through this sense-and-response mechanism. Think of the possibilities ...

- Visualise a warehouse where perishables do not perish, where theft is fully detectable, where systems exactly match physical inventory counts, where transfers with trading partners are automated and precise.
- Think of an affordable solution for millions of small independent stores to manage their business in a totally different way. From inventory management and sales to replenishment and theft-control, everything in their stores could be controlled and managed.
- Imagine total product visibility, transparency and a supply chain built on real-time, on-demand information, and then think of the associated impact on your asset management and working capital.
- Envisage a store where your product is on the shelf every time consumers reach for it, where shelf-replenishment is triggered automatically and theft is fully detectable.
- Consider a perfect demand-driven and networked economy synchronising activities across the supply chain from point-of-purchase all the way back through raw material procurement.
- Contemplate a world where you could sell one, replenish one, sell one, replenish one. Better yet, sell one, make one.

Today this vision is a few steps closer to becoming a reality. In the real world, it has been difficult to implement this vision because of an inability to sense objects through some form of wireless network. While computers have become adept at sensing each other through a network, they have not been very good at sensing other objects. By adding a tiny silicon chip to an object, however, it has been possible to get all objects to become "computers" that can be sensed in a wireless network.

"It's not about the technology — the technology is simply the enabler. It's about the vision. When every item in the supply chain has a unique identity, the supply chain efficiencies are limitless and 'perfect retail' is a real possibility."

Jamshed Dubash
Technology Director, The Gillette Company

2.3 EPC Architecture

A key component of the EPC network are inexpensive tags and readers passing small bits of information or the EPC while leveraging the Internet to hold large amounts of information that can be shared between trading partners. The goal of the EPC network is to allow computers to sense products automatically and make intelligent decisions about them. The network seeks to provide a streamlined method for discovering significant product details quickly in order to allow computers to monitor, decide, and take action without human intervention.

The EPC network is based on the following principles:

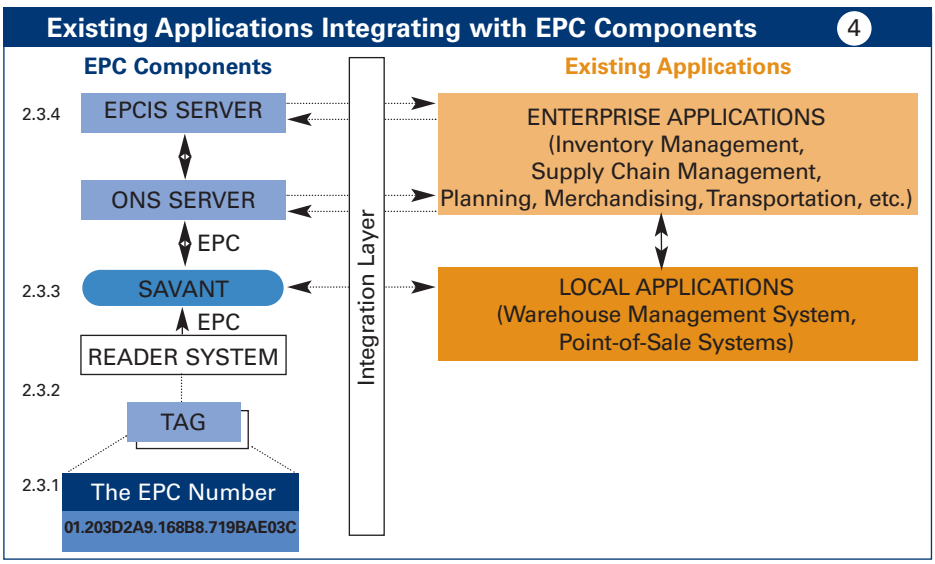
- Inexpensive tags and readers that conform to a standard specification and to the local air interface protocols, which vary depending on country or region.
- Minimum information stored on the tag. Under the pure EPC vision, the only information stored on the tag would be the EPC number.
- The use of software — called a savant — to act as a connecting layer between the reader and applications to filter the EPC data and pass on only appropriate product movement information to application systems.
- Information related to each object is securely stored on a public network with the appropriate security controls. It can be accessed when required through the services of an object naming service (ONS) that points to a computer where the information about the object is held. The EPC information service (EPCIS) on that computer will provide a description of the product in physical markup language (PML).
- Interoperable tags and readers are based on an open, global standards-based system. These standards ensure that any EPC-compliant tags can be read by any EPC-compatible reader and that a tag applied in one country should work in any other country.

2.3.1 EPC Numbering Scheme

At the very heart of the EPC network is an identification standard. Just as every car today has a unique vehicle identification number, each item manufactured in the future will have an EPC. This unique serial number will have the flexibility to allow the EPC network to track shipments, pallets, cases, or individual items throughout an entire supply chain.

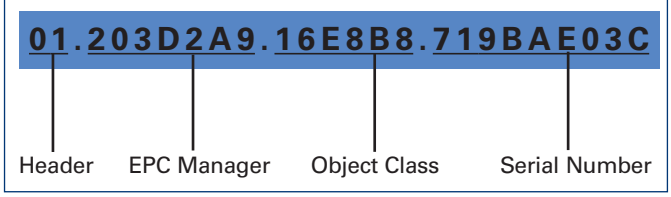
The EPC number is made up of four key elements:

- The header defines the overall number length of the EPC, including the number, type, version, and length of the subsequent partitions.
- The EPC manager is the company or entity responsible for managing the subsequent codes.



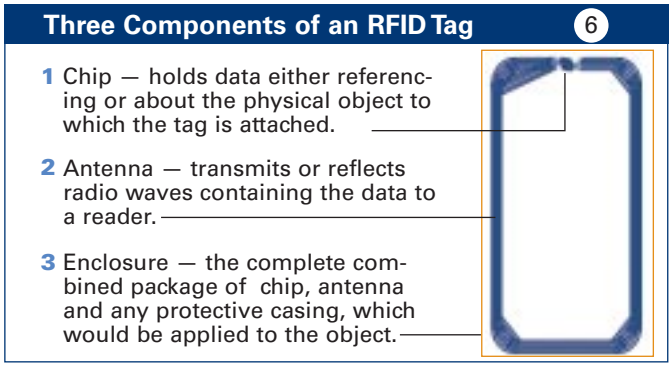
Source: IBM Business Consulting Services

An Example EPC Number (96 Bit Version) 5



Source: Auto-ID Center

Three Components of an RFID Tag 6



Source: IBM Business Consulting Services

- The object class, which identifies the item, e.g., the stock keeping unit (SKU) or consumer unit.
- The serial number provides a unique serial number for all items within a given class.

2.3.2 Tags & Readers

Tags

Most RFID tags contain a semiconductor chip and a transmitter connected to an antenna.

Generally, RFID tags have three key advantages over the everyday bar-coded labels:

- RFID tags are less susceptible to damage.
- RFID has the ability to read multiple tags in extremely short periods of time, no line-of-sight required.
- RFID has the potential for a read/write capability, making the tags reusable.

The amount of memory can vary, depending on whether the tag is a simple 'passive' tag or a battery-powered 'active' tag. Additionally, this memory can be configured in a number of ways (e.g., read-only, write-once, read-write).

The types of tags include:

- **'Passive' tags** are the least expensive to manufacture. They have no power source of their own since they depend upon the tag's antenna to draw power from the reader. Passive tags generally have to be within close proximity — three to five metres — to the reader.
- **'Semi-passive' tags** have batteries but lie dormant until they receive a signal from a reader. This conserves battery power and provides a much longer tag life for objects that do not require constant tracking.
- **'Active' tags** use a battery to emit a constant RF signal carrying identifying information. They are typically larger, more expensive and have a shorter operational life than passive tags.

Readers

The reader is made up of an antenna and a controller. The controller codes, decodes, checks and stores the data, manages communications with the tags and communicates with the host. Some devices are readers-only while others can both read and write. For example, a reader/writer can be used when a new product is manufactured, and readers will be used to monitor the product as it moves through the supply chain. Readers also come in many form factors, such as hand-held devices or fixed installations at doors, portals, or shelves.

There are two basic choices for reader technology based on the job or the type of work to be performed:

- **Stationary** — Entrances, portals, conveyors across assembly lines, points of sale, overhead.
- **Mobile** — Handheld, wireless or batch update.

2.3.3 Savant

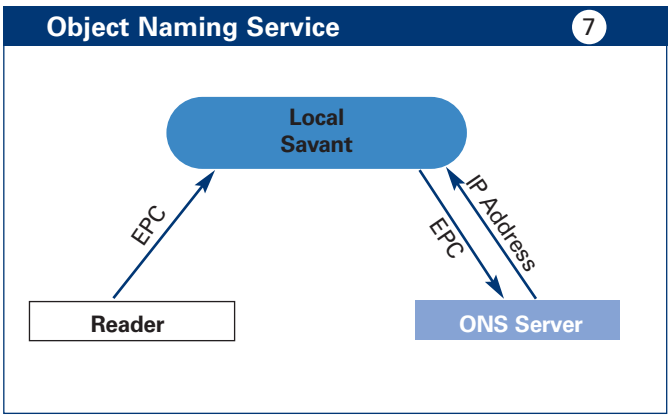
The savant is software based on open architecture that resides on a server and provides the 'intelligence' at a local level to control and integrate the RFID tags, readers, and local infrastructure.

The savant interacts with readers through a reader interface. It also interacts with applications through an application interface. In addition, the savant facilitates interaction with other services through other specialised interfaces. Using an example of a pallet moving into a warehouse, the primary roles of the savant are:

- **RFID Event Aggregator** — For example, a distribution centre dock door or entrance may have a number of devices, including two readers — each with two antennae that are connected together to monitor products as they are shipped or received. As the pallet passes through the entrance or warehouse door, savant aggregates a number of tag reads, receives and takes in the information from the two readers, and then compiles the list of items associated with the pallet.
- **Controller** — The dock-door portal could also be equipped with a presence detector for sensing the arrival and departure of pallets at the entrance to activate or deactivate the readers. This is usually necessary in Europe, where regulations state that RFID readers can only be switched on 10 percent of the time or less.
- **Gateway to the information network** — The savant provides the link to internal applications and the external EPC network.

2.3.4 ONS, EPCIS & PML

Object Naming Service (ONS) — The ONS acts as a directory and converts an EPC into a uniform resource locator (URL) on the Internet. The URL is then used to look up an Internet protocol (IP) address, where more detailed information about the item, case, or pallet can be found.



Source: IBM Business Consulting Services

EPC Information Service (EPCIS) — EPCIS is a computer system that manages and delivers a physical markup language description of the product to the information requesters. EPCIS also can support a range of high-level queries, such as:

- To what class of object does this EPC refer — an item, a case, or a pallet?
- Which path did this pallet with this EPC take?
- What are the dimensions of this object? In addition, source queries could be made but require extensions to the basic PML (object-centric) query services.
- Has this pallet been outside of its allowable temperature control? If so, where did this happen?

Physical Markup Language (PML) — PML is an Auto-ID designed method of describing products in a way that both humans and computers can understand. PML is an eXtensible markup language (XML) vocabulary for describing physical objects, systems, processes, and environments associated with an object. The main goal of the PML is to provide a common, standardised vocabulary to represent and distribute information related to RFID-enabled objects for business processes and applications. These include inventory management, automated transactions, supply chain tracking, and machine control.

The PML language itself is still evolving, but it is basically composed of core and extension components. The PML core is primarily focused on how Auto-ID systems share information internally, while PML extensions are focused on how product information is communicated to other applications.

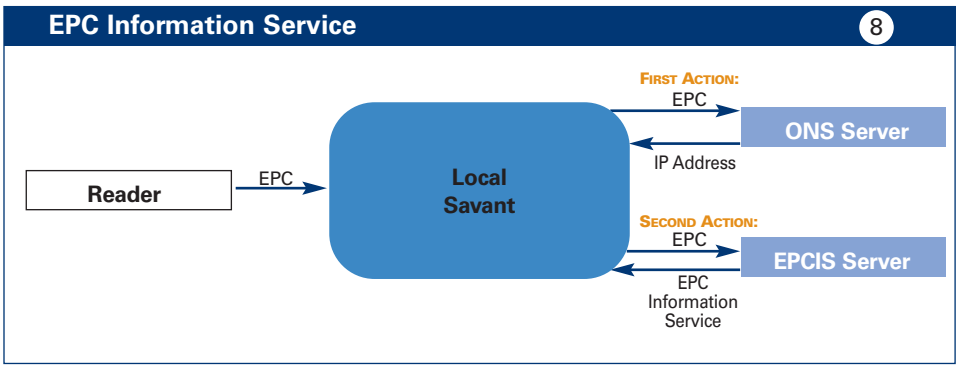
Currently, this language supports the following core elements:

- A hierarchical structure that represents the relationship among items, e.g., cases on a pallet.
- Physical properties, e.g., geometry, composition, and mass.
- Trace information, e.g., time, location, and ownership. The relevant data addressed by a PML document may be scattered among the supply chain partners and stored in various formats, including relational database, XML document, flat files, and so on. In general, such data can be categorised as:
  1. Catalogue/product-level data: Created and provided by the vendor of the product, this product data is applicable to all items and is

static. Examples include the mass and dimension specifications of a product.

2. Item-level manufacturing data: Created by the manufacturer when an item is built or assembled. Examples include lot number, serial number, expiration data, etc. Such information does not change after it is created by the manufacturer.
3. Item-level logistics data: Typically captured as the item moves through the supply chain, this information may include trace data (e.g., time and location), observations from other sensors (temperature and humidity sensors), aggregation status, etc.

While the concept of using the EPCIS and PML as the primary means for trading partner collaboration is accepted by some companies, it is yet to be validated by the CPG industry. Also, significant technical challenges remain to support this type of collaboration.



Source: IBM Business Consulting Services

3. Enabling the Vision

3.1 Introduction

Considerable work has been done through research, field trials, and industry validation to develop the RFID technology and the EPC vision.

Today, broad support is building in the industry for the initiative, and leading companies are poised to make the transition from evaluation to adoption. Of course, differences of opinion exist about the timeline for industrywide adoption. However, sufficient building blocks are in place today to start translating the EPC vision into action on a wider scale.

The rate of adoption will be based on the development and implementation of open and voluntary standards in the following areas.

3.2 Consistent Global Identification

Today when product codes cannot be read, it is necessary for each product in a shipment to be unpacked, scanned individually with all the product characteristics checked and entered by hand into some form of local system. The amount of extra work is huge. The EPC network, on the other hand, is based on the concept of consistent global identification. Before it can become a reality, however, a number of key issues must be resolved to ensure proper migration of current standards, synchronisation of data, and integration of the Global Trade Item Number (GTIN) with the EPC number for current members of the EAN•UCC system.

Integration of U.P.C., EAN-8 & EAN-13

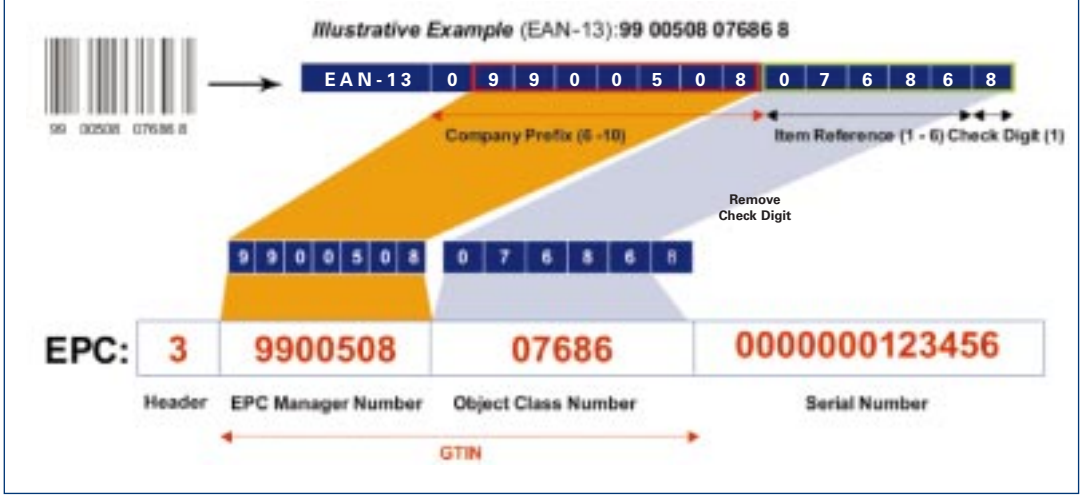
2005 Sunrise

With the exception of the United States and Canada, all retail products are marked with EAN-8 and EAN-13 symbols. However, the US and Canada use a 12-digit Universal Product Code (U.P.C.) so products made outside the US and Canada must be relabelled with a 12-digit U.P.C. for sale in these countries. The UCC has announced that by 1 January, 2005, all US and Canadian companies must be capable of scanning and processing EAN-8 and EAN-13 symbols in addition to the U.P.C. symbols at the point-of-sale. The initiative supporting this issue is called 2005 Sunrise.

Global Data Synchronisation

Much has been written about the benefits of global data synchronisation, of the ability for every participant in the supply chain to have accurate and timely information about the goods flowing through that supply chain. Given the emergence of standards for data messaging, the provision for a global registry, and the emergence of interoperable data pools, the push for data synchronisation worldwide is gaining momentum. The question

An Example of How GTIN Integraton Could Work With the EPC 9



Source: IBM Business Consulting Services

raised by some is whether the emergence of the EPC network vision will detract from global data synchronisation activity. The answer: **a resounding "no."** These two initiatives will complement each other as integral parts of the industry's drive to cut costs and boost efficiency. The industry needs master data to be synchronised. Savings from increased warehouse productivity, better inventory management, and increased on-shelf availability — all of which can come from the emerging EPC network — cannot be realised if supply chain partners do not have synchronised master data.

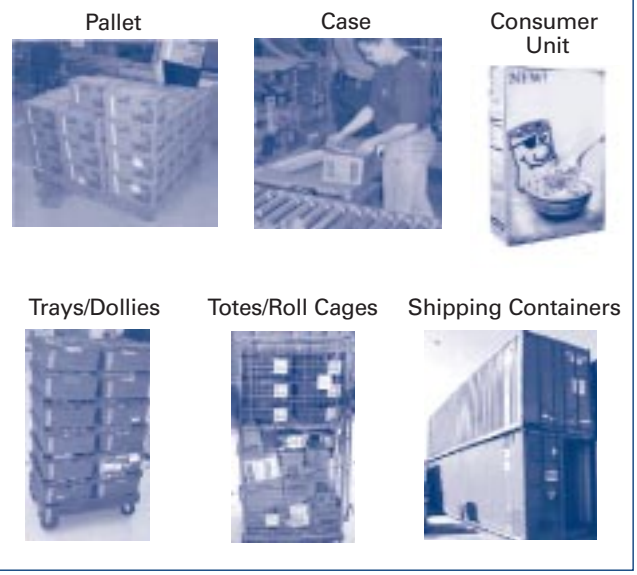
How to Integrate the GTIN into EPC
Migration to the Electronic Product Code numbering system can come about only while ensuring that all Global Trade Item Numbers (GTINs), which represent current global identification standards for companies using the EAN•UCC system, can be incorporated into the EPC. The illustration on the previous page shows how a GTIN could form part of the EPC.

This illustration does not reflect the final standard as of this date. The EPC manager and the object class together will be today's Global Trade Item Number for those industries that use the GTIN. For industries that do not use the GTIN, a different header and EPC number format could be used.

Integrating Other Numbering Standards into EPC
A number of other EAN•UCC numbering standards currently are in existence — namely the EAN•UCC-128 and SSCC-18 (Serial Shipping Container Code) or SSCC has a fixed-length, 18-digit number bar code, which identifies a logistics unit and thus is referred to as a "license plate". There is also the Global Returnable Asset Identifier (GRAI), which is used to track returnable assets such as beer kegs or crates. A clear method for integrating these numbers or using them with the EPC is required.

Consistent Shipping-Unit Identification
For the purpose of this section, a shipping unit is defined as a pallet, a dolly, or a roll cage that can contain either one product or more than one product. Current practice within the EAN•UCC

Examples of Objects That Can Be Tagged 10



Source: The Gillette Company & Integrated Produce Intelligence

system is that shipping units can be identified by using the SSCC standard. Using the Electronic Product Code, there is the option of either integrating the SSCC into the EPC numbering system on the tag, or allocating a number to the physical container and associating the content of that container with the asset for the time that container carries those products.

The EPC information service (EPCIS) will describe the hierarchical relationships between these containers and units, although further work is required to finalise definitions to resolve issues of consistent identification of shipping units.

"Creating the right migration path for current EAN•UCC system users will aid the implementation of the EPC network in the consumer goods sector."
Peter Jordan
Director, IS Strategic Projects, Kraft Foods International

3.3 Tags
Tag Specifications & Interoperability
The EPC network is initially based on passive tags that contain minimal data (only the EPC number). The Auto-ID Center developed protocols for class 0

and class 1 tags — wireless tags that are already in operation in the market. These two classes of tags have been used in the field tests and operational trials. Standards for the other classes of tags have yet to be developed.

EPC Tag Classes [11]

Class	Comments
Class 0	"Read-only" passive identity tags
Class I	Write once passive identity tags
Class II	Passive tags with added functionality, e.g., memory or encryption
Class III	Semi-passive RFID tags
Class IV	Active tags - communicate with readers and other tags on the same frequency band
Class V	Essentially 'readers' - can power class I, II and III tags as well as communicating with class IV and with each other.

Source: Auto-ID Center

In the past, there was no interoperability between tags and readers from different manufacturers. Recently, however, tag and reader products have been launched that provide this interoperability.

Class 0 and class 1 tags have very different communications protocols. Work is currently underway to define a unified protocol for class 0 and class 1 tags, referred to as class 1 version 2. This protocol will incorporate the best features of both classes and will allow a single reader to read tags of either class. Today "agile" readers can read both, but this requires two separate reads and is seen as a short-term solution.

The other benefit of a unified protocol is that as tags, readers, and protocols evolve to new higher classes, it becomes easier to migrate the infrastructure to accommodate these higher classes. This migration should be done through a firmware upgrade to the readers rather than by replacing the entire infrastructure.

In practice, companies will need the flexibility to select any class of EPC tag, although the unified protocol has additional benefits. The reader infrastructure will need to be upwardly compatible. Companies could begin testing now with either or both class 0 and class 1 tags, which are currently available. However, the ability to purchase tags and readers at affordable prices is dependent on the availability of standards and sufficient demand.

Form Factors

The form factor is the description of the size, configuration, or physical arrangement of a tag. Now that the tags are being deployed in real world environments and processes, more consideration must be given to the form factor of these tags, in terms of:

- **Shape & Size** — As the level of tagging is reduced (from container, to pallet, to case, and eventually to item-level at some time in the future), it is important that tags are available in a wide variety of shapes and sizes. This ensures that the tags do not spoil the aesthetics of the product or affect the physical handling processes. However, they still must be able to be read accurately.
- **Application** — Consideration must be given to how the tag is applied to a product. Containers and pallets will require tags to be securely attached to them to withstand physical handling. Case tags may be applied with adhesive, as they are generally handled less, but they must still withstand the rigors of navigating the supply chain. At the individual item-level, tags may also be applied with adhesive, but it would be more desirable from an aesthetic point of view for the tags to be integrated into the product packaging, which has serious implications for packaging manufacturers.
- **Ruggedness** — The tags will have to withstand different levels of physical abuse, depending on where and how they are applied. Tag suppliers need to ensure that the tags themselves or their protective coverings are suitable for the lifetime of the trip through the supply chain for that product or shipping container.
- **Product-Specific** — The physical characteristics of a product — for example, high liquid or metal content — can greatly affect the "read" performance of tags. Work being done on testing the tag readability for different products has been very suc-

cessful, with the possible exception of readability on products with high metal or liquid content. Tag suppliers continue to work in this area with expectations that a cost-effective tag can be made that "reads" efficiently no matter what type of product.

Additional Features of Tags

A number of application areas that would benefit from having more features placed on the tags are:

- Additional data on the tags, such as expiration date, etc.
- Sensors integrated with the tags — thermometers, altimeters, humidity devices, etc.

Tags that hold more data would be particularly suited to stand-alone operations in which it is not possible to reference or communicate with a data repository. This could apply to pharmaceutical and medical applications, where it may be necessary for a paramedic instantly to check a drug at an emergency site and have all of the required information to administer it.

Sensor-integrated tags are currently available and can monitor physical conditions. The tags have many applications, and they are usually active, used with containers, and are expensive. Tags monitoring refrigerated containers of ice cream, for instance, have both temperature and altitude sensors, since these are particular spoil factors for ice cream.

The Auto-ID Labs and tag manufacturers will continue to do research in this area. EPCglobal™ will drive development, adoption, and adherence of further open, voluntary standards for all classes of tags.

3.4 Readers

Specifications

In many ways the challenges in developing tags are mirrored in the requirements for developing the readers. The variety of suppliers, tag types, and frequencies being manufactured today means that there are no readers that can read all the tags in the supply chain.

Quality of Readers

Ongoing pilots at roll cage-level and tray-level have resulted in read rates that are accurate to 96 percent with readers placed approximately two metres from the tags. This is based on moving pallets or roll cages past a reader at an operational pace.

It may initially appear that anything less than 100 percent is not good enough. However, the 96 percent read rate should be compared with the 97 percent to 98.5 percent accuracy level currently being achieved by today's best-in-class bar-code scanning operations that are much more labour intensive. The small difference in accuracy is usually outweighed by the saving in labour. Further testing must be done with item-level tagging to ensure that the readers can improve this level of accuracy when more reads per second are required.

Environmental and product specifics can also affect the quality of the read. For instance, readers placed among high levels of metal racking can lead to poorer read rates, as will products with a high liquid or metal content. Solutions for these issues often can be generated by the reader and tag manufacturers working directly with their customers. However, it is crucial that successful solutions are shared throughout the industry via publication of best practices and through knowledge-sharing groups.

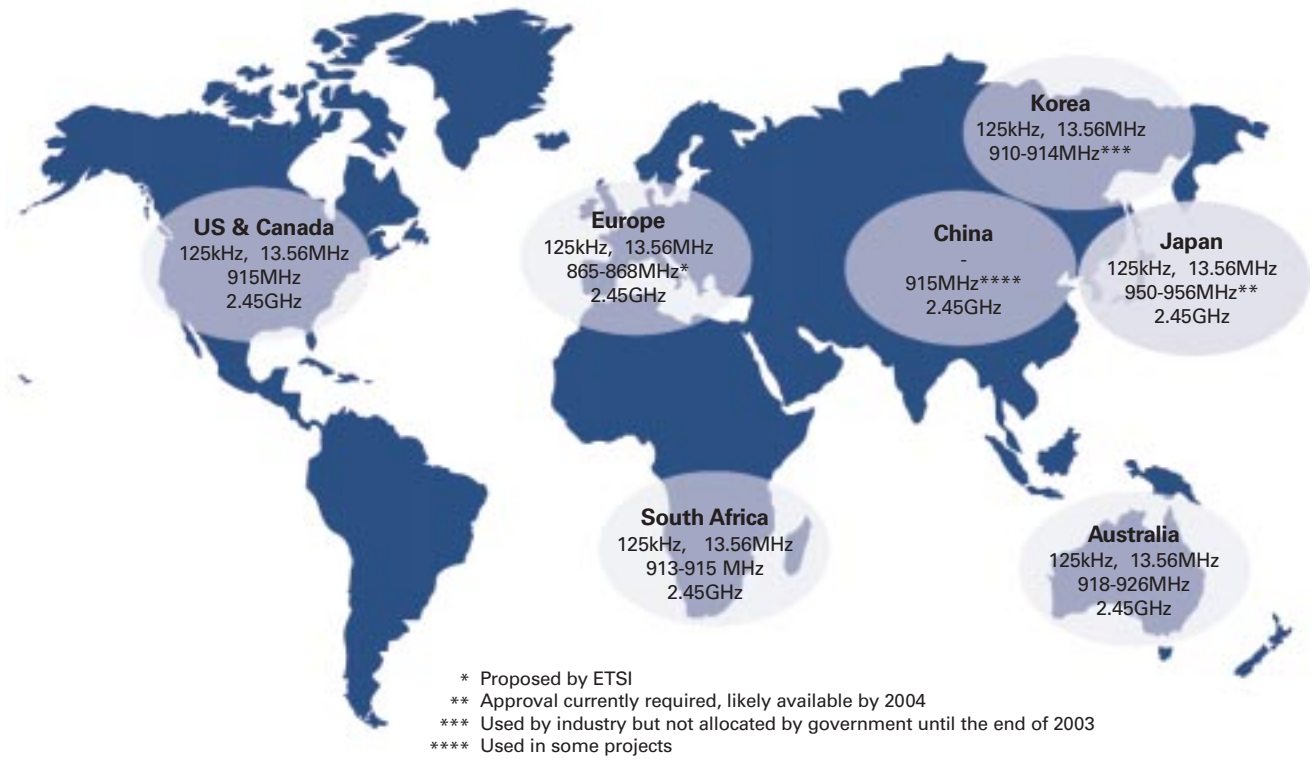
Greater Functionality of Readers

In the short-to-medium term, there will be a need for a variety of readers, such as:

- Hybrid devices that can read both current bar codes and EPCs.
- Wireless devices in which the data transfer to the savant is done over a wireless network.
- Upwardly compatible devices that can be upgraded rather than replaced as higher classes of tags reach the market. Selecting open standards-compliant equipment is the best guarantee against the technology becoming obsolete.

The improved functionality of readers will be further developed as demand increases in the future. However, current functionality is enough to get companies started with product tagging trials.

Differences in Allowable Radio Frequency Spectrums Around the World 12



Source: IBM Business Consulting Services

3.5 Radio Frequency Spectrum

RFID systems must operate in "free air" areas of the wireless communications spectrum across the regulatory boundaries of countries and geographic regions. Presently, these areas have not been harmonised globally, which limits the potential benefits that EPC/RFID promise.

In general, in-country regulations for radio communications vary and are regulated by different bodies. The US regulations are more liberal. Tags can operate between 902 and 915MHz, allowing a fair degree of frequency hopping and extending the distance over which tags can be read. In Europe, there are more limitations. For example, mobile telephone networks use this part of the spectrum, and further down the spectrum, the 865-868MHz frequency is reserved for medical services.

In addition, read performance relies on power levels, so the issue is linked to the radio frequency spectrum debate. Power levels are limited to 0.5 watts in most European countries. However, the method of measuring *average* power in the US is not the same as in Europe. The expectation is that Europe will have a power regulation of 2 watts in the near future, which would be roughly equivalent to 4 watts in the US.

At a European level, the following bodies are involved in developing standards and agreeing regulations:

- European Telecommunications Standards Institute (ETSI) is currently working on proposed standards for radio frequency spectrum usage across Europe.
- European Radiocommunications Office (ERO) recommends the approval of these standards.
- The European Commission publishes directives legitimising these standards.

Radio Frequency Band Benefits, Drawbacks & Applications 13

Frequency	Benefits	Drawbacks	Common Applications
Low (9-135 KHz)	• Accepted Worldwide • Works Near Metal • In Wide Use Today	• <1.5m Read Range • Impractical for Warehouse Operations • Not in EPC Standards	• Animal ID • Beer Kegs • Auto Key and Lock • Library Books
High (13.56 MHz)	• Accepted Worldwide • Works in Most Environments • In Wide Use Today	• <1.5m Read Range • Does Not Work Near Metal	• Item Level Track • Airline Baggage • Building Access
Ultra High (300-1200 MHz)	• Longer Read-Range Potential, >1.5m Read Range • Growing Commercial Use	• Not Readily Useable in Japan • Does Not Work in Moist Environments • Detuning When Tags in Close Physical Proximity	• Case, Pallet & Container Track • Truck and Trailer Tracking
Microwave (2.45 or 5.8 GHz)	• Longer Read-Range Potential, >1.5m Read Range	• No Commerical Use License in Parts of EU • Complex Systems Development	• Access Control (Vehicles)

Source: IBM Business Consulting Services

At a global level, the International Telecommunications Union (ITU) is responsible for regulating radio frequency usage worldwide. The diagram on the previous page shows some of the currently allowed and the proposed frequencies around the world.

The resolution of the air interface issue is critical to the mass standardised adoption of the EPC network and regulatory and standards bodies are actively engaged in reaching a degree of compatibility worldwide, e.g., UHF tags can be read in the whole range of 860-960 MHz without losing much efficiency, plus over similar distances when using approximately equal power ranges.

3.6 Interoperable Commercial Versions

Before it became the Auto-ID Labs, the Auto-ID Center published standard specifications for the savant, ONS, PML, and EPCIS components. Today's reality is that there is not a complete set of commercial versions of these products that are truly interoperable or "plug and play."

Many vendors have a version of each of these components and these have been used in the trials to-date. Each is in a different stage of evolution at the present time.

- It is generally agreed that some form of savant is required to filter data coming from readers to the applications that process it, and allows local and fast data access for key applications.
- The Auto-ID Center produced an open source version of savant, which has been modified a number of times by systems integrators, often in conjunction with early adopters to allow pilots. These prove that the technology works and can be used in testing. However, it is still unclear whether these systems are robust enough and scalable to the extent required.
- An ONS is an essential component of the EPC vision and is based on the structure of a domain

name service (DNS). EPCglobal™ currently has a request for proposal underway to establish an ONS service by the end of 2003.
- The EPC information service (EPCIS) and the physical markup language (PML) are standard means of delivering information and important components of the EPC network. The development of open, voluntary standards for both is necessary.
- It is important for the PML that it is based on eXtensible markup language (XML) and that it is integrated with the EAN•UCC Global Data Dictionary.
- Savant products based on open, voluntary standards are key to the adoption of the EPC network. Savants will make the interfaces to application packages easier and more profitable for industry companies.
- Providers of application software need to build links from the savant API into their own systems.

3.7 Internal/External Infrastructure

Three main issues relate to data management under EPC network adoption:
1. How do we deal with this much larger volume of data?
2. How do we share this data with our trading partners?
3. What data management policies should we consider?

Data Volumes

EPC network adoption will drive up the volume of data that companies will find they need to process by a significant amount. The Auto-ID Center did a great deal of work on ways to deal with this increase, and the work continues in the Auto-ID Labs.
- The EPC vision states that data about objects — object information and event information — should be stored on a network and accessed as needed rather than being pushed from one party to the next.
- The savant is a means of filtering data. As a number of different radio tags are read, a level of data aggregation might be done, and some choices need to be made about what data to store — the raw data or the aggregated amount.
- As the level of tagging increases and many more objects are tagged, it must be clear that read and write times need to be managed successfully so that they do not become a process bottleneck.
- The volume of data will increase significantly if consumer unit-level tagging is adopted. However, this is still a few years away.

Sharing Data With Trading Partners

Sharing data with trading partners will continue to be a critical issue and an important part of the EPC vision. The transition to a new way of doing business and a new way of sharing information may not be easy. However, the tremendous benefits promised by the EPC vision and already seen in the pilot tests taking place around the globe are assuring companies that the next generation of partnering is well worth the effort.

Under the EPC vision, there are two potential approaches for exchanging data about a tagged object between trading partners:
1. Object and event data are held by each trading partner and a means of information access is provided for trading partners as required.
2. Object and event data are published on a public network and access provided as required (i.e., the true EPC network vision).

The first option is the one that many leading adopters have in mind. This relies on having data warehouse capability and capacity, but it is a means of transitioning to the ultimate EPC network vision of accessing data when required. It also provides companies with a means of ensuring data confidentiality and of controlling data access. Organisations in the test and trial stage may be happy with object and event data being stored on the tag itself — the first option — and read where required when the tag flows through the supply chain.

Object and event data could also be sent as an additional transmission from one company to its trading partner (analogous to email). Some organisations may have a preference for this approach, since it gives more control and security

to data transmission. This may be the option that many companies start with to reduce the complexity of data sharing.

As the technology and the organisations using it become more mature and are further down the adoption route, levels of data storage will increase and it will become desirable to have the data stored in only one place and accessed as necessary. This is the second option (analogous to browsing a web page). This is the true EPC vision, but at present there are extremely few providers for the hosting service.

Within the next 12 months — or by November of 2004 — a standard way of sharing data will need to be found. Without the appropriate data-sharing service/provider, it will be difficult to move from bilateral trading partner pilots to large-scale adoption.

Data Management Policies to Consider

In addition to managing potentially large volumes of data, companies need to consider management policies for:

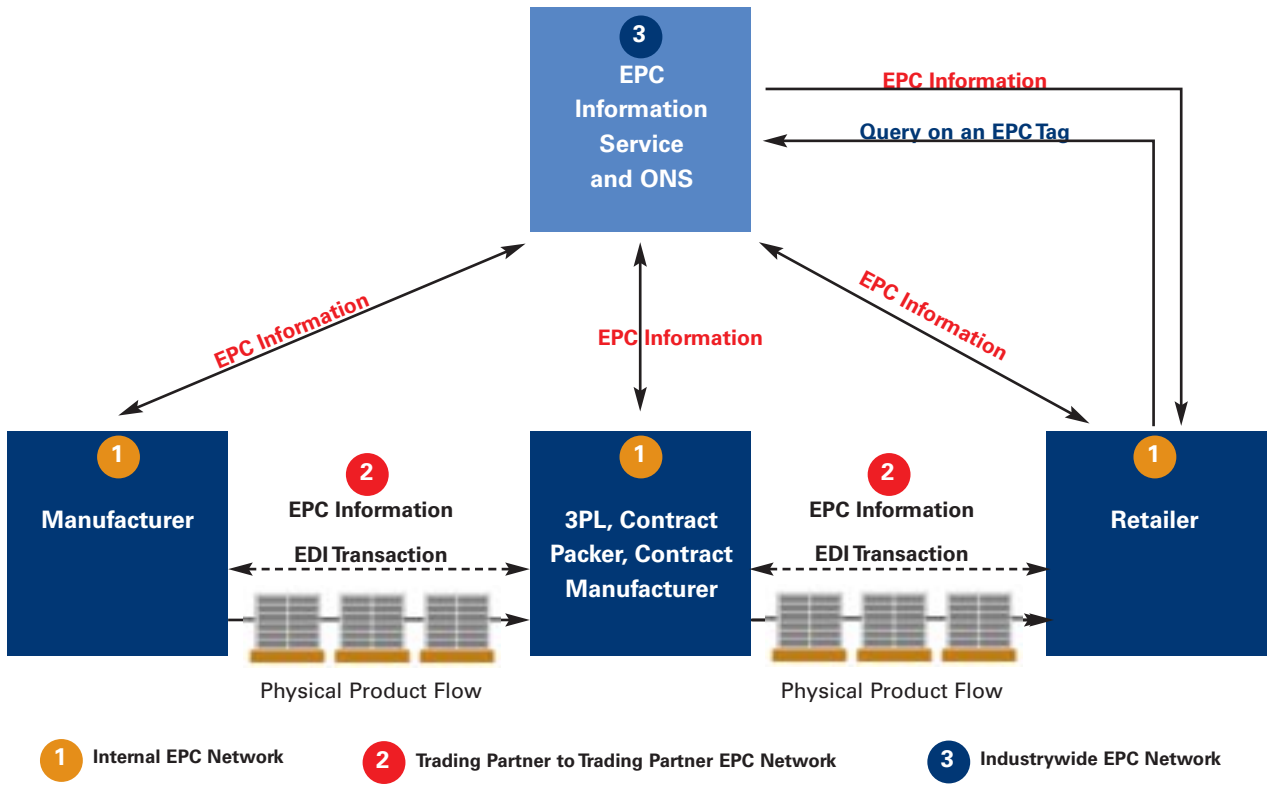
- Data ownership.
- Data confidentiality and security.
- Data retention and archiving.

This is an area most early-adopter companies have considered, but it is too early in the process for final decisions. However, the issue of data management will continue to evolve with wider adoption and certainly will be more important when consumer item-level tagging becomes commonplace.

3.8 Evolution Toward the EPC Vision

The EPC network (see diagram below) has three major dimensions:

Evolution Toward the EPC Vision 14



Source: IBM Business Consulting Services

1. **Internal EPC Network** For EPC adoption each company will require an internal EPC infrastructure as described in the section on EPC architecture. (See page 10.) An open, standards-based approach is important in order to obtain third-party products for each of the individual components. This approach is currently in use by companies that are conducting operational trials.
2. **Trading Partner-to-Trading Partner EPC Network** While there are benefits in applying this concept within a company, a significantly higher rate can be found in applying this concept in an end-to-end supply chain. This means that there is a requirement to share EPC data among trading partners and service providers, such as third-party logistics providers, contract packers, contract manufacturers, etc. Two essential pre-requisites for data sharing among trading partners include:
   - The use of voluntary, open standards.
   - A standard message format and method for exchanging data. A feature of this model is that data may be duplicated at different points in the total supply chain, holding it closer to the point of use. Each trading partner may hold a copy of the data. This model is expected to be in operation by 2004.
3. **Industry EPC Network** Eventually, any company will be able to plug into an industrywide EPC network. If a company has any question about an EPC tagged object, the request for information about that object will go into the network and the information returned may come from multiple data sources in multiple enterprises. This example is the ultimate EPC network vision, wherein data is held once and accessed when needed. The journey to this level, however, will take a number of years.

3.9 Public Policy Issues

As has been the case with almost all other technologies through the years, consumer advocates are concerned about the potential for misuse of RFID tags. Such technological advances as the Universal Product Code or U.P.C. (which took 10 years to fully implement) and telephone Caller-ID were negatively viewed by privacy-minded consumers when they first appeared.

RFID has been around since World War II and has been used successfully for decades in military, medical, and environmental applications to identify *physical* objects using radio waves. Today, RFID systems are used in a variety of consumer applications, such as ExxonMobil's Speedpass payment system and the EZ Pass system used in toll booths on many highways. Other applications in use today include access systems for office buildings and car immobiliser systems.

Today, the EPC vision is about moving products in the supply chain to reduce time, costs, and waste in the industry — all of which could result in fresher, more secure and possibly cheaper products for the consumer. In the near term, the EPC network will be primarily tagging these products in case and pallet levels through factories, distribution centres, backrooms, and stores. The area of primary consumer interest — item-level tagging — is not expected to be adopted in the mass market for several years.

Since its founding, the Auto-ID Center has actively sought the views of consumers, government officials, and public policy experts on the privacy issues inherent in implementing the new technology. The Auto-ID Center's successor, EPCglobal™, will continue this work, in addition to building on the extensive research already done into privacy issues.

As time goes on, the EPC network used to track goods through the supply chain can provide significant benefits — and not just to the manufacturers, wholesalers, and retailers. Of course, these industry partners will gain in efficiency, reduced supply chain costs, increased market share, reduced shrink, etc. But the *consumers* themselves will also be winners with fresher products, delivered to them in a more secure environment in these days of bio-terrorist fears for food and consumer packaged goods, delivered with fewer logistical costs, and with fewer possibilities for an out-of-stock of their favourite products.

Widespread and effective *communication* of these consumer benefits is of paramount importance to ensuring a positive public perception of EPC

technology. Industry representatives that have resources, knowledge, and expertise in this area are asked to help EPCglobal™ to accomplish this mission.

Additionally, in order to address policy issues that have been raised, the EPCglobal™ and its industry sponsors have developed a set of principles to guide the implementation of the EPC. These principles are based on research and discussion that have taken place over a period of time involving governments, consumers, and businesses. They are intended to assist companies address the implementation issues in a manner that respects the privacy of consumers, as well as their own business needs and processes.

Broad industry agreement to a basic set of privacy guidelines was achieved at the Auto-ID Center's final Board of Overseers meeting in Japan at the end of October 2003. A full copy of this agreement may be seen in the Appendix of this report.

These guidelines will help steer the future use and deployment of EPC technology and are intended as complements to existing legislation and regulation in the various nations and regions of the globe. The principles are based on a belief that consumer acceptance of EPC is crucial to the full adoption of the technology and the ability of consumers, business, and society as a whole to realise its full benefits.

A great deal of effort worldwide was made to include every aspect of the debate on the most effective, efficient way to deploy EPC technology in a manner consistent with the privacy concerns. Special efforts were also made to include consumer notice, consumer choice, consumer information, and records use and retention into any EPC network adoption plan. Industry feedback from manufacturers and retailers on this issue has been built into the company roadmap and the industry action plan included in this report.

As further developments in technology and its deployment occur, it is expected that these guidelines will evolve, change and continue to represent the fundamental commitments of industry to consumers.

EPCglobal™ will oversee and be responsible for updating these guidelines. EPCglobal™ also will work with its Independent Policy Advisory Council, made up of privacy experts from academia, law and public policy arenas, to manage future EPC privacy issues. It also will work with two other organisations — a technical group comprised of experts in the field of privacy, security, and cryptography, plus a forum of chief privacy officers from its sponsoring companies.

The self-regulation framework is a useful first step in addressing privacy concerns. Companies that are more advanced in EPC adoption/piloting are giving a range of useful advice:

- EPC end-users are strongly urged to help formulate and then adopt and follow voluntary industry guidelines as well as develop and publish their own company consumer policies.
- Companies should set up mechanisms to assist them in understanding public concerns and responding to those concerns.
- Communication with consumers about privacy concerns should be an ongoing, two-way process — not a dialogue carried out via press releases.
- Public officials, serious privacy advocates, and concerned members of the public are far more interested in action than words. Announcements and other communications will only be effective if they describe concrete actions that are to be taken.
- Learning from precedents in the past. For example, the experiences of business-to-consumer Internet sites could be considered when formulating company policy in this area.
- Every opportunity should be taken to inform consumers about how the use of EPC technology will bring benefits to them directly. Consumer education is critical in forming the right perceptions.

Some concluding thoughts in this area are:

- Each company considering EPC adoption must address consumer privacy issues explicitly.
- Most public privacy concerns apply only to consumer unit-level tagging.
- In certain areas, collective industry action is the best way to mitigate against potential risks.

3.10 Conclusion

Further developments are still required in the areas of standards, technology, regulatory constraints, and communications before the EPC vision can be brought to full realisation on a large scale. However, when talking about fulfilment of the promises and benefits of RFID it is no longer a question of *"if"* but rather a question of *"when."* There is not a single element of the EPC vision today that is insurmountable. An action agenda for the industry, found in the next section, gives some indications of how this vision can be achieved. However, there is no reason for companies to wait. They can begin to pilot the EPC network concepts today.

4. A Company EPC Roadmap

4.1 Introduction

This chapter provides insights into how manufacturers and retailers can apply the RFID technology to address business issues. It also describes the process these companies will go through as they pursue EPC adoption. The insights are based on the learnings and experiences of early-adopter companies that have already embarked on their EPC journey.

The section begins with a brief description of the most popular EPC business initiatives that companies are considering doing or that they are currently piloting.

4.2 Lessons Learned from Early Adopters: Key Business Initiatives

Before a description of how companies are thinking of deploying the RFID technology, it is important to note that this technology is an *enabler* — not a *solution* by itself. Overall, the technology has the potential of providing a much more accurate product tracking system and improved visibility by capturing product movements while, at the same time, improving efficiency in data collection and processing.

The competitive advantage will come from: (1) determining where and how to apply this technology to achieve business value, which will vary by company and by trading relationship, and (2) creating new business processes that are RFID-enabled to achieve concrete operational improvements.

The diagram below highlights the principle benefit areas that most manufacturers and retailers are targeting in their EPC adoption plans.

The following are a number of key considerations to keep in mind:

- Companies will achieve different benefits with EPC adoption. Many of these benefits will vary by product category, supply chain processing (full pallet vs. case vs. item processing), and current opportunities for improvement (e.g., is shrink a real issue in this company?).
- In general, heavily automated and low labour-intensive distribution centre (DC) operations will

Key Benefits From Business Initiatives 15

Factory	Finished Goods Warehouse	Distribution Centre	In-Store Handling	Store-Shelf
				
• Plant Inventory Accuracy (Finished Goods). • Automatic and Verified Shipment Data Reported to Finance and Inventory Systems.	• Reduced Labour Costs in Receiving, Putaway, Picking, and Shipping. • Proof of Ownership During Transit. • Reduction in Reverse Logistics/Returns and Claims. • Improved Goods Transfer and Payment Process. • Improved Service Levels Through Reduced Out-of-Stock.	• Improved Efficiencies in Receiving and Payment for Receivables. • Reduction in Labour Costs. • Reduction in Reverse Logistics/Returns. • Reduction in Inventory. • Reduction in Obsolescence.	• Inventory Reduction (Backroom, Lower Obsolescence). • Better Visibility of Back Room and On-Shelf Inventory. • Decreased Theft. • Improved On-Shelf Availability and Reduction in Out-of-Stock (Improved Replenishment). • Store Labour Productivity Improvement. • Reduced Defensive Merchandising Leading to Improved Sales.	

Source: IBM Business Consulting Services

have less potential from deploying EPC than operations that are not as automated today.
- Trials have been conducted both within the four walls of a company as well as collaboratively with trading partners. In general, manufacturers and retailers agree that the benefit potential increases significantly when trading partners adopt this technology across company operations.
- Trials have been done at load carrier (logistics assets), pallet, case, and item levels. The results of these trials vary significantly in terms of benefit potential and overall return-on-investment opportunity.
- Many of the leading adopters are still in the early stages of adoption and will use pilots as a way to validate the benefits and the costs.
- Unit-level tagging can create significant benefits in terms of out-of-stock reductions and improvements to the overall consumer shopping experience. However, costs also increase significantly with unit tagging. Given current technology prices, item-level tagging may be reserved for high-cost and high-margin items until tag costs drop significantly.
- There is a general perception that greater benefits accrue to the retailer than to the manufacturer with this initiative, especially if the manufacturers are asked to absorb the total tag costs. This perception is due in part to the belief that retailers will more easily generate scale through their system than their manufacturing partners.

This final point is critical and should not be understated. Manufacturers have built considerable efficiencies over the years by creating supply chains based on minimising exceptions to improve efficiency and velocity. If only a portion of a manufacturer's customers are using RFID tagging and exception handling must be introduced, this could lead to significantly higher supplier costs in the near term due to increased pick facings, repacking of pallets at the DC in order to tag individual cases, and so on.

Additionally, much of the historical discussion on the cost of implementing RFID has revolved around the recurring tag costs to the manufacturer. Retailers, however, will need to make significant infrastructure investments to deploy this technology across their warehouses and stores, especially the considerable one-time capital costs in the roll out of RFID throughout their operations. There are also significant costs involved in the shelf-level implementation scenario.

Both manufacturer and retail trading partners need to consider not only the magnitude of costs but also the timing and accounting impact of these costs. Both partners also need to engage in fact-based dialogues when discussing deployment options and benefit sharing to ensure a win-win scenario.

"In Unilever we see RFID technology and the use of EPC impact our total supply chain. More than ever before, we need total alignment across our logistics, our customer interaction, and our technology to maximise the value of this breakthrough technology. That is the challenge we face, and we have taken up the gauntlet."

Nigel Bagley
GCI Programme Manager, Unilever

Business Applications Under Trial or Consideration

In what areas are the RFID piloting pioneers focusing? Research indicates that while there are many ideas on how the EPC network enables performance improvement, the leading adopters have converged on a common set of priority applications focusing primarily on implementations and piloting trials at the pallet and case levels. These applications include:

- **Shrink Reduction in the Supply Chain** — Today retailers are tagging pallets, dollies, cases, and trays to track these units internally within their own supply chains. While source tagging is a natural complement to the infrastructure, shrink reduction trials nevertheless are driven by retailers' desires to address current business problems.

  Industry research illustrates that retail shrink levels are approximately 2 percent of sales, which cost retailers some $32 billion in the US in 2001 and

some 30 billion in the same year in Europe. And — perhaps more importantly — shrink mitigation techniques employed in recent years may not have produced the expected results. In 2001, the industry shrink rate in the US was virtually identical to the historic 10-year average of about 2 percent of sales.

IBM business case analysis has shown that the use of RFID can improve shrink for the average retailer by 25 percent at the case level and up to 40 percent at the item level. Therefore, many retailers are placing a high priority on testing shrink applications, often without waiting for participation by suppliers. Many retailers are applying their own tags and constructing track-and-trace visibility of product movements in order to improve internal causes of both accidental and deliberate shrink.

Both retailers and manufacturers will continue working together in piloted trials to understand how to leverage the EPC network to reduce losses due to shrink.

- **Improving On-Shelf Availability** — Often-quoted industry studies note that 30 percent of out-of-stocks occur on a store shelf although a supply of the product in question is located somewhere within the same retail establishment. Often the product is not replenished in a timely manner because store staff do not know where the product is located. Both manufacturers and retailers are concerned about this high incidence of out-of-stocks, which seriously affect sales, brand loyalty and consumer satisfaction.

  In recent US surveys, out-of-stocks are estimated to be as high as 10 to 15 percent daily on core items — even higher on advertised specials. Industry executives globally, however, have referred to this as the single largest potential benefit area from RFID and the EPC network for both manufacturers and retailers.

  The current focus in on-shelf availability is pilot testing the ability to improve retail in-store replenishment processes by providing visibility to case-level inventory in the backroom. Recent estimates note that US retail companies lose billions in sales annually due to their inefficient back-room systems. Some RFID applications currently being tested and considered include using smart-shelf technology and item-level tagging to improve visibility to stock in the backroom by providing the capability to recognise low-stock levels and send replenishment prompts to store personnel (perhaps by messages sent via wireless PDAs).

  If retailers share back-room visibility with manufacturers, replenishment processes and algorithms may be significantly improved, resulting in better fill rates and, ultimately, fewer out-of-stocks at the store shelf.

- **Eliminating Shipping & Receiving Errors** — The elimination of errors in shipping and receiving requires joint participation from a supplier and a retailer, and involves case-level tracking of shipments from both trading partners. EPC information must also be communicated from one partner to another. These trials focus on eliminating the approximate 1 percent discrepancy rate that requires significant administrative and management support to resolve on a monthly basis. In the case of the manufacturer, the reduction of shipping/receiving errors will result in lower costs for administrative labour normally used to resolve errors and potentially could reduce the amount of product being written off due to charges related to erroneous shortages, etc.

- **Productivity & Labour Efficiencies** — Both suppliers and retailers are testing RFID non-line-of-sight improvements over existing bar-coded ID systems in terms of reductions in data entry and processing to improve product velocity. These trials provide valuable ground-up insights on improving key performance metrics in the distribution centre and back-room environments. Receiving points especially are renowned trouble spots in the supply chain, and, generally, if a company can increase the speed of receiving, it

also can increase the productivity of the entire site (putaway, picking, staging, shipping, cycle counting, and physical stocktaking).

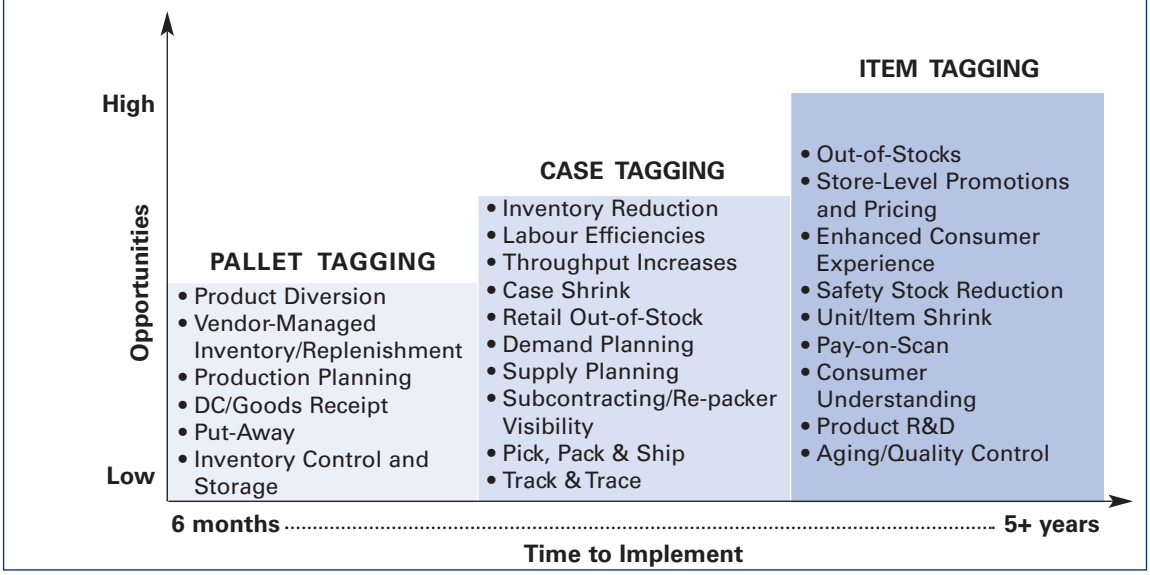
The vision of companies today is to leverage the EPC network to maintain or improve current accuracy levels while, at the same time, reducing labour expenses related to audit and exception handling processes, etc. RFID technology and the EPC network, therefore, have the potential to mitigate the pressure currently found within operations to balance the traditional trade-offs between accuracy, labour, and throughput.

- **Tracking High-Value Maintenance, Repair & Operations (MRO)** — For items such as spare parts, this four-wall RFID trial opportunity is available to both the manufacturer and retailer, but typically the manufacturers' conversion assets will increase the requirement for MRO tracking. Trials focus generally on tagging repairable or high-value spare parts to improve stock visibility at a lower labour cost. Mobile readers in the plant can ensure that assets are controlled, that shrink is reduced, and that warranty coverage is maximised. Active tags and "write many/read many" tags may be considered for these types of applications.
- **Asset Tracking** — Within vertically integrated supply chains, piloted trials in asset tracking are prevalent in the produce, beverage, and foods categories, involve tagging of returnable containers such as trays, containers, pallets, or kegs. Active tags are sometimes considered for this category of tracking. These trials typically test enhancing first-in, first-out compliance (for perishable products) or reducing asset loss (for beer kegs and pallets).
- **Tracking Speciality Orders** — Some multi-category retailers as well as do-it-yourself retailers have tested item-level tracking of customer speciality orders. This will help improve customer services by tracking custom merchandise that is often mixed in with regular merchandise and can be "lost."

Other Ideas Also Being Considered

- **Increasing Home Delivery & Direct Store Delivery (DSD) Accuracy** — Tagging at the item, tray, container, or box level will enhance home delivery channels as well as direct store delivery (DSD) operations by ensuring the right products are loaded and delivered by the right vehicles. RFID can also enhance the loading process to ensure delivery compliance in both channels.

Opportunities From EPC Tagging 16



Source: IBM Business Consulting Services

- **Enhancing the Shopping Experience** — The METRO Future Stores Initiative has begun trials on the integration of RFID tags into store loyalty cards. It is expected that, as item-level tagging in stores increases, a three way association of product, store, and customer will be made providing the customer with a range of benefits via digital shopping-assistance devices. These benefits include store product finders, out-of-stock notifications and substitution suggestions, streaming digital media, price checks, and related applications. Industry marketers are excited about the possible use in the future of smart-shelf technology — perhaps in conjunction with loyalty cards — to present real-time marketing messages to the consumer, e.g., pointing out promotions at the point of purchase-decision.

- **Authentication** — Trials are underway within the retail pharmacy and pharmaceutical supply chains to use RFID as a way to test whether or not products are authentic. The idea is that any duplicate reads, (e.g., reads that do not link to a manufacturer's product or batch information, etc.) could be the sign of non-authentic product. Expiration dates for items could also be checked to ensure safe and effective product usage. This presents a huge opportunity to address drug safety and regulatory concerns and could also remedy the rash of recent blockbuster drug counterfeiting issues.

Business Application Conclusions

The RFID technology has many potential uses. Detailed interviews with early adopters that illustrate the business case will drive which applications become the standard processes for tomorrow.

- Business process change is essential. The technology is only an enabler — not a business solution on its own.
- Data and information-sharing across company boundaries can drive significant benefits for both manufacturers and retailers. The EPC network vision provides a framework and mechanism to make this data sharing a reality, but implementing this in a consistent manner across trading relationships requires more work on industry standards through the EPCglobal™ organisation.
- The main focus of early adopters is pallet/case-level tagging. Many companies believe that a greater level of benefits can be achieved through just case-level tagging.
- Consumer unit item-level tagging has some incremental benefits. However, there are a number of issues that need to be addressed before this can be considered on a broader scale.

"RFID enables us to have the full visibility of the items, cases and pallets in the entire collaborative supply chain. This information can easily be joined with our supply chain partners. Using RFID, we can increase efficiency and reduce costs across the entire process chain."

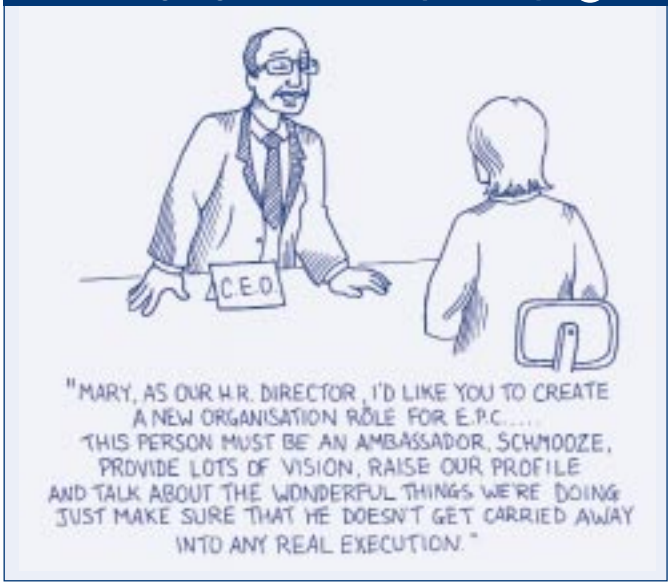
Dr. Gerd Wolfram
Project Manager, METRO Group Future Store Initiative

4.3 The EPC Adoption Journey

The EPC adoption journey for individual companies includes four distinctive phases or steps along the roadmap. However, before describing the milestones along the way, leading adopter companies wish to share some of their insights on lessons learned about the core elements of this roadmap to EPC implementation:

Evolving Supply Chain Trends 17

Allocating Organisational Responsibilty 18

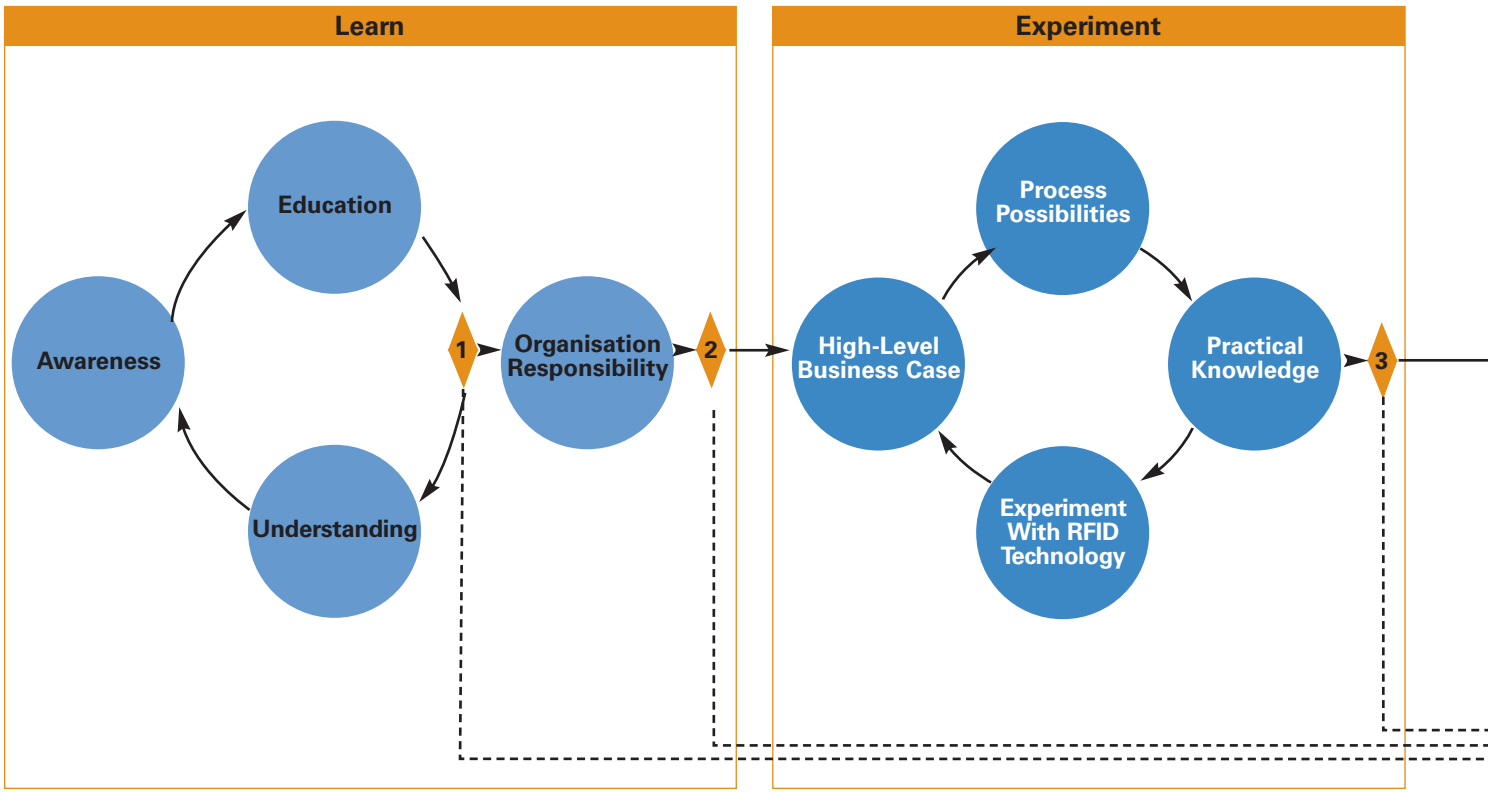


- This is a journey that is new, and there is no *single* route for getting to any given destination.
- Along the way, there are a number of distinct checkpoints or milestones to consider — markers that will determine the path that will be taken and about how long the journey may take.
- While there are direct steps in each phase, this journey is an iterative process.
- Today, most companies have begun the EPC adoption journey and are at a minimum at the first phase or "*learn*."
- Some companies have moved quickly into the *experiment* phase. A few have moved to the *evaluate* phase and are characterised as the early adopters.
- Finally, today only a small group are publicly committed to the *adopt* phase. However, the expectation based on company comments from varied parts of the globe is that there will be a rather large push toward adoption of RFID technology and toward pilot testing over the next two years.

4.3.1 Learn

In the beginning, many companies have a few individuals — most frequently from manufacturing, distribution and logistics, IT, store operations, or finance — who have a foundation of understanding

EPC Roadmap — Learn, Experiment, Evaluate, Adopt

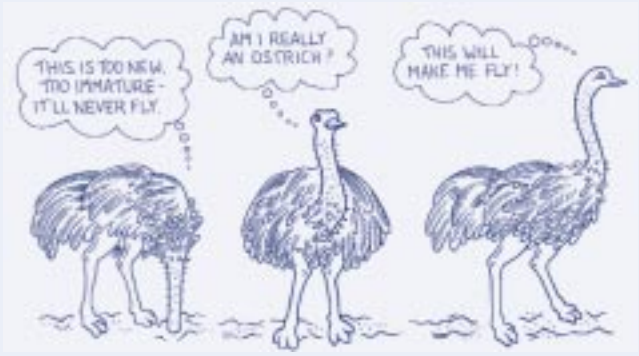


around current RFID technology and the EPC vision. For some companies, these individuals have focused on RFID as a matter of personal interest with no active company role for the initiative at this time.

The first key decision point during phase one of an EPC adoption roadmap is that someone in the company — frequently from the group mentioned above — becomes an RFID champion within that company. This person will usually be given the responsibility at the very least to monitor developments about RFID and keep senior management informed. This role is usually carried out in addition to the existing set of responsibilities for that individual. Once an RFID champion is appointed, more people in the company become aware of the tagging initiative. Education spreads as company staffers attend conferences, read articles, study white papers, and begin disseminating information.

This is a critical time for a company. What happens next can go one of three ways. The first outcome is that the initiative stalls. The person responsible for EPC does not believe in the vision and either decides to put his or her head in the sand with a "We will wait for two or three years and be a fast follower" approach. Or he or she does the

The Ostrich View of EPC Vision 19



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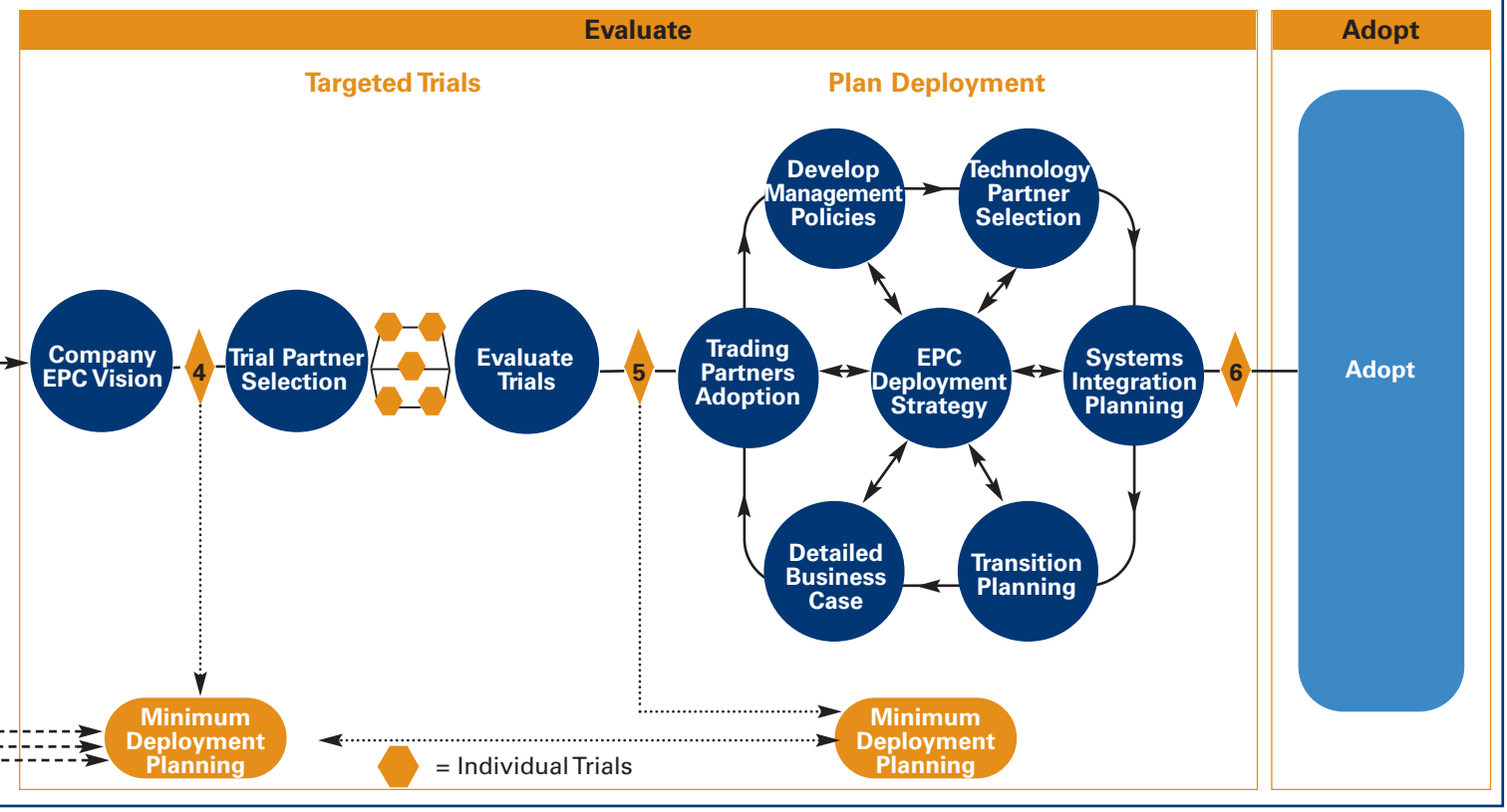


minimum that is necessary to comply with requests from only their most important trading partners. The final extreme is that the individual believes more is possible than actually is at that time and does not attach a firm basis of reality to grandiose ideas of implementation.

The turning point at this decision juncture is that the person responsible for EPC realises that, in order to move forward, he or she will need to transform theoretical knowledge into practical knowledge and action. This realisation is reached by recognising that the technology is evolving, others are getting a head start, and perhaps the time has come to move to the next stage — experimentation — if the company is to grasp the true potential for the EPC vision.

Working Towards the Business Case 21

4.3.2 Experiment

The first key activities include developing a high-level business case and a small technology proof-of-concept pilot specifically focused within the four walls of a company. This is a critical step in order to drive realism and pragmatism into the leadership, allowing the company to continue strategically on the journey. However, it is important the business case and technology proof-of-concept is not over-engineered at this stage. If successful, some initial funding is usually provided.

Companies that are further down this EPC adoption roadmap contend, without exception, that this step is all about business process and simply being comfortable with the technology. The *experiment* phase is an iterative combination of understanding business process possibilities coupled with limited trials of the RFID technology.

Many companies currently in this phase report that the practical experiments give them far better insights than a substantive paper-based business case exercise.

Barriers to Execution 22

The development of the core elements of RFID — tags and readers — is fast changing as technology and manufacturing innovation improves the reliability, functionality, and cost of the equipment. This *experiment* phase allows companies to understand more clearly how well suited this current technology is to the company's products and environments. The key knowledge gained has been that it is very difficult to understand process possibilities and technology capabilities without a degree of experimentation in the company's internal environment.

Another turning point in the EPC journey is reached when the experiments are successful, the process opportunities are evident, and a critical mass of people in the organisation are excited about the

Source: IBM Business Consulting Services

possibilities of the EPC vision. In the end, the EPC leaders will go to their board or senior management to request permission to continue the journey. This request is based on confidence in the business case and in the technology being ready to deploy to scalable pilots within the company. Most likely, the decision to pilot will be made both from the internal four walls of a company application, as well as in response from a trading partner request.

Companies that do not move to the *evaluate* or *pilot* phases have reported the delay is due to the company's wish to continue the *experiment* phase to seek further comfort with the business case and the application priorities.

However, there may also be another reason not to move forward fully into the *evaluate* phase. Some companies decide that the journey through this transformational process is too early, too expensive or there are more important initiatives on which to focus. They decide instead to opt for a minimum deployment plan — something that meets the basic requirements of important trading partners but does not move toward wider adoption. This minimal approach of responding to retailer requirements to tag has been termed a "slap and ship" approach. It allows a company to apply tags to selected products but to do nothing more. Research indicates this is not a recommended option since the cost of tags with no incremental benefit from shared information or process change is not viable for very long in most companies.

Early adopters have demonstrated that the real value from the EPC vision comes from trading partner *collaboration* — a collaboration of process and information flows.

"You need to pilot test the EPC network to identify where the benefits are. 'Launch and learn,' then develop your business case."
Dick Cantwell
Vice President, The Gillette Company

Key Questions to Ask (Experiment)

- What is driving this initiative? What happens if we do not get on board? Will it generate savings, or do we have to do it to maintain market share?·
- So how much better is this than my current supply chain management system?
- What are our suppliers/customers doing in this space? Have they already started or are they holding back?
- How can I keep my competitive information and strategies intact when I collaborate with others in this initiative?
- How big does the project team need to be? Which departments will need to work with this?
- What are the regulatory bodies? Have they published global standards?
- Which industry groups are orchestrating this initiative? Are they all aligned? Are we members of any of them?
- What is the public opinion on this initiative? Do we need to put any statements out to position ourselves?

Experimentation Checklist

- ✔ Understand your visibility requirements: What items do you want to read? Where? How often? From what distance?
- ✔ Query other end-users about recommendations for trials: What to do? How to do it? Recommended technologies? Many experienced end-users are willing to share their learning experiences.
- ✔ Move into the action phase in a real world setting. Place tags on pallets, cases, and products. Set up readers at the points where you seek enhanced visibility, outside of the laboratory environment.
- ✔ Evaluate technical performance. Do you get reliable reads?
- ✔ Assess the economic benefits. How is it better than or different from what you are currently doing?
- ✔ Understand the impact of the technologies on business process, plus integration issues with enterprise systems.
- ✔ Make a decision to (a) move forward with a larger-scale implementation, (b) refine the trial — different processes, technologies, items, and/or read points, or (c) slow down activities.

Source: Matrics, Inc.

4.3.3 Evaluate

Company EPC Vision

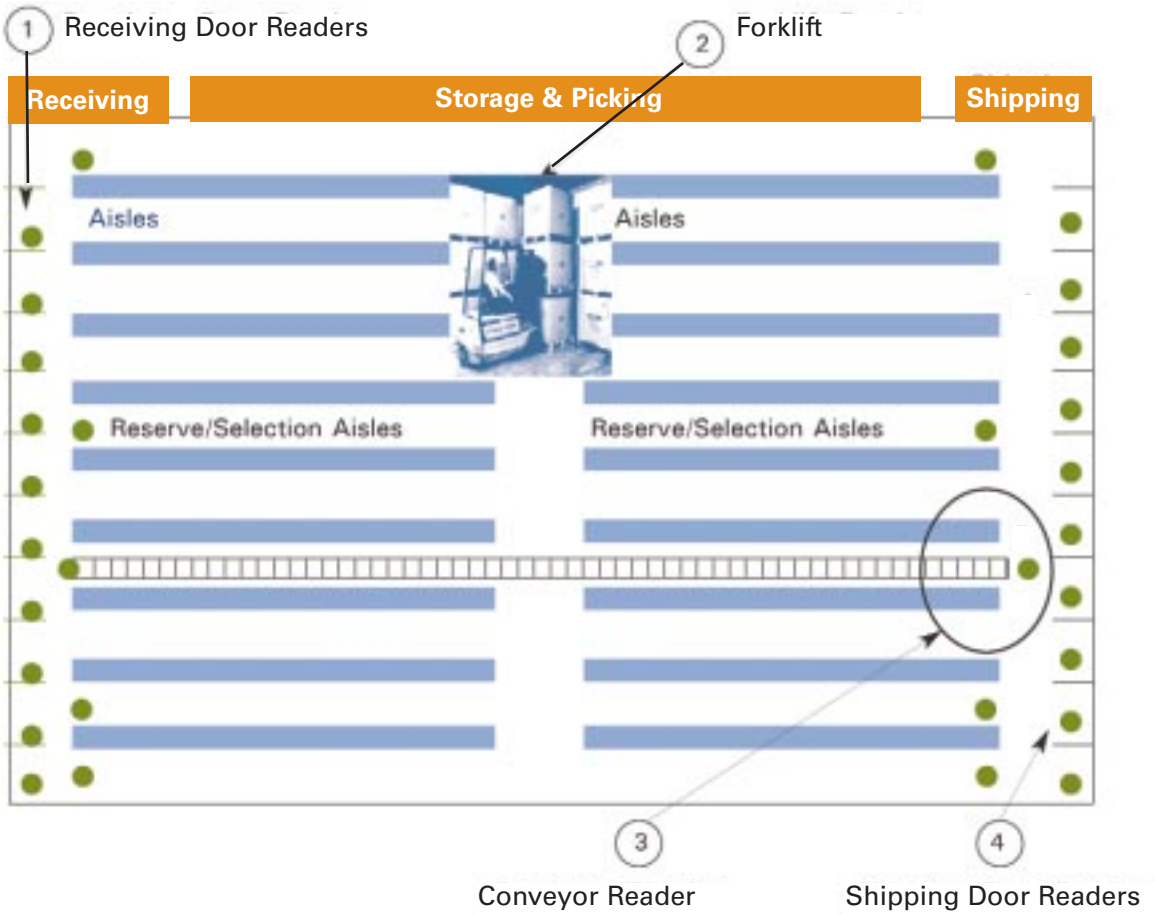
Entering this phase implies that a company is serious about conducting operational trials. The first activity within the *evaluate* phase is to develop a company EPC vision. This process involves a degree of evangelism within the business to expand enthusiasm throughout the company. One of the first steps is to identify the priority business application areas of focus. There is also the small matter of getting funding agreed for selected operational trials.

This decision point is another important turning point. Agreement needs to be made on funding and what company resources to commit. The alternative is to start planning for the minimum that could be done to either create some value or respond to requests from important trading partners.

Trial Partner Selection

The technology in this area is changing constantly, especially since a number of suppliers have been working hard to make their products EPC standards-compliant. The advice from companies that are more advanced in this journey is that you

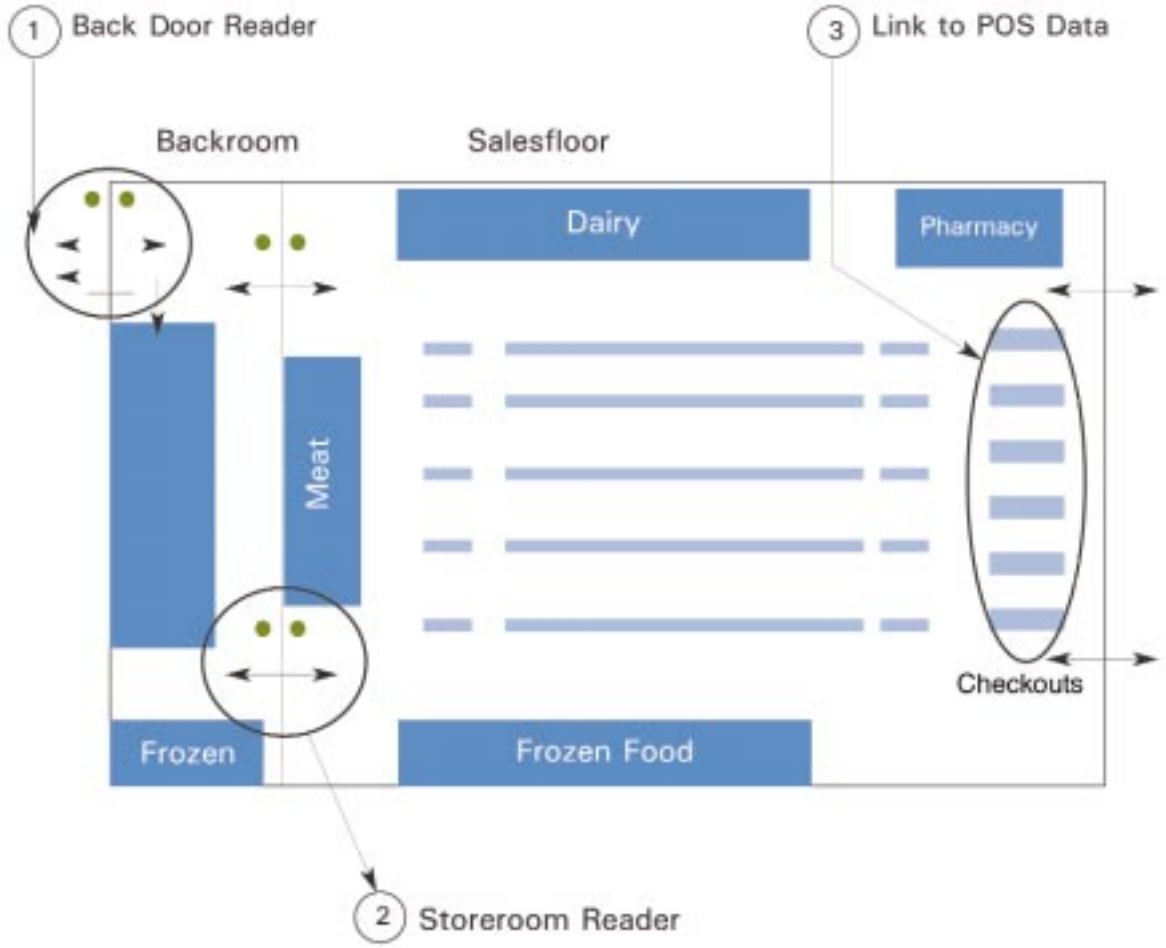
Trial: Distribution Centre — Pallet and Case Level Movement 24



Trial Issues	
Set Up	• Define appropriate scope for DC trial: Which products, categories, and suppliers have the capability to tag pallets and cases, and at what point in supply chain? • Redesign the processes: Where are the transaction points in the process that require readers for measurement and tracking? • Test the vendors' technology in the environment. • Set up trial to ensure tight control and measurement of success (technology, system interfaces, processes, and staff).
1. Receiving	• How is advance ship notice (ASN)/dispatch advice data reconciled between trading partners to auto confirm receipt, and match purchase order (PO)? • How does DC layout and product characteristics affect deployment and location of readers (read and power ranges)?
2. Forklift /Order Picker	• What are the training requirements for staff? • How can we ensure tagged (and non-tagged) product is correctly recognised? • What interface requirements are there to local warehouse management system (WMS) to validate product, quantity, and update inventory and location data?
3. Conveyor	• How do we interface with WMS to confirm picking and transit between locations within DC (reserve, pick, dispatch)?
4. Shipping	• Do third-party logistics providers (3PLs) have the capability and interface requirements to confirm dispatch, plus track and trace?

Source: IBM Business Consulting Services

Trial: Retail Store — Case Level Movement 25



Trial Issues	
Set Up	• Define appropriate scope for retail trial — which product categories at a case level and number of control stores. • Start trial at case level first to capture benefits from backdoor to shelf replenishment, rather than item level on shelf to POS. • Redesign the processes — where are the transaction points in the process that require readers for measurement and tracking? • Test the vendors' technology in the environment. • Set up trial to ensure tight control and measurement of success (technology, system interfaces, processes, and staff).
1. Backdoor	• How is ASN reconciled and automatic deductions at receipt to dispatch from DC? • How do we record both tagged and non-tagged movements from backroom to shelf?
2. Storeroom Reader	• How do we link updates of inventory-on-hand from backroom to shelf case fill? • How are store staff trained to undertake manual shelf checks and plannograms with tagged and bar-coded product?
3. Link to POS Data	• How do we interface real-time POS data with inventory-on-hand data on tagged product in backroom to replenishment algorithms to trigger automatic replenishment?

Source: IBM Business Consulting Services

need to find the right partners to help you with the trials. These include:

- Tag suppliers.
- Reader suppliers.
- RFID technology integrators.
- Systems integrators.
- Middleware/EPC component suppliers. (e.g., a vendor that has a working version of a savant.)

It goes without saying that it is also necessary to identify the right industry trading partners with whom to conduct collaborative trials. Early experience indicates it is easier to pilot with like-minded companies that are at the same point in the EPC evolutionary journey as your company.

Evaluate Trials

The objective of the trials is to prove the integrated technology and process changes necessary to deliver the targeted benefits. Examples of a trial in a DC and a retail store are shown in the graphics. There will be a need to do a proof of application for the RFID technology, e.g., the ability of readers from one manufacturer to read tags from a different manufacturer, applying tags on different types of products, configuring readers in different locations, testing read rates and reliability in different environments, etc.

The trials need to minimise disruption to existing systems and to minimise reporting and workflow requirements so that they are almost "black box" components. Through these pilots the overall components will be tested and proven.

Moving to an operational pilot, companies will scale up the volume and velocity going through the EPC network. The next key decision point comes at the time when a company decides to go for wider adoption and roll out.

EPC Deployment Strategy

A number of iterative activities shape the EPC deployment strategy, including:

Trading Partner Adoption

As stated earlier in this report, the main benefits from EPC adoption come when it is applied across the entire supply chain. Early adopters have all agreed that developing and deploying an EPC network takes time, dedicated effort and a significant commitment.

Develop Management Policies

At this stage in the process, policies will need to be considered, developed, and appropriate mechanisms applied to address:

- Privacy and public concern management.
- Data management and data security.
- Health and safety legislation compliance.
- Organisational change.
- Process re-engineering.
- Internal communications.
- Employment affairs.

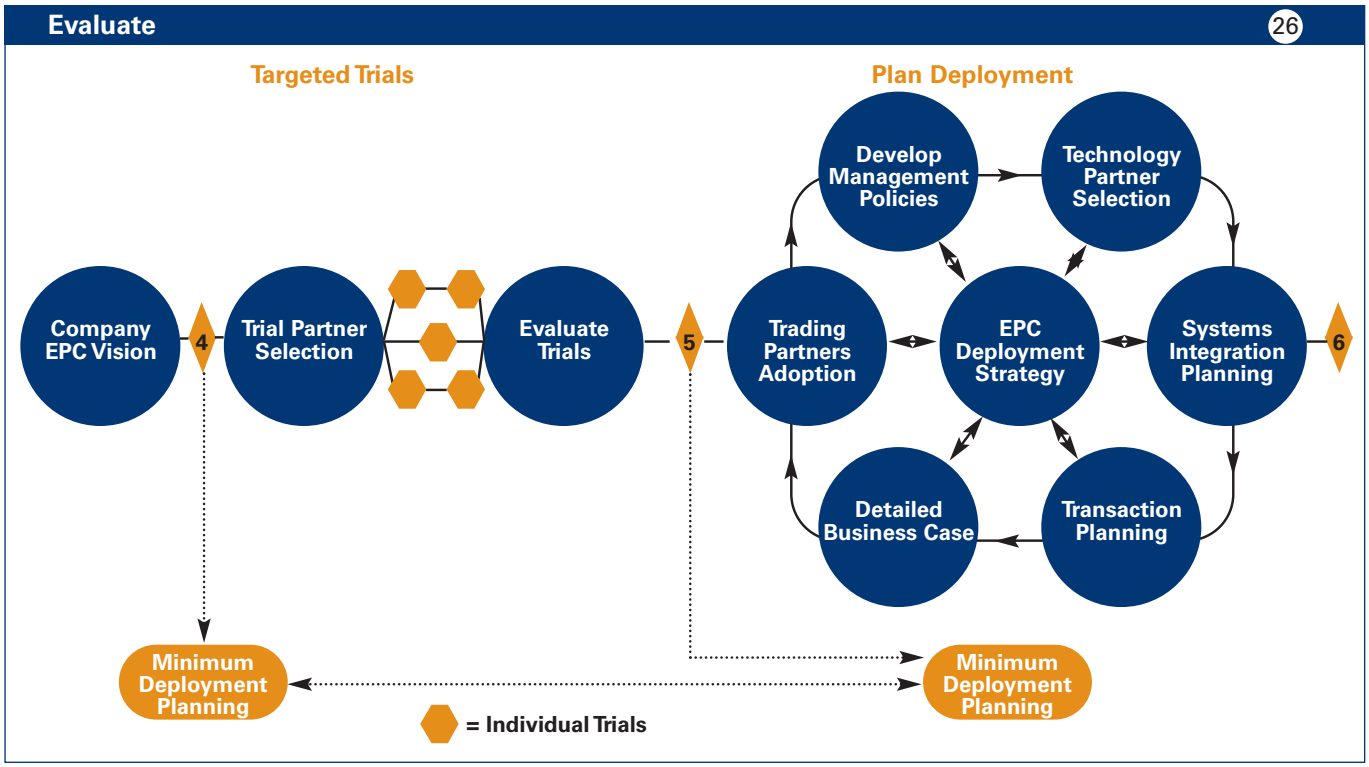
Technology Partner Selection

Technology partner selection is an extension of the activities in trial partner selection to suppliers of the EPC equipment. At this stage, a company is making longer-term commitments and, therefore, the selection and procurement exercise may take longer.

Systems Integration Planning

The deployment programme needs to consider the systems integration tasks, which represent one of the major challenges for the organisation. How will RFID-enabled information systems interlock with enterprise applications and local applications?

The result of this exercise must identify application interfaces and architecture requirements for software and hardware solutions, data storage, and network capacity needs. The volumes of data from tag reads will be enormous, and that data will need to be stored, analysed, filtered, presented, manipulated, and shared with partners. In addition, all data must be clean, accurate, and synchronised, and all parties must be using the same base data model. The capability and possible shortcomings of the current IT environment must be reviewed and decisions taken on hosting or outsourcing needs, as required.



Source: IBM Business Consulting Services

Transition Planning

A deployment plan will be required to assess the company's present position and to determine how willing or able the company is to embark with this initiative. What steps must be taken to get the company into a state of readiness? What business processes need to be changed to gain value from automatic detection of product movement?

Each company needs to recognise the scale of change involved and should identify interdependencies and constraints with other IT, business and supply chain initiatives.

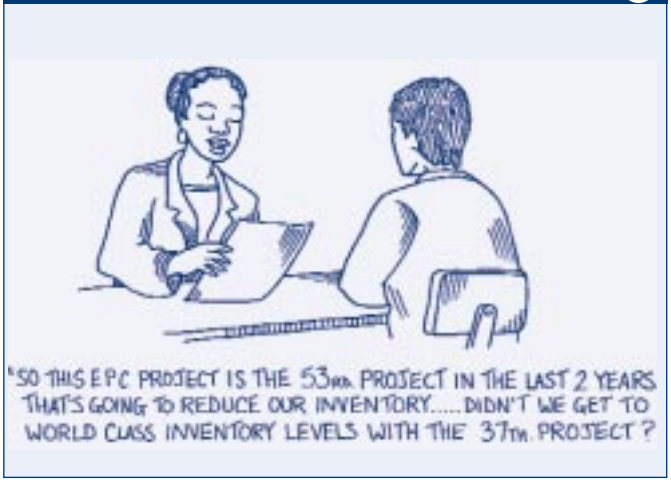
The plan will need to identify the products, locations, processes, sequence, and timing for deployment, including organisational and staff responsibilities. A successful implementation will identify measurement criteria to drive the undertaking and redirect planning where necessary (e.g., key performance indicators (KPIs) for process performance, financial measures to record business case success).

Detailed Business Case

As the trials conclude and the deployment strategy is solidified, revisiting the business case can be important. The trials will give greater visibility of the adoption route to be taken, allowing more refined assumptions on the costs, benefits, and return on investment (ROI) to be analysed for the company.

A cost range of tags, readers, and infrastructure will be required to allow sensitivity analysis and review of deployment options (pallet, case, and item tagging). It is important when developing the network revenues to agree on the costs of the tags and readers over the life of the model and to agree on an ROI timeline.

Prioritising Competing Initiatives for Deployment 27



The following basic categories of costs are applicable to both manufacturers and retailers alike:

- Process and organisation change.
- Tags (vary by frequency and range, including chips, antennae, and application costs; cost more if it is a permanent tag for inventory location).
- Reader systems (base, shelf or mobile, network costs to connect readers to antenna/host systems).
- Infrastructure costs (savant licenses, servers/hardware, data storage costs, network costs for event data transfers between servers).
- Software integration with existing legacy and enterprise applications, and existing application implementation costs (modifications to support new functionality). In distribution centres, integration is to a warehouse management system (WMS). In retail stores, it is to a sales and inventory system.
- Corporate IT costs or costs of EPC management allocated to manage the EPC database and coordinate with outside agencies to maintain stan-

"Technological superiority is not just about image. It's about constantly optimising business processes and systems, and is one of the important ways of guaranteeing future business success. Solutions that are sustainable worldwide can only be delivered if everyone works together. That's why we're working together with 40 business partners from the consumer goods and IT industry as part of the METRO Group Future Store Initiative."

Zygmunt Mierdorf
Member, Executive Board, METRO Group

Key Questions to Ask (Evaluate)

- Are we going to have to stop any other initiatives to make room for this?
- What is our real priority here?
- What level of tagging are we going to — pallet, case, item?
- Where are the break-even points in the business case?
- How long can we postpone this decision?
- How much information are we going to hold on the local servers and external data repositories?
- Are we going to host all this ourselves?
- What alternatives are there?
- How long do we have to run dual/hybrid processes (EPC and bar code)?
- How much extra does it cost to run both?
- How can I be sure that the physics will allow the technology to enable my end vision? What time frame?
- While the goal is an open standards environment, how can a retailer ensure that interoperability of tag types and readers will not become an issue?
- Will read rates at least match today's bar-code scanning accuracy, and will this accuracy be maintained worldwide with different frequency and power limitations?
- There is a need for viable, stable, and low cost devices to achieve the business benefits, but should we start piloting now to test case/pallet level applications? Should we wait for the debate over the item-level tag price to end?

dards and protocol, plus ONS fees, and other corporate IT overhead.
- Training, maintenance, and support.

The companies leading the charge towards adoption state that the emphasis on costs will change as the implementation becomes more mature:
- **Year One** — The most significant cost is in systems integration, only a small number of tags and readers will be required for operational testing.
- **Year Two** — As adoption ramps up, significantly more tags and readers will be required to track products through the supply chain and will become the largest cost element.
- **Year Three** — When much of the hardware and infrastructure is in place, deeper process change takes over as the largest focus, in terms of detailed design, development, education, implementation, and continuous improvement.

4.3.4 Adopt

It is recognised that this final phase of the journey is as yet uncharted territory, since the leading players in this initiative are currently progressing through the *evaluate* phase and have not progressed to *adopt*.

Nevertheless, it is envisaged that the deployment through this final phase will be an evolutionary process with each piloted roll out building from the lessons learned previously. It is expected that the deployment will involve increasing levels of complexity as implementations progress from *initial* adoptions on to *scale* and, finally, to *institutionalise*.

Phases of EPC Vision Adoption 28

Profiles	Initiate	Scale	Institutionalise
Site	• 3 Stores • 1 Distribution Centre	• 20 Stores • 3 DC's	• 800 Stores • 20 DC's
Tags	• 1,000+ • Expensive • Working Type 1	• 100,000+ • Cheaper • Fully Reliable	• 10 Million+ • Commodity • Highest Performance
Process Change	• Hybrid Processes • Discrete Components of Revised Processes • Visibility	• More Fundamental Process Reconfiguration • Track & Trace	• Switching off Old Process • Further Upstream and Downstream Process Transformation
Product Range	• Few Selected Product Categories	• Compatible Product Categories	• Multiple Product Categories
Company Organisation	• 2-5 Team • Multi Functional	• 15+ Team • Specific Responsibilities	• New Organisational Responsibilities
Value Realisation	• Basic Productivity Improvements Obtained • Mostly Internal	• Significant Benefits in Supply Chain Functions • Some Sharing With Trading Partners	• Enabling Benefit Across Whole Supply Chain • Mature Gain-Share Model
Trading Partner Adoption	• 5-10 Trading Partners	• Top 100	• Entry Criteria to Doing Business
Application Software and Interfaces	• Adaptors in a Few Application Packages	• Savant Plug-Ins in Major Application Packages	• Pull Information as Required and Savant

Source: IBM Business Consulting Services

Key Questions to Ask (Adopt)

- How well are the interfaces to partner data working?
- Are we making sense of it all or just spending time processing it?
- Are we really benefiting from sharing our data?
- Are our own systems showing signs that they are at maximum capacity?
- How mature are my processes (and that of my trading partner) to absorb the scale of changes required?·
- How well have employees adopted the new processes?
- Do we need to develop improved education and communication materials before further roll out?
- Will tag manufacturers propose different adoption routes as technology develops and costs fall?
- How has the company managed to use cross-company data to drive benefits? How is this data being used to collaborate with trading partners — a collaboration that is necessary to achieve the benefits across the supply chain.
- How do I effectively encourage technology vendors to develop common specifications and interoperability and for costs to fall?

Three Degrees of Belief in the EPC Vision

Interviews reveal there are different degrees of belief in the EPC vision in the industry. It is important to note that all three categories believe that there is value in applying RFID technology. The three types of believers include:

"Non-Believers" take the position that they can apply any technology they wish to use without complying with any EPC standards. In interviews, companies that have vertically integrated supply chains were considering taking this approach.

"Half-Believers" have a degree of support for the EPC Vision. They use EPC-standards-compliant tags and readers but implement the rest of the vision in a way that works best for them.

"Full-Believers" passionately believe in the EPC vision and are committed to implementing the full EPC architecture (tags, readers, savant, ONS and EPC information service or EPCIS).

Today, many companies are taking a first position as half-believers with an expectation of moving forward to full-believers in the future.

Three Levels of Beliefs in the EPC Vision 29

1. Non-Believers	2. Half-Believers	3. Full-Believers

• Belief in RFID, Not EPC
• Proprietary
  • Technology
  • Numbering Scheme
  • Information Exchange
• Largely Intro-Company Application
• Bilateral Arrangement With Trading Partner
	• Partial Belief in EPC Network Vision
	  • Tags & Readers
	  • EPC Numbers
	• Information Exchange mechanism With Trading Partners
	• Data Duplicated Across Trading Network
	• Stepping Stone to Ultimate EPC Network Vision
		• Commitment to Applying EPC Network Vision
		  • Tags & Readers
		  • EPC Numbers
		  • Some Form of EPC Information Service
		• Store EPC Data & Provide Access
		• Eventually Use ONS & EPCIS

Source: IBM Business Consulting Services

Short-Term Action Plan

The following table describes a set of generic short-term actions that a company should consider while setting off on the route towards EPC adoption. There are no set time frames associated with these actions, and each company will develop at its own pace, depending on a number of factors such as senior-level sponsorship, approach to new technology, supply chain automation, etc.

These actions themselves are not set in stone either, as technology develops and standards become more widespread, these short-term actions will also change.

Recommended Company Roadmap — Short-Term Actions 30

1. Formalise the learning process. Assign a senior executive and mobilise a cross-functional team to learn more about the technology and its possible applications.
2. Participate in EPCglobal™.Become actively involved with setting the industry standards by participating in the various action committees. This also provides an opportunity to share ideas and learn from industry peers.
3. Develop your own preliminary vision. Identify how the EPC vision could address your own business issues. Begin to formulate a vision for how your company may apply the technology and change its business processes to gain real value.
4. Conduct a business case analysis. Before making any significant business investments, conduct at least a high-level business case analysis to identify your own value proposition and to understand the cost and benefit drivers plus process changes required for your business. A fact-based analysis will provide the right framework for making investment decisions and can be refined as you progress along the roadmap.
5. Communicate with your trading partners. Actively investigate where your trading partners are along the adoption roadmap so you can prepare appropriately.
6. Initiate some controlled pilots or trials. Get out of the conference room and start learning by doing. Trials will help identify new opportunity areas and provide a practical grounding around what is technically feasible at this time. Trials also provide an opportunity to refine the business case and deployment plans based on practical lessons.

Source: IBM Business Consulting Services

5. Industry Action Plan

5.1 An Industry To-Do List

To accelerate the process by which companies start the journey toward the EPC vision and adoption, a number of steps need to be taken. Some of these steps are within the control of individual companies. However, certain joint industry actions can contribute in removing many of the barriers for EPC adoption and accelerate the pace of that adoption. This section contains a commentary on some of the organisations that will be critical in enabling EPC adoption worldwide. It also contains a "to-do" list for the industry.

5.2 Key Players

The following are organisations working to bring the promise and the priorities of the EPC vision to the forefront of the industry's agenda.

Auto-ID Center

The Auto-ID Center was an independent, not-for-profit global research organisation headquartered at the Massachusetts Institute of Technology (MIT). Founded in 1999, the center was created to build the next generation of bar code. In order to achieve its goal, the founding sponsors — Gillette, Procter & Gamble and the UCC — enlisted the support of more than 100 global organisations and companies. The Auto-ID Center concluded operations on 31st October 2003, and its research will now be conducted by the Auto-ID Labs.

EPCglobal™

EPCglobal™ was approved in September 2003 as a joint venture between EAN International and the UCC. The new organisation serves as a registry for all Electronic Product Codes (EPCs). It also administers standards related to the codes and directs implementation and commercialisation of the EPC network — a linking of radio frequency identification (RFID) and Internet technologies to enable companies to have true visibility of their supply chains in real time in any industry any where in the world.

Specifically, EPCglobal™ will:

- Manage the centralised EPC numbering database, the intellectual property licensed by MIT to EPCglobal™, and all derivative works developed from that intellectual property, plus public policy issues.
- Design the global marketing and communication templates for the EPC system.
- Channel users' funds for future EPC research.
- Lead the EPC technical standards development and recommendation process.
- Become the global clearing house for knowledge sharing and information dissemination on the EPC network through user and technology action groups.

The Auto-ID Labs

The Auto-ID Labs around the world will continue the work begun by the Auto-ID Center, researching and developing the RFID technology necessary to execute the EPC vision. The labs are located at MIT in Boston, the University of Cambridge in England, Adelaide University in Australia, Keiko University in Japan, Fudan University in China, and Universität St. Gallen in Switzerland.

EAN, UCC & the GSMP

EAN International is a global standards organisation, and the UCC is the US member organisation of EAN. Together, they co-manage the EAN•UCC System. EAN International will facilitate the cooperation between EPCglobal™, users and the EAN member organisations. Through the Global Standards Management Process (GSMP) it will manage the development of the standards required for the application of the EPC system in its served industries.

The EAN Member Organisations

The EAN member organisations will provide the local marketing, implementation, and support for the EPC network. For example, they will support the pilot tests, implement products and services including certification/compliance testing against the open and voluntary standards, and provide training and educational support in accordance with the marketing and communication templates developed by EPCglobal™.

The Global Commerce Initiative (GCI)

Founded in October 1999, GCI is the single unifying force bringing manufacturers and retailers together on a worldwide parity basis to simplify and enhance global commerce. It is a global user group, and its

charter is to drive the implementation of EAN•UCC standards and best practices.

The GCI EPC Working Group (previously the Intelligent Tagging Working Group) is an end-user group driving the adoption of standards-based RFID. It has published the *GCI Intelligent Tagging Model*, describing the key business applications and requirements for RFID.

The Global Commerce Initiative is supported by eight sponsoring organisations, all of whom have a role to play in completing this industry action plan. These sponsoring bodies are:

- Industry trade associations representing the interests of manufacturers and retailers worldwide (AIM — the European Brands Association, CIES — the Food Business Forum, GMA — Grocery Manufacturers of America, and FMI — Food Marketing Institute).
- The regional Efficient Consumer Response (ECR) initiatives and VICS (Voluntary Inter-Industry Commerce Standards).
- EAN International and UCC.

5.3 Action Plan

Although RFID is being used around the world today in a wide variety of tracking, inventory, and payment systems, the current focus in the food and consumer packaged goods industry is in supply chain and logistics applications. Global manufacturers and retailers are moving forward with RFID adoptions and field testing in an increasing number of supply chain areas.

What actions are needed by the industry as a whole and its varied organisations to encourage these manufacturers and retailers, and facilitate further testing and adoption of RFID technologies? Some critical actions are highlighted in the chart opposite — actions that need to be taken before the end of the first quarter of 2004. Industry assumptions are that a number of companies are getting prepared now for the end of 2004, when a much wider scale of adoption is expected. This assumption is derived from announced intentions of several leading companies.

The industry action plan builds on the requirements identified in Section 3, "Enabling the Vision," that need to be met if this vision is to become a reality. The plan identifies the responsibilities of the different stakeholder groups that are able to drive adoption of the EPC vision. These groups also have the authority to solve the issues identified in the following section.

In order to complete this action list of industry expectations, the following needs to happen:

1) Standards organisations should allocate the correct resources and provide mechanisms to deliver against this action list.
2) Industry has the responsibility to ensure that companies put the right calibre of people into the relevant industry work groups. Companies also need to make a commitment to implement resulting best practices.
3) Trade associations need to work closely with both standards bodies and industry organisations to ensure a consistent message is delivered.

Progress against this action list will be monitored by GCI.

Industry Action Plan 31

Action	Responsible
1. Communications and Marketing Large-scale adoption of the EPC vision requires that more companies understand the concept behind the vision — its technology and the business benefits for manufacturers, retailers, and third-party companies. This wider adoption should be promoted by developing and publishing consistent marketing and communications materials to increase the awareness of EPC in the industry.	Standards Bodies Trade Associations Industry
2. Sharing Best Practices A limited number of manufacturers and retailers are conducting field trials with the available technology and have developed considerable knowledge to date. These insights and experiences should be shared with others who are not so far along on the EPC journey or with those who have yet to begin the journey. A best practice group for knowledge and experience sharing should be established for this purpose.	Industry
3. Wider-Scale Adoption Wider-scale adoption of the EPC vision will also require other companies to participate. Encourage third-party logistics providers, contract manufacturers, contract packers, and packaging suppliers to develop approaches for adopting and implementing the EPC network to service the future tagging requirements of manufacturers and retailers.	Industry
4. Supporting Open Standards A common and open standards-based approach is required for the development of the EPC vision technology architecture. This can be achieved by getting a critical mass of important retailers and manufacturers to announce their support for an open and standards-based development approach. Communication should be planned with clarity on the points of commonality, focusing on messages to give confidence that there is a recommended way forward.	Industry Trade Associations
5. Migration Path for EAN•UCC Numbering System There will be a period of time as existing identification schemes (e.g., GTIN) migrate to EPC. To facilitate this move and allow the use of both schemes as transition occurs, the industry should agree and develop an industry standard for the inclusion of GTIN in the EPC number. In addition, other EAN•UCC standards require definition for migration into the EPC numbering system.	Standards Bodies
6. Integration of PML With EAN•UCC System Develop agreed-upon EPCIS and PML specifications integrated with the EAN•UCC Global Data Dictionary.	Standard Bodies
7. EPC Application Scenarios The implementation roadmap to move pilot trials from the four walls of a company to collaboration with trading partners is complex. Data management structures should be agreed upon and infrastructures established. For example: application scenarios should be defined for the location-to-location delivery process, and as such an EPC scenario goes outside the four walls of one company, shows how advance ship notices (ASNs) will be sent, how the EPC numbers will be communicated between trading partners, who will own and hold what data, etc. What levels of data security and integation are required?	Standards Bodies Industry

Continued on the next page.

Industry Action Plan (continued)

Action	Responsible
8. Tag Specifications The technical development, enhanced functionality, and innovation in the various types of tags are progressing within the industry. As a result, tag specifications should be provided that are open standards-compliant, interoperable and upwardly compatible, as new versions are designed. Manufacturers should be encouraged to develop products that meet the latest specification of these criteria.	Standards Bodies Industry Hardware Providers
9. Reader Specifications In tandem with tags, reader specifications also should be developed that are open standards-compliant, interoperable, and upwardly compatible. Manufacturers should be encouraged to develop products that meet the latest specification of these criteria.	Standards Bodies Industry Hardware Providers
10. Harmonisation of Radio Frequency Clarity of the regulations' harmonisation process is required across the industry. Details on what has been agreed upon should be published. The harmonisation process also should be explained. Statements from regulatory groups, e.g., International Organization for Standarization (ISO), ETSI etc., should be obtained to help define what information should be given to CEOs so they can participate more fully in the debate and help to influence government and regulatory bodies in this harmonisation process.	Standards Bodies Industry
11. EPC Software The EPC network is the infrastructure for the adoption of the EPC vision, with the principle building blocks of the savant software, ONS and EPCIS as components of this infrastructure. Technology vendors should be encouraged to provide open standards-based products that work with savant and standard application program interface.	Industry Software Providers
12. Quality Assurance & Compliance The availability, performance, and efficiency of tag and reader equipment need to match — if not exceed — currently available technological solutions. Quality assurance and certification should be encouraged from tag and reader suppliers on their products' compliance with technical specifications, including robustness, reliability, read distances, read rates, etc.	Industry Hardware Providers
13. Public Policy Agree on public policy issues and privacy statements and commit to implementing these.	Trade Associations Standards Bodies Industry

6. Glossary

Active Tag: An RFID tag that uses a battery to power its microchip and communicate with a reader.

Agile Reader: Generic term for a device that can read different types of RFID tags, such as those made by different manufacturers or those that operate at varied frequencies.

Air Interface Protocol (AIP): Section of the tag class specification that details the protocols for the wireless communication between tags and readers.

Advance Ship Notice (ASN) or Dispatch Advice: An electronic data interchange (EDI) transaction in which the shipper notifies a customer of a pending shipment.

Application Program Interface (API): The specific software layer prescribed by an application program by which another application can make requests of the system or application.

Auto-ID Center: The Auto-ID Center was an industry-funded program founded in October 1999 by the UCC, Massachusetts Institute of Technology, Procter & Gamble and Gillette. It was replaced in the autumn of 2003 by the Auto-ID Labs and the EPCglobal™ organisation.

Bar Code: An array of symbols (bars and spaces) representing data on products that could be scanned easily by machines to communicate data about the product or shipping container to which it is affixed.

Bit: The smallest unit of digital information — a single one or zero. A 96-bit EPC is a string of 96 ones and zeros.

Class 0 Tags: Tags with a number embedded at point of manufacture; write once, read many.

Class 1 Tags: Tags on which the user inserts a number at the point of using the tag; tags that can be written once, read many (WORM).

Domain Name Service (DNS): A service used on the Internet to help the network route information to the correct computers.

EAN International: A global organisation in identification and e-commerce that manages and provides standards for the unique and non-ambiguous identification and communication of products, transport units, assets, and locations.

EAN•UCC System: The EAN•UCC System offers multi-sector solutions to improve business efficiency and productivity. The system is co-managed by EAN International and the Uniform Code Council

Electronic Article Surveillance (EAS): Simple electronic tags that are either on or off. When an item is purchased or borrowed legally, the tag is turned off. When someone passes a gate area holding an item with a tag that has not been turned off, an alarm sounds.

Electronic Data Interchange (EDI): The computer-to-computer transmission of information between trading partners in the supply chain. The data is organised into specific standards, file formats, and transaction sets following specific guidelines

Electronic Product Code (EPC): This coding scheme, developed by the Auto-ID Center, uniquely identifies an individual item.

EPCglobal™: This new entity is a joint venture between the Uniform Code Council and EAN International approved in September 2003 to serve as a registry for the electronic product code (EPC), to administer standards related to the codes, and to direct the implementation and commercialisation of the EPC vision and the EPC network.

EPC Information Service (EPCIS): EPCIS is a computer system that manages and delivers physical markup language (PLM) to information requesters.

eXtensible Markup Language (XML): A widely accepted way of sharing information over the Internet in a way that computers can use, regardless of their operating system.

EZ Pass: An RFID device used to automate payments at highway toll booths in North America.

File Transfer Protocol (FTP): A standard Internet protocol to exchange files between computers on the Internet.

Global Commerce Initiative (GCI): A voluntary body created in October 1999 to improve the performance of the international supply chain for consumer goods through the collaborative development and endorsement of recommended standards and key business processes.

Global Returnable Asset Identifier (GRAI): A unique number used to track a returnable asset, such as a crate or beer keg.

Global Trade Item Number (GTIN): An umbrella term used to describe the entire family of EAN•UCC data structures for trade item identification

Global TAG (GTAG): Is an RFID standard developed by the UCC and EAN International. The air interface protocols developed by this project team are currently going though the process to become international standards.

Interrogator: A particular type of agile reader that can also write to certain types of tags.

IP Address: A 32-bit number — although 128-bit versions are also used — that identifies each sender or receiver of information that is sent in packets across the Internet.

Object Name Service (ONS): A system for looking up unique EPCs and pointing computers to information about the item associated with the code. ONS is similar to the domain name system, which directs computers to sites on the Internet.

Passive Tag: An RFID tag that does not use a battery. The tag draws energy from an electromagnetic field created by the reader.

Personal Digital Assistant (PDA): Any small mobile hand-held device that provides computing and information storage plus retrieval capabilities for personal or business use.

Physical Markup Language (PML): A method of describing products in a way that computers can understand, PML is based on the widely accepted eXtensible markup language used to share data over the Internet in a format all computers can use.

Radio Frequency Identification (RFID): A method of identifying unique items using radio waves. The big advantage over bar-code technology is that lasers must see a bar code to read it. Radio waves do not require direct line-of sight and can pass through materials, such as cardboard and plastic.

Savant: A middle layer between the reader and applications systems that filters the data and then passes appropriate product movement information to application systems.

Serial Shipping Container Code (SSCC): A unique number that can be used as the key to access information regarding a logistics unit or its attributes, e.g., the SSCC-18 or "license plate" used on variable content containers, pallets, and shipments.

Stock Keeping Unit (SKU): An identification of a particular product that allows it to be tracked, especially an individual size, colour, flavour or pack of a product that requires a separate code number to distinguish it from other products.

Speedpass: An RFID-based device used by Exxon-Mobil to authorise payments in retail outlets, especially in service stations.

Third-Party Logistics Providers (3PL): A service organisation offering logistics and other supply chain services to companies and organisations.

Ultra High Frequency (UHF): A band of the electromagnetic spectrum in the radio wave range.

Uniform Code Council, Inc. (UCC): UCC is the US member organisation of EAN International. It jointly manages the EAN•UCC system and is a partner in managing the EPCglobal™ organisation.

Universal Product Code (U.P.C.): A bar-coding and numbering system of North America developed in the late 1960s and early 1970s by the U.S. food and grocery industry and used for product identification of consumer items that are typically scanned at a retail point-of-sale.

Uniform Resource Locator (URL): A unique address of a file that can be accessed over the Internet.

Value-Added Networks (VANs): Private networks that exist between trading partners to exchange transactional data in a secure environment.

7. Appendix

Guidelines on EPC for Consumer Products, Adopted by the Auto-ID Center Board of Overseers October 29, 2003

Introduction

Electronic Product Code (EPC) is an emerging system that uses Radio Frequency Identification (RFID) for the automatic identification of consumer products. RFID is now being used in everything from automobiles to security pass cards, and it serves a variety of purposes. One of its widespread uses is in devices such as EZ Pass in the US and Liber-T in France that speed the passage of autos through highway toll booths.

EPC has the potential to be used on many everyday consumer products as they move through the supply chain – from factories through distribution centers and into retail stores. As EPC evolves, it promises to offer significant benefits to consumers and companies. The improved information in the supply chain will help speed products to the shelf and insure they are available when consumers want and in the quantities they need. Removal of expired products will be easier, and prompt removal of any recalled product will be facilitated. In addition, checkout times for customers could be significantly shortened.

To allow EPC to realize its potential for consumers, retailers and suppliers, it is important to address privacy concerns prompted by the current state of the technology while establishing principles for dealing with its evolution and implementation. Accordingly, the sponsors of EPC have adopted the following Guidelines for use by all companies engaged in the large-scale deployment of EPC. These Guidelines are intended to complement compliance with the substantive and comprehensive body of national and international legislation and regulation that deals with consumer protection, consumer privacy and related issues. They are based, and will continue to be based, on industry responsibility, providing accurate information to consumers and ensuring consumer choice.

As new developments in EPC and its deployment occur, these Guidelines will evolve while continuing to represent the fundamental commitments of industry to consumers. It is hoped that further developments, including advances in technology, new applications and enhanced post-purchase benefits, will provide even more choices to both consumers and companies on the use of EPC tags. The sponsors of EPCglobal support continuing their focused efforts in these development areas to assure responsible and effective development of both the EPC technology and these Guidelines.

These Guidelines will be administered by EPCglobal, a joint venture between EAN International and the Uniform Code Council. The EAN.UCC also sets and maintains standards for the product code now used on consumer products. EPCglobal also will be responsible for updating these Guidelines. For EPC to gain broad acceptance, consumers must have confidence in its value and benefits. . . and the integrity of its use. EPC participants are committed to gaining and retaining this public confidence. EPCglobal will monitor the proper use of these Guidelines and be responsible for updating them.

Because EPC is an emerging technology in an early development stage, usage Guidelines supplementing or modifying those below will evolve as applications are developed and implemented. For example, if developments in the technology or its use provide consumers added flexibility in controlling EPC tags or record personal consumer information beyond that provided by conventional bar code technology, changes to notices required to consumers or to the Guidelines themselves may be appropriate. Given the current state of the technology and the relatively early stage of its deployment at the consumer unit level and to allow participants appropriate time to

implement the Guidelines, EPCglobal has established January 1, 2005 as the expected date by which companies will follow the Guidelines below.

Guidelines

1. Consumer Notice
Consumers will be given clear notice of the presence of EPC on products or their packaging. This notice will be given through the use of an EPC logo or identifier on the products or packaging.

2. Consumer Choice
Consumers will be informed of the choice that they have to discard, disable or remove EPC tags from the products they acquire. It is anticipated that for most products, the EPC tags would be part of disposable packaging or would be otherwise discardable. EPCglobal, among other supporters of this technology, is committed to finding additional cost effective and reliable alternatives to further enable consumer choice.

3. Consumer Education
Consumers will have the opportunity easily to obtain accurate information about EPC and its applications, as well as information about advances in the technology. Companies using EPC tags at the consumer level will cooperate in appropriate ways to familiarize consumers with the EPC logo and to help consumers understand the technology and its benefits. EPCglobal would also act as a forum for both companies and consumers to learn of and address any uses of EPC technology in a manner inconsistent with these Guidelines.

4. Record Use, Retention and Security
As with conventional bar code technology, companies will use, maintain and protect records generated through EPC in compliance with all applicable laws. Companies will publish, on their Websites or otherwise, information on their policies regarding the retention, use and protection of any consumer specific data generated through their operations, either generally or specifically with respect to EPC use.

Summary
The purpose of these Guidelines is to provide a responsible basis for the use of EPC tags on consumer items. Under the auspices of EPCglobal, these Guidelines will continue to evolve as advances in EPC and its applications are made and consumer research is conducted. As EPC evolves, so too will new issues. EPC participants are committed to addressing these issues and engaging in a dialogue about them with interested parties.

Global Commerce Initiative
Maarweg 133
D-50825 Koeln
Germany

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