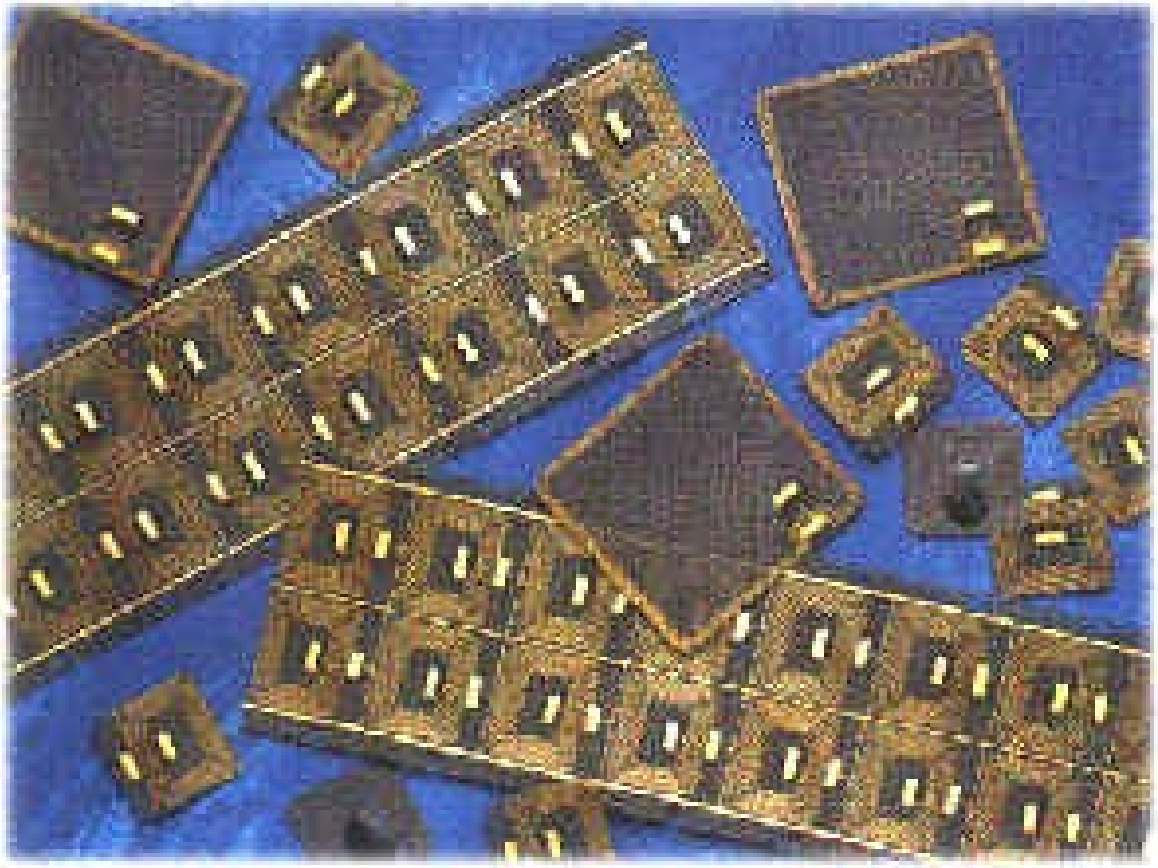
Radio-frequency identification

- (RFID)

What is RFID?

- RFID = Radio Frequency Identification
  - Used to identify objects (including people)
  - RFID tag (or transponder)
    - Stores information on a microchip
    - Has an antenna
  - Radio waves are reflected to a reader
  - Reader passes information to a computer

Gemplus GemWave™ Series



How does the system work?

- The reader sends out electromagnetic waves
- The tag antenna receives these waves
- The microchips circuits are powered by the field created by the reader
- The microchip modulates the waves that are sent back to the reader
- The waves are converted to digital data

RFID tags are being placed in Euro notes

Is RFID better than bar codes?

- They are different technologies that have different applications, sometimes overlapping
- Bar codes are “line-of-sight”
  - Scanner must be properly oriented
- Bar codes can be read if they are within range

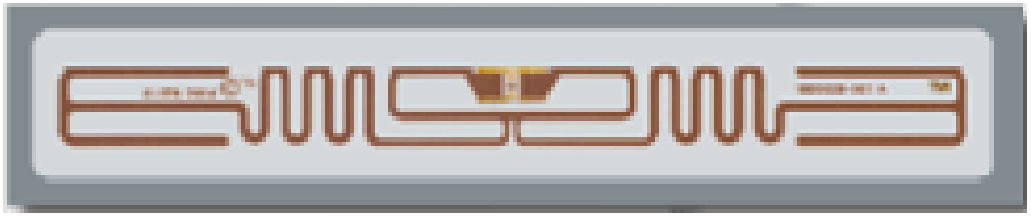

SO 354 Fused Teflon

Is RFID better than bar codes?

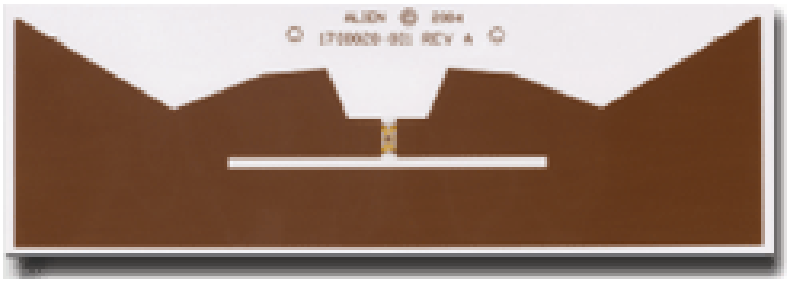
- If a bar code is ripped or dirt covered, it can’t be scanned
- Bar codes usually contain less information than an RFID tag
  - Manufacturer and product, but not the unique item

Will RFID replace bar codes?

- Doubtful
- Bar codes are inexpensive and work well for certain tasks



Alien Squiggle ‘T’: Low cost, general purpose



Alien M Antenna: Low environmental dependence, general purpose

Alien 2 x 2: Low cost, airplane baggage

Is RFID new?

- Originated in the 1970s
- But, it has been too expensive for widespread application
- If the price comes down enough they have lots of advantages
  - Radio waves travel though non-metallic materials
  - Unique serial numbers can be stored

What problems have existed?

- All RFID systems use proprietary technology
  - If Company A puts an RFID tag on a product, it can’t be read by Company B unless they use the same RFID system
  - Unless they use the same RFID system from the same vendor
  - That is, a lack of a standard

“Trends,” Inbound Logistics
January, 2005

- Report of a survey of 669 supply chain and information technology executives
  - 75% say it is “important” or “very important” to have an effective advanced infrastructure in place to support RFID mandates
  - 33% have already implemented these effective advanced infrastructures

“Trends,” Inbound Logistics
January, 2005

- Report of a survey of 669 supply chain and information technology executives
  - 66% say they are installing RFID because of customer mandates such as Wal-Mart or DoD
  - 60% believe RFID system deployment will reduce labor costs and boost process efficiency – ultimately making them more competitive

Cost Trends of RFID

Time

The cost of readers is currently
US$300 to US$1000 each.
Expected to shrink to less than half that
by the beginning of 2007.

What about the cost?

- Readers cost US$1000 or more
- Tags cost US$0.20 or more
  - If an item costs US$2.00, a US$0.20 tag is 10% of the cost

Flash: Buy 1,000,000 tags and Alien Technology will sell them for less than $0.20 each
See: http://www.alientechnology.com/products/rfid-tags/

Want to buy an RFID reader?

PSION TEKLOGIX
information in motion

ALIEN

LXE®
An EMS Technologies Company

EMS
ESCORT MEMORY SYSTEMS
A DATALOGIC GROUP COMPANY

RF CODE

Active Wave

RFID Wizards

Costs of RFID implementation

- Source: Accenture as reported in *Logistics Today*, January, 2005
  - Tag prices are 2% to 8% of the total cost
  - Readers and controllers typically are 7% to 10% of the total cost
  - Software and software integration are typically 52% to 80% of the total cost

“RFID hardware shrinking in size”

- *Inbound Logistics*, December, 2004
- Readers have shrunk from large units the size of a dictionary to the footprint of a credit card
- Over time it is predicted that reader modules will shrink into chips
- By 2007, RFID reader functionality will be in PDA’s and cell phones

What frequency do the tags use?

- Actually, there are several frequencies
  - Low is @ 125-135 KHz
  - High is at 13.56 MHz and 433 MHz
  - Ultra-high is in the range 860-960 MHz
  - Microwave is at 2.45 and 5.8 GHz
- Radio waves behave differently at different frequencies, so it matters which is chosen

Which frequency is right?

- 13.56 MHz is cheaper than UHF
  - Uses less power
  - Better able to penetrate non-metallic substances
  - Ideal for scanning objects with high-water content at close range
    - Example, fruit

Which frequency is right?

- UHF tags offer better range and can transfer data faster
  - But, they use more power
- But, they require a clear path between the tag and the reader
- Better for scanning boxes passing through a bay door into a warehouse

Are these frequencies standard?

- Most countries have assigned the 125 kHz area of the radio spectrum for low-frequency systems
- 13.56 MHz is used around the world for high-frequency systems
- Countries have not agreed on the UHF spectrum
  - It will take years to work this out

What's the problem with metal and water?

- Radio waves bounce off metal and are absorbed by water at UHF
  - That makes tracking metal products or those with high water content a problem
  - System design and engineering can overcome these problems
- Low- and high-frequency tags work better
  - Low-frequency RFID tags are even embedded in metal auto parts to track them

Passive or active tags?

- Active RFID tags have a power source…a battery…to run the microchip's circuitry and to broadcast a signal to a reader
- Passive tags draw their power from the reader which sends out electromagnetic waves that induce a current in the tag's antenna

Passive or active tags?

- Current interest is on passive tags which are less costly by far
- Their read range is about 6 meters
- Active tags can be read for more than 30 meters

What is an EPC?

- EPC = Electronic Product Code = RFID
  - Developed by the Auto-ID Center as a successor to the bar code
  - A numbering scheme that is used to identify products as they move through a global supply chain

Three ‘standards’

- EPC
  - Businesses in the USA and Europe
- ISO 18000
  - Favored by the USA military establishment
- Asian version
  - Avoiding the payment of royalties
  - Generation 2 standards will be royalty free!
    - Announced December 16, 2004
    - Actually, only the most basic version!!!
      - Clarified on February 3, 2005

Global acceptance?

- While Wal-Mart has worked closely with EPS Global to promote open standards, those standards are still far from being globally accepted
- The ISO has been involved in the process, so the momentum of the world's largest retailer and other global companies could carry the EPC Global initiatives into accepted standards worldwide

Source: Logistics Today, January, 2005

How much information can a tag store?

- Typically, 2KB
  - Companies are now looking at a simple “license plate” tag that contains only a 96-bit serial number
  - Cheaper

Slap-and-Ship

Wal-Mart

Wal-Mart

Venture Research's belt-driven Slap and Ship workstation

WAL★MART®
COMPLIANT
RFID Solutions

A 3-phased approach

- Pilot projects operating in parallel, but could be in series
  - Slap-and-ship with a portable station in the shipping area
  - Print-and-apply systems in the manufacturing line
    - Producing both RFID-compliant and non-compliant cases and pallets
    - Meeting the needs of the customer
  - Warehouse management system integrating RFID

Beaver Street Fisheries in Jacksonville, FL

Return on Investment

- It will be tough to generate a ROI with slap-and-ship
- Most organizations are a long way from achieving ROI on RFID
  - Because they are aligned in silos of automation
  - There is a receiving system, a production system, a QA system,…
  - And, they won't share information
  - Another silo will be constructed for RFID

Source: Logistics Today, January, 2005

Acronyms

- US DoD
  - United States Department of Defense
- WMS
  - Warehouse management system
- ERP
  - Enterprise resource planning
- ASN
  - Advanced shipping notice

Wal-Mart

- Wal-Mart and the US DoD RFID mandates have sparked a new software market for RFID compliance solutions
- These applications are typically designed to work with existing WMS and ERP systems
- The result is an ASN that is transmitted to the trading partner

Wal-Mart

- Unless the supplier ships exclusively to Wal-Mart or the DoD, a decision in advance needs to be made concerning a tag or no tag
- One approach is to tag every shipment
  - Slap-and-ship
  - There is an extra cost for attaching tags when not needed

But!

"Rapid growth rates predicted for RFID based
on the Wal-Mart compliance deadline
of January 2005 did not come true."

Marketstat, May 27, 2005

Can reader collision occur?

- The signal from one reader can interfere with the signal from another reader if the coverage overlaps
- TDMA = Time Division Multiple Access
  - Technique that is used to overcome the problem

Can tag collision occur?

- If a lot of chips are being read in the same field, it’s possible that more than one chip reflects a signal at the same time
  - This confuses the reader
- Vendors have developed techniques to overcome this problem

What are some common applications?

- The most common are tracking goods in the supply chain, reusable containers, high value tools, and parts moving in a production line
- Applications are limited only by the imagination!

Controlling access to buildings

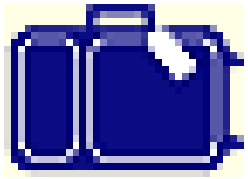
Tracking cattle

Tracking legal files

Tracking baggage

Delta

Halted!



Halted!

RFID applications according to Marketstat:

29% Supply Chain Management
20% Access Control
12% Asset Management
10% Point-of-Sale
8% Baggage Control
8% Other
6% Vehicle Identification
4% Animal Tracking
3% Tire Tracking

May 27, 2005

Will RFID lead to massive layoffs?

- RFID is a labor-saving technology, so some workers will lose their jobs
  - Because fewer workers will be needed to scan bar codes
- But, the transition from bar codes to RFID tags will take 10 years or more
  - So, there will be ample time to make changes
  - The technology will create new jobs

Port of LA/Long Beach

Container ships

Port of LA/Long Beach

From autos to zinc (shown here)

Port of LA/Long Beach

Cruise ships

Port of LA/Long Beach

Intermodal

Port of LA/Long Beach

- Port of LA/Long Beach is a 70-acre yard and transload facility encompassing 1100 parking slots and 250 dock doors
- Can track and trace the comings and goings of each of the containers and trailers in its yard

Port of LA/Long Beach

- Attached RFID tags (small, active radio transmitters) via a clamp to every container and trailer that enters the yard
- Also, a real-time locating system as well as its rule-based yard management system software

Port of LA/Long Beach

- While consumer goods companies continue their elusive search for ROI from their RFID investments, very significant savings are being accomplished for companies using the less-publicized but more robust active RFID technology
- An example from *Logistics Today*, September, 2004

Port of LA/Long Beach

- Previously relied on traditional data entry to capture location of the containers and trailers into PCs on a batch basis
  - Very labor intensive
    - Was hands on
    - Now totally live and accurate

Port of LA/Long Beach

- How the old system worked:
  - “In a traditional yard, the driver comes in, gets a gate pass from a guard, is told to drop off the container at a specific container at a specific location. Then, the driver goes to another window to get the paperwork signed. If the driver is making a double transaction, he/she then goes to another location, picks up the container, goes to the gate, shows the paperwork, shows it to the guard, and leaves”

Port of LA/Long Beach

- How the new system works
  - “When a container comes to the gate, the driver knows that he/she is there for a double transaction. An operator standing in the lanes at the gate has a handheld device tethered to a printer. The drivers don’t have to stop at the window and leave their cabs any more.”

Port of LA/Long Beach

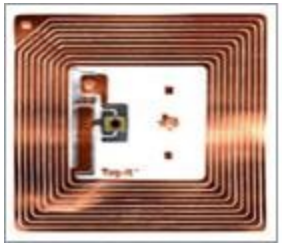
- Time to complete a double transaction decreased by 66%
- Eliminated 100% of costs associated with manual search
- Improved gate personnel productivity by 50%
- Increased daily throughput of the yard by 38%

Big players in RFID

IBM

HP

Sun



TI

SAP

Intermec

Some challenges that must be faced

- High price tags
  - $0.25 to $0.35 in large quantities and $0.50 to $0.70 in small quantities
    - Too high to be absorbed into the item cost
- Tag performance
  - 10% to 12% are dead-on-arrival
  - Only 80% to 90% that pass inspection can be read

Some challenges that must be faced

- The laws of physics
  - RF does not easily pass through metal or liquid
- Global standard still does not exist
- No ROI seems to be forthcoming
  - $13 million to $23 million investment
  - Must find alternative benefits
    - Theft prevention, counterfeit prevention, labor reduction, …

On the contrary!

- According to a recent survey by BEA Systems of 150 information technology and logistics executives from the UK and Finland, a whopping 70 percent of respondents claim the need for "a lot more information" before making a decision one way or the other about deploying RFID.
  - Reported in *RFID Update* on July 12, 2005