

BRIEF

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What You Need To Know About RFID In 2004

RFID is one of many technologies that will extend the Internet to the physical world. Unfortunately, the focus on the electronic product code (EPC) overshadows the broader context -- and power -- of RFID. Smart companies will test EPC now *and* link pilots to process change and other extended Internet technologies.

There's been a lot of talk about radio frequency identification (RFID). Case in point: A recent Google search on the term RFID returns 620,000 documents -- 75% of which have been published in the past 12 months.¹ But what exactly is RFID (see Figure 1)?

RFID is a data collection technology that uses electronic tags to store identification data and a wireless transmitter or reader to capture it.

IN 2004, MANY COMPANIES WILL NEED TO ADOPT RFID

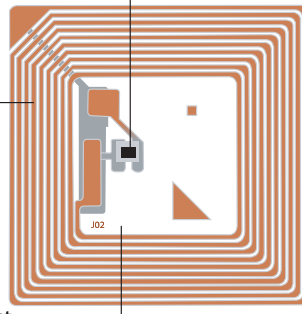
Retailers like Wal-Mart and Tesco and organizations like the Department of Defense (DOD) and the Food and Drug Administration (FDA) are asking companies to use RFID to track assets, products, and materials. Some high-profile mandates and initiatives originate from firms and organizations like:

- **Wal-Mart.** The retailer has mandated that its top 100 suppliers tag pallets and cases with electronic product code (EPC) tags by 2005. It requires the use of a UHF tag that holds a 96-bit EPC tag containing a Global Trade Identification Number. As soon as the specification is solidified, Wal-Mart will require suppliers to move to Class 1 version 2 of the EPC, a tag that will carry a 96-bit serial number and be field programmable. Additionally, Wal-Mart has asked pharmaceutical manufacturers to tag bulk containers of class 2 drugs like OxyContin by March 2004.
- **Department of Defense.** The DOD has required its suppliers to put RFID tags on freight containers, pallets, cases, and big-ticket items by 2005. Using active and passive tags, it plans to leverage the EPC but will also comply with ISO standards.²

Figure 1 Understanding RFID And Its Uses

RFID tags are made up of three parts:*

1. **Chip:** holds information about the physical object to which the tag is attached
2. **Antenna:** transmits information to a reader (e.g., handheld, warehouse portal, store shelf) using radio waves
3. **Packaging:** encases the chip and antenna so that tag can be attached to physical object



Did you know? Tags come in two varieties: active and passive. Passive tags derive their energy from radio frequencies transmitted by readers. They cost less because they don't require batteries. Active tags contain their own battery sources and are always on.

Four most common flavors of RFID (commercial use):

	Radio frequency	Benefits	Limitations	Common commercial uses today
1.	Low frequency (125 to 134 Kilohertz)	<ul style="list-style-type: none"> • Frequency accepted worldwide • Works well near metal • In wide use today 	<ul style="list-style-type: none"> • Limited read-range potential (impractical for some warehouse operations such as pick and pack); less than 1.5 meters 	<ul style="list-style-type: none"> • Animal identification • Beer keg tracking • Automobile key-and-lock, anti-theft systems
2.	High frequency (13.56 Megahertz)	<ul style="list-style-type: none"> • Frequency accepted worldwide • Works well in moist environments • In wide use today 	<ul style="list-style-type: none"> • Does not work well near metal • Limited read-range potential; less than 1.5 meters 	<ul style="list-style-type: none"> • Library book tracking • Pallet/container tracking • Access control (buildings) • Airline baggage tracking • Apparel item tracking
3.	UHF (868 to 928 Megahertz)	<ul style="list-style-type: none"> • Longer read-range potential; more than 1.5 meters • Commercial use is growing rapidly 	<ul style="list-style-type: none"> • Frequency not licensed for commercial use in Japan • Detuning when tags are in close physical proximity • Does not work well in moist environments 	<ul style="list-style-type: none"> • Pallet and container tracking • Truck and trailer tracking (in shipping yard)
4.	Microwave (2.45 Gigahertz)	<ul style="list-style-type: none"> • Longer read-range potential; more than 1.5 meters 	<ul style="list-style-type: none"> • Frequency not licensed for commercial use in parts of Europe • Complex systems development • Not in wide use today 	<ul style="list-style-type: none"> • Access control (vehicles)

*Note: This is a common RFID tag, shown true to size. RFID tags come in hundreds of shapes and sizes.

Source: Forrester Research, Inc.

- **Tesco.** Beginning in April 2004, the UK retail giant will put RFID tags on cases of nonfood items at its distribution centers and track them through to stores. Some of its suppliers will begin putting tags on cases of products delivered to Tesco distribution centers in September 2004.
- **Healthcare Distribution Management Association (HDMA).** The nonprofit organization for healthcare distributors recommended that manufacturers and wholesalers of pharmaceutical drugs and other healthcare products begin putting RFID tags carrying EPCs on cases beginning in 2005. It also expects the adoption of EPC tags at the selling-unit level by 2007.

IS RFID READY FOR ADOPTION?

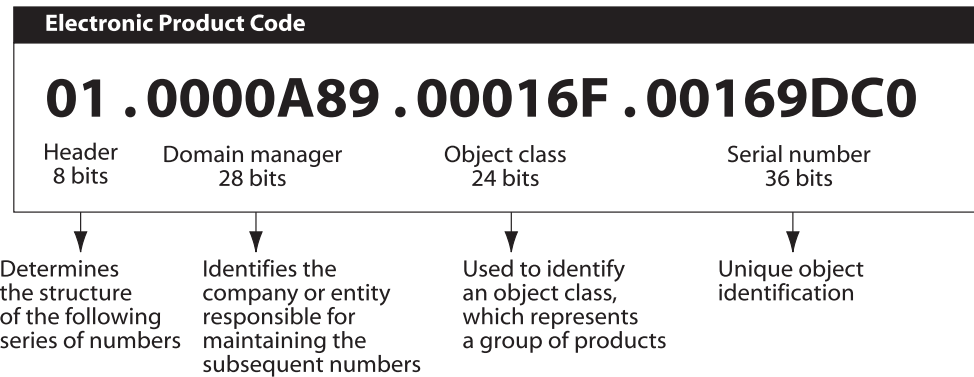
Since these requests are new, companies fear that they must adopt an immature technology. But RFID is mature: The US military and companies like Scottish & Newcastle have used radio frequency technology for years (see Figure 2). What's new are widely adopted data standards like the electronic product code (EPC). EPC will track and trace products as they pass between partners in a supply chain and across borders. To work, EPC requires:

- **Agreement on what is stored on the tag.** EPCglobal -- a subsidiary of the Uniform Code Council and EAN International -- is locking down a specification for the size and content of EPC tags, which typically use a 96-bit numbering scheme to identify individual objects throughout all parts of the supply chain (see Figure 3).³ This specification is getting broad support -- the DOD is poised to extend the EPC tag, not compete with it. This alignment should make companies like Pfizer and Johnson & Johnson, which sell to Wal-Mart and the government, less anxious.⁴ Flexible readers are already being designed to handle EPC tags as well as longer DOD tags that include its unique code.
- **New RFID hardware and software.** Country-specific frequency and power regulations prevent a global tag standard that would provide instant economies of scale for production. Manufacturers like Alien Technologies are using low-cost methods that they hope will position them to fill massive orders. Hardware manufacturers like Thing Magic and Symbol are racing to introduce readers that support multiple protocols and frequencies, read both bar codes and RFID tags, and provide accurate readings in various physical environments. Also, software vendors like SAP and RedPrairie are tuning their applications, building middleware, and aligning with services partners like IBM Global Services to do implementations.

Figure 2 Uses Of RFID Span Numerous Industries

Implementations of RFID					
Company	Item tagged	Type of tag/chip	Read/write	Year/stage	Outcome
Harley Davidson	Bins carrying parts of custom motorcycles during assembly	Passive 13.56 MHz	Read/write	1998/rollout	Automatically displayed manufacturing instructions for employees at each stage of the assembly process
Toyota: Phase 1	Carriers containing car frames as they move through paint stations during production	Passive 13.56 MHz	Read/write	2001/rollout	Streamlined manufacturing and vehicle tracking; saves on interest charges
TrenStar	Beer kegs as they move through the supply chain	Passive 125-128 MHz	Read/write	2001/rollout	Improved demand forecasts and increase efficiency; identification of black-market sales and elimination of misdirected shipments
International Paper	Cores of large paper rolls moving through the warehouse	Passive 915 MHz	Read only	2003/running	Reduction of lost and misdirected paper rolls
Gap	Denim apparel through the supply chain and onto store shelves	Passive 13.56 MHz	Read/write	2001/pilot	Improved customer service through better inventory management on shop floor; increased supply chain efficiency and data accuracy
Raxel	Reusable plastic containers for carrying biohazardous waste	Passive 905-928 MHz	Read/write	2002/implemented	Avoid contamination by ensuring proper cleaning, asset visibility
Michelin	Tires	Passive 905-928 MHz	Read/write	2003/running	Compliance with the TREAD act and recall management
Las Vegas Airport	Airline baggage tags	Passive 902-928 MHz	Read/write	2003/deployment	Automated rerouting of baggage and increased accuracy (99.5% up from 70%-85% accuracy with bar codes) to ensure that they send each bag back to the right airline
Department of Defense	Shipping containers	Active 433 MHz	Read/write	1994/rollout	90% reduction in the number of containers required

Source: Forrester Research, Inc.

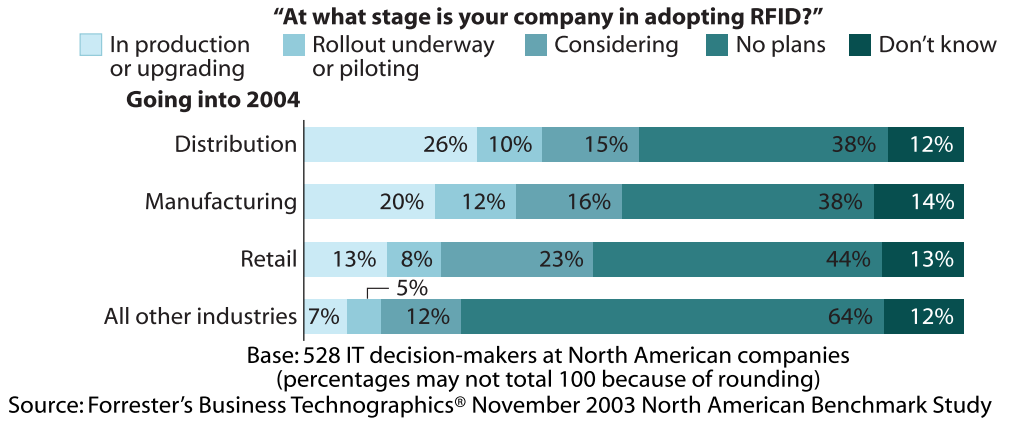
Figure 3 A Sample 96-Bit EPC

Source: Forrester Research, Inc.

SO WHAT SHOULD YOU DO ABOUT RFID IN 2004?

With high-profile EPC mandates, most companies need to pay attention to RFID in 2004. Here are some must-dos for the year ahead:

1. **Pilot EPC now.** Companies that will be affected by these mandates need to test the technology immediately. Why? The competition is taking these mandates seriously. For example: Companies like Intel and Procter & Gamble now have VPs of RFID research and development.⁵ IT decision-makers at firms that have run pilots say they've already determined ways to improve their operations (see Figure 4). Even those companies not directly affected by these mandates should begin pilots to gain advantage over their competitors. For example, Michelin was one of the first firms to develop RFID-tagged tires. Its pilot gave it insight into how radio waves travel through rubber. This knowledge will allow it to be one of the first companies to offer innovative services like roadside assistance for flat tires.
2. **Explore other uses of RFID and X-Internet technologies.** Companies need innovation centers to evaluate RFID within the context of a larger trend: The extended Internet, a set of technologies that connect firms' information systems to physical assets, products, and devices (see the May 2001 Forrester Report "The X Internet").⁶ The reason: Many benefits -- such as supply chain visibility -- can happen only when RFID works with complementary technologies like Bluetooth and GPS. Case in point: Third-party logistics provider DHL used both RFID tags and existing satellite tracking systems to monitor the movement of Nokia phones throughout its distribution chain.

Figure 4 Companies Are Taking RFID Mandates Seriously

Source: Forrester Research, Inc.

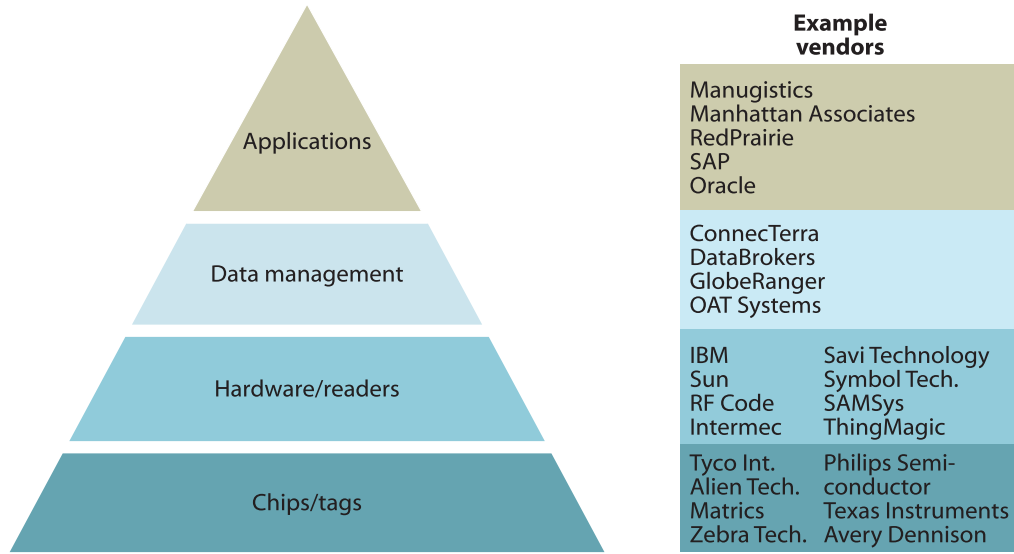
3. **Use pilots to model implementation costs based on process change.** Studies have measured the costs of RFID deployments based on requirements like billions of tags, new network equipment, readers, printers, and storage hardware -- and with some suppliers still quoting more than \$1,000 per reader, technology costs add up quickly (see the August 2002 Forrester Report "RFID: The Smart Product (R)evolution").⁷ But Forrester believes that companies will spend much more on training, analyzing data, and optimizing processes than they will on technology. Companies should use pilots to plot where processes will change. In the end, this technology is a bigger boom for re-engineering consultants like Accenture and IBM Global Services than for tag manufacturers like Philips Semiconductor and Texas Instruments.

WHAT 2005 WILL LOOK LIKE

What can companies expect from RFID as more sectors adopt the technology?

- **RFID traffic will flow to existing applications and over existing networks.** Eventually, RFID data will travel over an IP network, but it is clear through conversations with Wal-Mart and its suppliers that the bulk of the early data communication will occur across existing VANs and go directly from reader to ERP or warehouse management system.⁸ Why? To switch from their existing EDI networks or start streaming RFID data over the Internet, companies need to see real benefits. Despite plans for a UCC/EAN/EPCglobal- or VeriSign-sponsored registry and increasing EDI over the Internet data transfers, the earliest that firms will even have access to this new network service will be late 2005.⁹

Figure 5 A Collection Of Vendors Is Necessary For EPC Pilot Design



Source: Forrester Research, Inc.

- The bulk of the ROI will come from using RFID data to trigger events.** Capturing, segmenting, and acting on RFID data is a process management and business intelligence problem -- not a data storage problem. Firms will turn to hardware vendors like RF Code and Intermec that are improving data filtration on their readers and tags, so that only valuable data is transferred from readers to databases. But vendors like BEA, IBM, and Sun -- as well as a crop of new startups -- will do the real work of organizing the data to help trigger transactions and business rules (see Figure 5).
- Privacy concerns won't derail in-store RFID.** Early pilots like Benetton's and Gillett/Tesco's failed to address privacy concerns, and therefore became a target for privacy groups (see the December 2003 Forrester Report "The X Internet And Consumer Privacy").¹⁰ But firms have learned their lesson quickly, and there are now good examples of how to address consumer fears. Marks & Spencer and Metro AG lead the way with responsible communication of consumer data practices. And Wal-Mart will ensure that the pallets that wind up on Sam's Club floors have removable tags.

¹ Google retrieved 620,000 RFID documents, and 460,000 of those were published in the past year.

² Today, the EPC standard is outside of the scope of ISO standards. Over the next 12 months, organizations like the Uniform Code Council will be working to rationalize the two.

³ EPCglobal is a joint venture between EAN International and the Uniform Code Council. It will continue the research done by the MIT Auto-ID Center and work toward the development of industry-accepted standards and commercial adoption. The newly formed organization has taken on the mission of working with end users and hardware, software, and integration solutions providers to build the EPC Network infrastructure and support implementation.

⁴ The DOD does not require a longer tag with a UID for most of its low-cost products, so for most purposes, its suppliers will be fine using an EPC.

⁵ RFID is the fourth most searched term on Forrester's site in the past 365 days, and during the same period, we've spoken to more than 30 vendors about their RFID-related products and customer pilots.

⁶ "The X Internet" describes how the Internet will evolve beyond the Web. Forrester calls this next phase the X Internet.

⁷ "RFID: The Smart Product (R)evolution" includes a graphic, Figure 5, that outlines the potential costs of an RFID implementation based on sample tag, reader, and business process costs.

⁸ Wal-Mart's mandate recognizes the increased use of AS1 and AS2, but Forrester believes that VANs and point-to-point connections will remain a critical component to the RFID architecture because of companies' sunk costs in VANs.

⁹ Forrester believes that the development of this public network won't happen until there is a critical mass of tagged logistics containers. Wal-Mart and the DOD are both still skeptical of the value of ONS and PML.

¹⁰ Forrester's research on RFID and consumer privacy shows that consumers are willing to trade personal information for value. It is incumbent on companies to demonstrate that value and make privacy statements simple and clear.