

A chilling thought!

"There was of course no way of knowing whether you were being watched at any given moment."

George Orwell, "1984"

Author and wit Quentin Crisp described euphemisms as "*unpleasant truths wearing diplomatic cologne*"; and on matters concerning cologne, Quentin was a force to be reckoned with.

My daughter's social security number recently dropped through our letterbox, a gentle reminder from the State that time had come to commence a lifetime's toil. Although several years of study lie ahead, the college vacations now offer the opportunity - so Jean informed us - to supplement the pittance paid her by her miserly parents. This was excellent news indeed, for my daughter has developed a remarkable talent for outlay and it was heartening to see her become immersed in the *Situations Vacant* columns of our local rag. Having learned not to play with fire I didn't enquire too closely about her intentions, but it came as quite a surprise when,

some days later, Jean announced that she was to start work as a "console operator".

Console operator? Perhaps I've been around IT for too long, for the vision that flashed through my mind on hearing this news was one of watchful technicians confronting a bank of message-laden screens on the operations bridge of some Big Blue installation. Alas, not so. Just as the Head Programmer of old has transformed into the service provider's Chief Software Architect; Learning Solution Consultants have displaced Trainers; and Public Relations Officers now style themselves Media Outreach Coordinators, I guess that I shouldn't be surprised to find our local supermarket's checkout girls also wearing a discrete splash of diplomatic cologne. After all, when properly considered, "console operator" isn't an entirely misleading description of their role, for what are the innocuous looking point-of-sales terminals they attend but consoles, optimised to pour an endless stream of purchase data (yes, even my one-horse town has 24 x 7 shopping) into the company's ever-churning accounting, supply chain and data mining systems?

Supermarket retailing has moved a world apart from the high street grocery stores of my youth. Refrigeration and sleek vacuum packaging have put paid to the suspended sides of ham and bacon, the whole cheeses, and the sacks and

casks of various comestibles that together gave rise to the characteristic and unforgettable grocery store aroma¹. Gone is the marble-topped counter resplendent with bacon slicer, coffee grinder and brass weighing scales, crowned by a cash register exhibiting similar architectural lines to the Bank of England. Gone also is the apron-clad proprietor who, much to my dismay, always had time to update my mother on all the local gossip, and in full and complete detail! These changes owe much to Piggly Wiggly.²



Piggly Wiggly®

Piggly Wiggly was the creation of Clarence Saunders, an American, who to the grocery trade was what Charles Babbage was to computing, a creative genius with ambition. Whereas Babbage's mission was to enhance the quality of mathematical tables, Saunders' strove to improve shopping for customer and grocer alike. Despite his

The bar code...

...a method of automatic identification that allows information to be captured quickly and accurately by a computer. A bar code symbol consists of a series of bars and spaces of various thicknesses. These are broken down into groups of bar/space patterns that represent human readable characters.

¹ Visitors to London can still sample that aroma in the Food Hall at Harrods. Well worth a visit.

² Piggly Wiggly... <http://www.pigglywiggly.com/>

later attempts at automation being, like those of Babbage, for another age, Saunders introduced many successful and startlingly simple innovations, including that which underpins the supermarket concept, "self-service".

In grocery stores of the time, shoppers presented their orders over the counter to sales assistants, who then gathered the groceries from the store's shelves. Saunders' idea was that the customer would do this by walking around the store with a basket (the supermarket trolley was a much later innovation). And the payoff? Customers received the benefits of greater variety, lower prices and quicker shopping, but gone forever was the old high street grocery store with its characteristic aroma, furnishings and personal service.

Saunders opened his first Piggly Wiggly store in Memphis in 1916 and it quickly became popular. Customers entered through turnstiles and with no assistants to shop for them selected their groceries from open shelves, paying for them at a "checkout". Piggly Wiggly went on to become a group of independent franchises, which by 1929 was the second largest grocery group in the US and its creator a millionaire. Then came the Wall Street Crash followed by a legal dispute with the New York Stock Exchange that drove Saunders into bankruptcy. Although Piggly Wiggly survived - and remains alive and well - Saunders had no further connection with the business.

Not a man deterred by setbacks, Clarence Saunders went on to experiment with automated self-service shopping. In his *Kedoozle* store - a name derived from the phrase "key does all" - the merchandise was displayed as single units each within a glass cabinet under which was a keyhole. Customers entering the store were handed a small pistol-like key that they placed in the keyhole below the goods they wished to buy, the quantity being determined by the number of times they pulled the key's trigger. This action, recorded on punched tape, activated back office machinery to assemble the order, which was then despatched to the checkout on a conveyor belt. On reaching the

checkout, the customer's tape was run through a reader to produce the bill, their groceries being assembled, boxed and waiting for collection. No need for shopping trolleys while there were savings in space, in the labour needed to stock the shelves and in the time customers spent queuing at the checkout. Alas, the machinery proved unreliable, particularly at busy times and the resulting delays coupled with a heavy maintenance bill killed Keydoozle.

Saunders never fulfilled his dream of truly automated shopping. At the time of his death in 1953, he was planning another automatic store based on a system he named "Foodelectric". And Piggly Wiggly? Saunders' reason for choosing this intriguing name remains a mystery. A story has it that it suggested itself when he saw several little pigs struggling to get under a fence from the window of a passing train. When asked why he chose such an unusual name Saunders' reply was, "So people will ask that very question". One can't argue with that!

An icon for today

Visitors to the Smithsonian Institution's National Museum of American History will not be surprised to find a pack of Wrigley's chewing gum displayed among other icons of American culture. But this particular pack of gum is more than that; on 26th June, 1974, it became the first bar coded product to be lifted from a supermarket trolley by a long-forgotten customer, and scanned at a checkout.

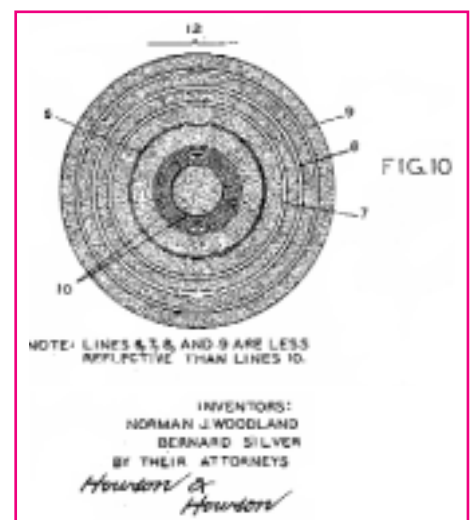
Looking around me I see several items branded in this way; the case of the CD I'm listening to, a book, a couple of magazines, the covers of some document folders lying on my desk beneath a can of Coke, all bear prominent bar codes. If I looked in our refrigerator, I'd find more. Back at the office, our electrical and IT equipment is bar coded to streamline identification during inventory. Conference delegates are sometimes asked to wear a bar coded ID badge, as are hospital patients; airline passengers' luggage, packages sent through the mail, and just about everything sold in a supermarket are bar

coded to aid identification and tracking. NASA relies on bar codes to monitor the thousands of heat tiles that need replacing after every space shuttle trip. Researchers have even placed tiny bar codes on individual bees to track their mating habits. The ubiquitous bar code is truly an icon for today.

The story began in 1948. A student at the Drexel Institute of Technology in Philadelphia overheard the chief executive of a local supermarket chain asking one of the deans to undertake research into a system that would automatically read product information at the checkout. The dean wasn't interested, but Bernard Silver told his friend Joe Woodland about the request and they began working on a solution.

Their first device used patterns of ink that glowed under ultraviolet light. It worked, but the patterns were expensive to print and there were problems with ink stability. Despite the drawbacks, the pair remained convinced they had a workable idea, Woodland even giving up teaching to devote more time to developing a practical system. And the outcome? An application to patent an invention relating "to the art of article classification ...through the medium of identifying patterns".

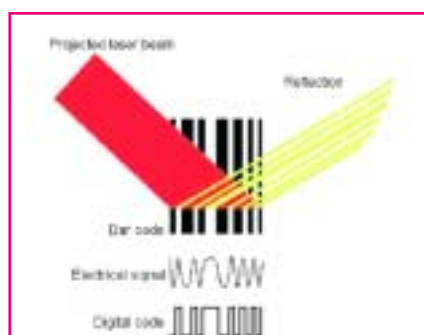
The patent was issued on 7th October 1952.³



In their patent ("Fig 10" is an extract), Woodland and Silver described their bar code as a symbol made up of concentric circles to enable reading from any

³ US patent 2,612,994 can be viewed online at... <http://patft.uspto.gov/netahtml/srchnum.htm> (you may need to install a Tiff image viewer to display it... <http://www.alternatiff.com/>)

direction, but they also described their "symbology" as a pattern of four straight white lines on a dark background, the first being a datum line from which the positions of the other three were fixed. Information was encoded by the presence or absence of one or more of the lines, thus allowing up to seven different article classifications (excluding the datum line, binary 111). However, the inventors noted that by adding more lines it would be possible to encode more classifications (e.g. 10 data lines enables 1023 classifications). A movie soundtrack player served as a bar code reader, but it was bulky and expensive to install while use of a high power



Bar code readers contain a light source, photo detector and signal processing circuitry. The light source shines light onto the bar code, is reflected back into the scanner and focused onto the photo detector, which converts the optical information into an electrical signal. The signal is then "cleaned up" with further circuitry and converted to a signal format that will be recognised by the device to which the bar code reader is connected.

filament lamp made its operation somewhat hazardous. A further problem was that the computers needed to process the information captured by the reader were not readily available in the 1950s.

Bar coding was a sound concept, but it was to be almost 20 years before microchip and laser scanning technologies were sufficiently mature to make it a practical proposition. By then, Bernard Silver was dead - he died in 1962, at the age of thirty-eight - and RCA had acquired the rights to Woodland and Silver's patent. Although Woodland went

on to develop bar coding further for IBM, work recognised in 1992 by the award of the National Medal of Technology by President Bush, he didn't grow rich from an idea that spawned a billion dollar business.

The problem with labelling

New technologies occasionally converge with emerging business demands to bring about a step-change change in the way that things are done. This was to be the case with bar coding.

By the early 1970s, laser scanners and a new generation of intelligent cash register - the electronic point-of-sales (EPOS) terminal - had arrived. These developments coincided with growing competition between the US



Equivalent UPC-A & UPC-E bar codes. UPC-E is a smaller seven-digit UPC symbology often used for small retail items. UPC-E compresses a normal 12-digit UPC-A number into a six-digit code by "suppressing" the number system digit, trailing zeros in the manufacturer's code and leading zeros in the product identification part of the bar code message. A seventh check digit is encoded into a parity pattern for the six main digits. UPC-E can thus be uncompressed back into a standard UPC-A 12-digit number.

supermarket chains that increased pressure on their already tight trading margins. The search was on to cut costs and the most obvious target was the checkout, where the EPOS terminal offered promising possibilities providing that each grocery product could be identified uniquely, automatically and, of course, cheaply.

When a bar coded product is scanned at the checkout, the bar code reader captures the product's unique reference number, which the EPOS terminal then uses as a key to enter a central database to obtain the product's price and description. By this means, it becomes

possible to price any item in the store simply by modifying its entry in the central database. Data captured at the checkout can also be used to track stock levels; to support automatic product re-ordering when stock falls below predetermined levels (a job for electronic data interchange - EDI); to identify fast and slow moving product lines; and, by using historical data, to predict seasonal fluctuations in demand. Furthermore, by cajoling customers into using personal loyalty cards, sales data can be linked to individual customer profiles to determine their purchasing habits (and so into the world of "data mining"). The big drawback is that to devise a labelling scheme for every supermarket chain is not just expensive; it also hinders supply chain integration due to manufacturers having to recognise different supermarket numbering schemes. Product labelling is only cost-effective when supermarket chains work cooperatively with each other and with their suppliers.

Back in 1970, this problem soon became apparent. The outcome was an industry committee, set up to formulate guidelines on barcode development and to devise a standard approach.

Some basic principles were to lie at the heart of the Committee's guidelines:

- to make life easier for the cashier, thereby reducing queues at the checkout, bar codes needed to be readable from almost any angle and at a wide range of distances;
- the labels, which would be reproduced by the millions, needed to be cheap and easy to print; and to be affordable...
- automated checkout systems needed to pay for themselves in two and a half years.

The last goal turned out to be quite plausible. Business consultants McKinley predicted that by adopting a universal labelling system the industry would save \$150 million a year at 1970 prices.

The Universal Product Code (UPC) was to emerge from these deliberations and from development undertaken by IBM (who recalled having Joe Woodland on their payroll).



MaxiCode is a 2D symbology that can encode about 100 characters of data in an area of one square inch. Within this small space are two MaxiCode components: black and white hexagons that pack information in two directions, and a target-like central pattern that allows the symbol to be easily located at high speeds.

The Universal Product Code

Introduced in 1973, UPC was the first bar code symbology to be widely adopted for product marking, in this case by the American grocery industry. Some 250,000 companies in 25 major industries now use the codes to reduce supply chain costs and improve business efficiency.

To obtain a company identifier code, a manufacturer registers with the Uniform Code Council⁴ and then registers each product, thereby ensuring that every package scanned at the checkout bears a unique product reference number. The code comprises two groups of six coded digits (the numbers below a bar code are translations for human use only). The first digit in the first group

indicates the type of product - zero for a national brand; 2 for variable weight, such as meat; 4 for price reductions; and a few other special items. The next five are the manufacturer's code, such as "30000" for the Quaker Oats Company. In the second group, the first five digits form the unique product code while the sixth digit is to verify that all the preceding digits are scanned properly. Thus the scanner will read "30000 06110" as a pound of Quaker's "Cap'n Crunch" cereal, or "30000 01020" as an 18-ounce package of "Old Fashioned Quaker Oats". To enable scanning in either direction, hidden cues in the code's structure tell the scanner which end is which, while printing the bar coded reference numbers on product wrappers during manufacture relieves stores from the expensive overhead of having to label every item they stock.

UPC is not the only bar code symbology now in use, there are many others designed for different industries, including the European Article Numbering system (EAN⁵ - also developed by Joe Woodland), which includes an extra pair of digits and is on its way to becoming the world's most widely used system. The United States Department of Defense adopted "Code 39" for marking all products sold to the US military. POSTNET is the standard bar code used in the United States for ZIP codes in bulk mailing.

An extension to the single dimensional bar code concept are two-dimensional (2D) bar codes that use two axes to enable information about an item to be encoded in addition to its identifying code. Some 2D codes, such as the hexagon-based Maxicode⁶, do not use bars at all.

An icon for tomorrow?

Although UPC symbols form the backbone of all things inventory in the grocery trade, the new Radio Frequency ID (or **RFID**) tag has superseded optical scanning. RFID offers the potential for 'smarter' more flexible supply chain management. It enables products to be identified, counted and tracked automatically, resulting - so its promoters claim - in "near-perfect stock and supply chain visibility".

Products are implanted with RFID tags during manufacture. Each tag contains a microchip on which is stored a unique Electronic Product Code (**EPC**) and a tiny radio antenna. At 400 microns square - a micron (μm) is one thousandth of a millimeter - a tag is smaller than a grain of sand.

As a palette of goods leaves the manufacturer, it passes through a beam of radio waves transmitted by an RFID reader. This causes the tags to "wake up" and begin broadcasting their individual EPCs. Depending on the radio frequency used, RFID systems give a range of up to 30 metres, thus removing the line-of-sight restrictions that apply to bar code scanning.

A local application linked to the readers then queries an Object Name Service database over the Internet. Acting like a reverse telephone directory, the ONS server matches the EPC to the address of a server that holds extensive information on the product; this links to and augments similar systems around the world to form a global database. Because the reader that sent the query is in a known location, the 'system' can identify which manufacturer produced the product, hence, should a product defect or tampering incidents arise, the source of the problem is easily located.

Back at the supermarket, deliveries update the store's retail systems automatically. What's more, because the supermarket's shelves are equipped with integrated readers, they "understand" what stock is being placed on them. When a customer removes an item, the



The EPC is made up of a header and three sets of data. The header

identifies the EPC's version number to allow for different lengths or types of EPC later on. The second part of the number identifies the EPC Manager; most likely the manufacturer of the product the EPC is attached to, for example 'The Coca-Cola Company'. The third, called object class, refers to the exact type of product, most often the Stock Keeping Unit; for example 'Diet Coke 330 ml can, US version'. The fourth is the item's unique serial number that describes exactly which 330 ml can of Diet Coke is referred to. This makes it possible, for example, to quickly find products that might be nearing their expiry date.

⁴ The Uniform Code Council... <http://www.uc-council.org>

⁵ EAN International... <http://www.ean-ucc.org/>

⁶ Example of 2D bar coding: Maxicode... <http://www.maxicode.com/>

diminished shelf immediately routes a message to the automated replenishment system, which if necessary orders further stock. And customer benefits? A reader built into the store's exit recognises each item in the shopper's trolley by their individual EPCs; a quick swipe of the debit or credit card and the customer's on their way. Gone is the checkout with its "console operator", while in another place, Clive Saunders beams with satisfaction.⁷ Perhaps 'RFID' will become tomorrow's icon?

And to conclude, a little science fiction - or is it?

Contrary to George Orwell's grim prediction⁸, 1984 passed free (overall) from his bleak vision of omnipresent state security. Nevertheless, one might reflect on events in the aftermath of 9/11 and on their implications for the future. For instance, it might concern us to learn that the role of the US Information Awareness Office⁹ is to *"imagine, develop, apply, integrate, demonstrate, and transition information technologies, components, and prototype closed-loop information systems that will counter asymmetric threats by achieving total information awareness that is useful for pre-emption, national security warning, and national security decision making."* Buried deep in this bucketful of gobbledegook, *'total information awareness'* sounds uncannily similar to an objective touched on earlier in this piece, *'near-perfect stock and supply chain visibility'*.

In the eyes of some, 9/11 nurtured the business case for tighter state security, while the technology necessary to deliver *'near-perfect stock and supply chain visibility'* is now available. Might business case and enabling technology again combine to bring about another step change, not in the way we identify and track groceries, but people and their possessions? Might the time come when, in place of a letter informing us of our social security number, we're implanted¹⁰ with an Electronic Person Code (EPC) tag at birth? Might a government department exist - Orwell named it "Ministry of Love", *Miniluv* for

An RFID system typically includes:

- a tag or label embedded with a single chip computer and an antenna;
- a radio (much like a wireless LAN radio) that communicates with the tag.

Unlike bar code-based tracking systems, an RFID system can read the information on a tag without requiring line of sight or a particular orientation. The tag can be programmed to hold information such as an item's serial number, color, size, manufacture date and current price, as well as a list of all distribution points the item touched before reaching the store.

short - to keep an outwardly benevolent eye on us, its inner role suitably shrouded in diplomatic cologne by its media outreach coordinators?

Consider a few of the advantages. We always know where our children are or can find out. Gone are the interminable queues at airport check-ins, security and immigration desks; embedded RFID tags ensure that, on arrival, we and our possessions are automatically scanned, identified and verified by reference to a global (and, naturally, error-free) Object Name Service database. What about a 'less-crime', if not a crime-free society? It's a big disincentive to commit crime when the authorities know where everyone and their possessions are at any given moment.

RFID delivers such capabilities on a plate; but there's a question to be asked. Where does state security start and finish and the violation of personal privacy and civil liberty begin? State security ruled OK in Orwell's starkly painted world. As he described it, *"there was of course no way of knowing whether you were being watched at any given moment"*. Might the application of RFID move us in that direction?

A chilling thought!

See diagram overleaf.

Ian Petticrew



⁷ Store of the future movie...

http://www.future-store.org/servlet/PB/menu/1000373_12/1073996191443.html

⁸ George Orwell - "1984" online edition... <http://www.online-literature.com/orwell/1984/>

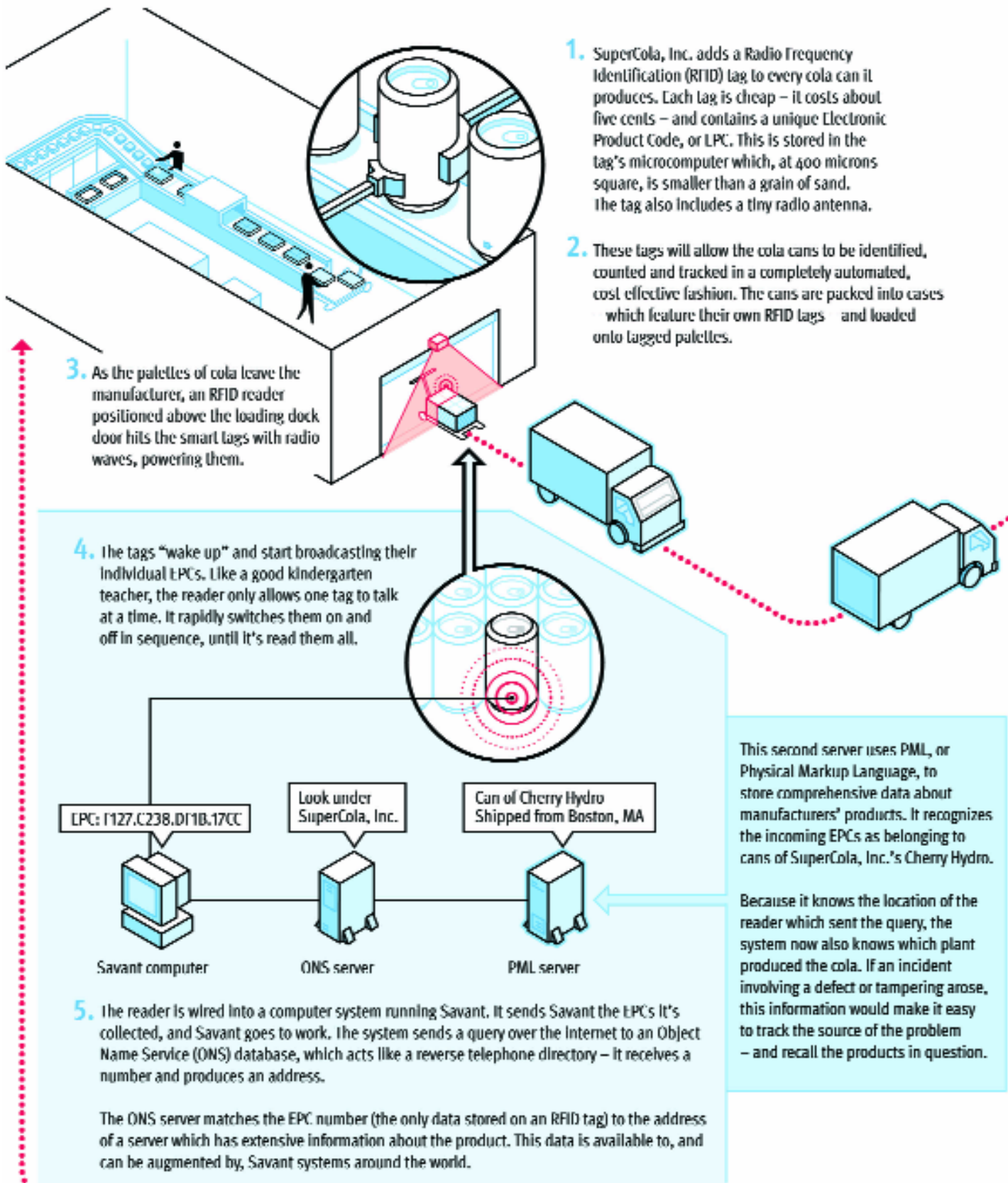
⁹ The IAO web site has been withdrawn, but see...

http://en.wikipedia.org/wiki/Information_Awareness_Office

¹⁰ It's quite feasible! See Kevin Warwick, Professor of Cybernetics... <http://www.kevinwarwick.com/>

HOW THE AUTO-ID SYSTEM WILL AUTOMATE THE SUPPLY CHAIN

With Auto-ID technology, physical objects will have embedded intelligence that will allow them to communicate with each other and with businesses and consumers. Auto-ID technology offers an automated, numeric system of smart objects that revolutionizes the way we manufacture, sell, and buy products. Here's how it works:



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