RFID: Technology and Applications

Effect on Manufacturing

- Need to ensure error-free, custom assembly
- Need inventory of components for the various customization options

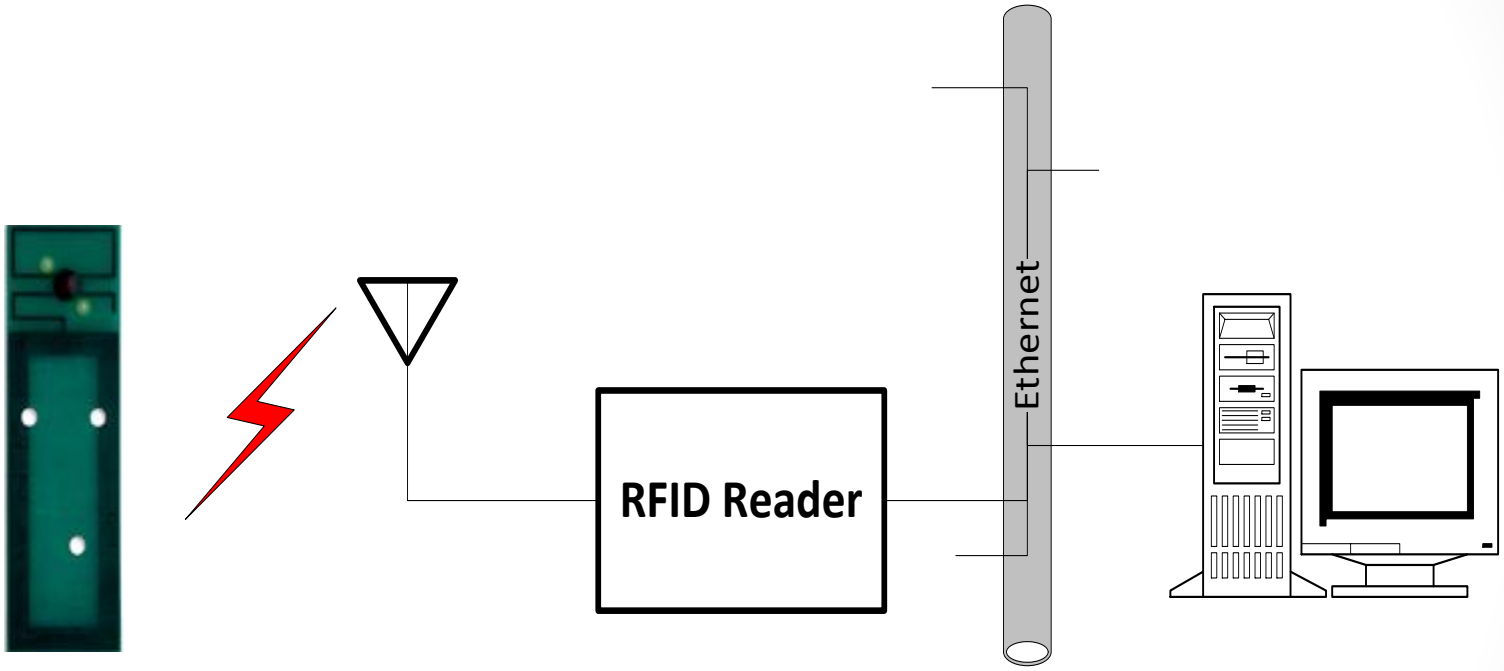
- Critical Issues
  - Assembly process control
  - Inventory management
  - Supply chain integration
  - Customer insight

- One solution: RFID

What is RFID?

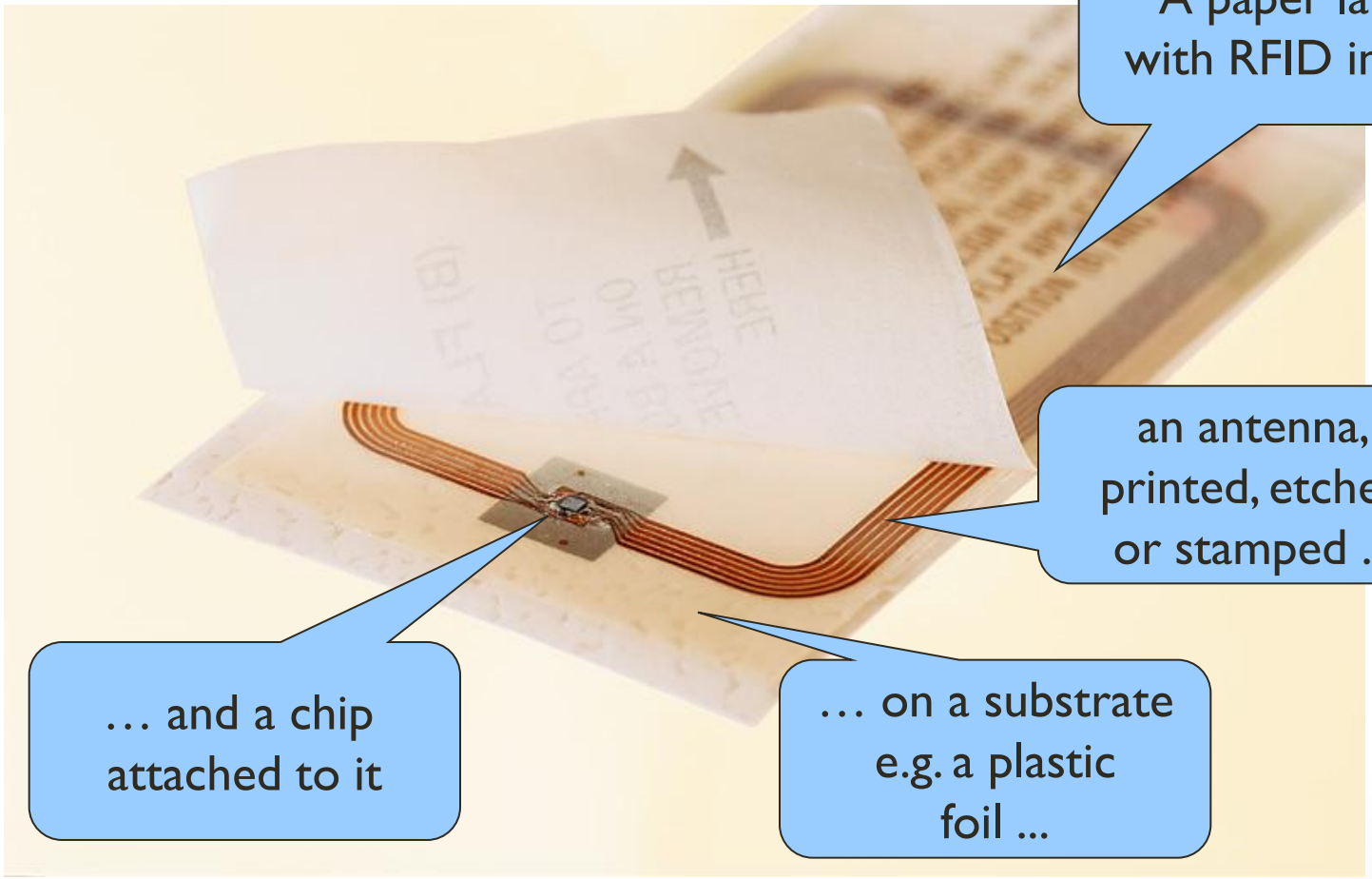
- RFID = Radio Frequency IDentification
- An ADC (Automated Data Collection) technology that:
  - Uses radio-frequency waves to transfer data between a reader and a movable item to identify, categorize, track
  - Is fast and does not require physical sight or contact between reader/scanner and the tagged item
  - Performs the operation using low cost components
  - Attempts to provide unique identification and backend integration that allows for wide range of applications
- Other ADC technologies: Bar codes, OCR

RFID System Components

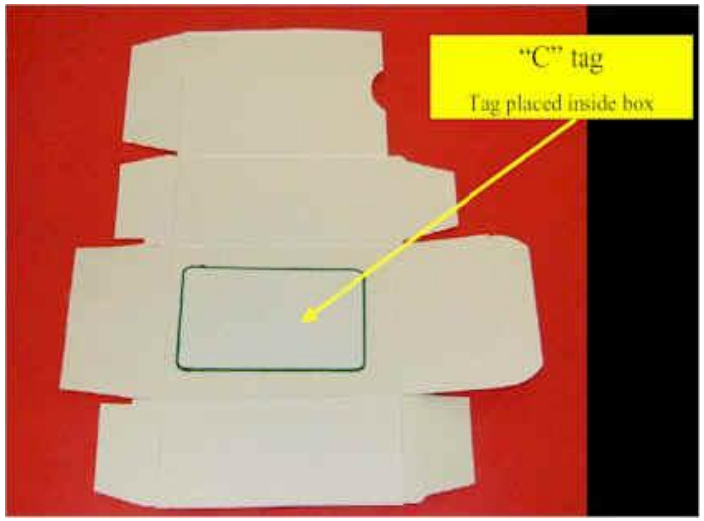


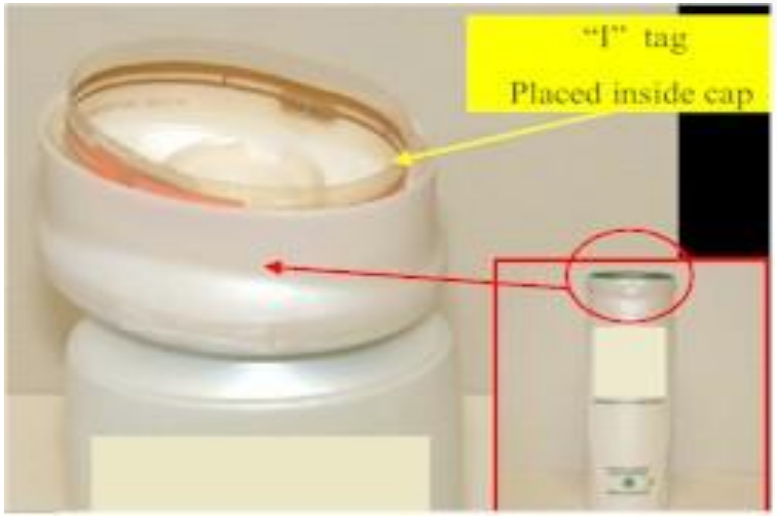
RFID Tag RF Antenna Network Workstation

RFID Tags: Smart Labels



Some RFID Tags

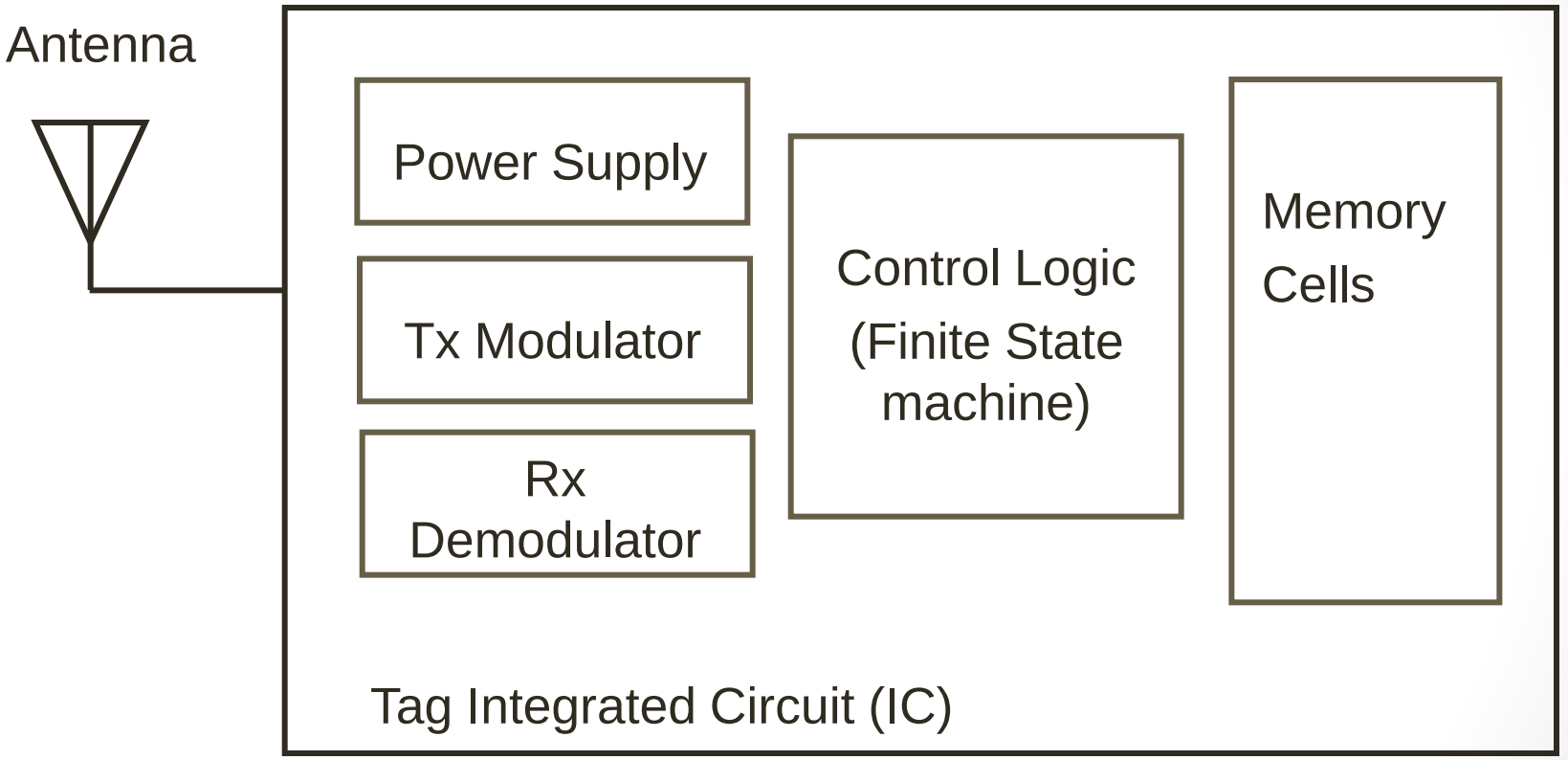




RFID Tags

- Tags can be attached to almost anything:
  - Items, cases or pallets of products, high value goods
  - Vehicles, assets, livestock or personnel
- **Passive Tags**
  - Do not require power – Draws from Interrogator Field
  - Lower storage capacities (few bits to 1 KB)
  - Shorter read ranges (4 inches to 15 feet)
  - Usually Write-Once-Read-Many/Read-Only tags
  - Cost around 25 cents to few dollars
- **Active Tags**
  - Battery powered
  - Higher storage capacities (512 KB)
  - Longer read range (300 feet)
  - Typically can be re-written by RF Interrogators
  - Cost around 50 to 250 dollars

Tag Block Diagram



RFID Tag Memory

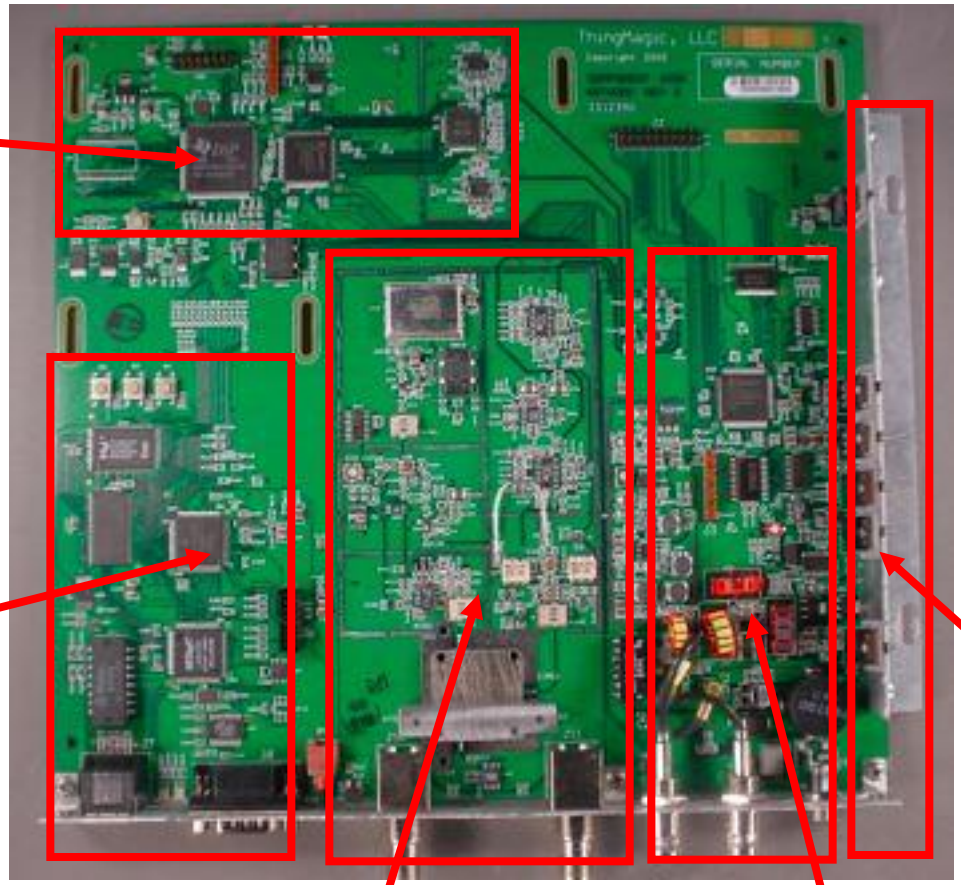
- Read-only tags
  - Tag ID is assigned at the factory during manufacturing
    - Can never be changed
    - No additional data can be assigned to the tag
- Write once, read many (WORM) tags
  - Data written once, e.g., during packing or manufacturing
    - Tag is locked once data is written
    - Similar to a compact disc or DVD
- Read/Write
  - Tag data can be changed over time
    - Part or all of the data section can be locked

RFID Readers

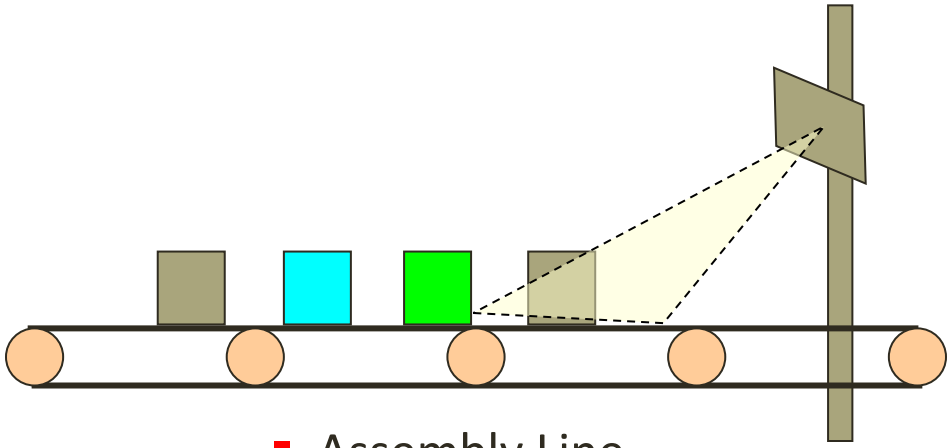
- Reader functions:
  - Remotely power tags
  - Establish a bidirectional data link
  - Inventory tags, filter results
  - Communicate with networked server(s)
  - Can read 100-300 tags per second
- Readers (interrogators) can be at a fixed point such as
  - Entrance/exit
  - Point of sale
- Readers can also be mobile/hand-held

Some RFID Readers

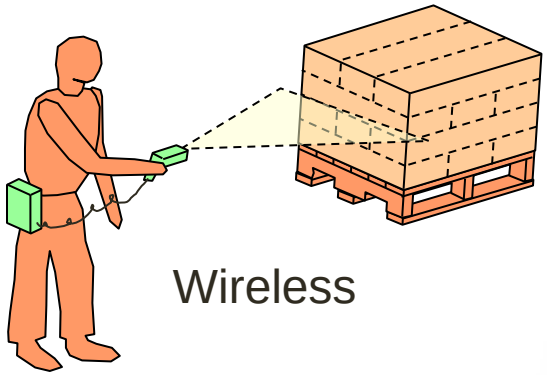
Reader Anatomy



RFID Application Points

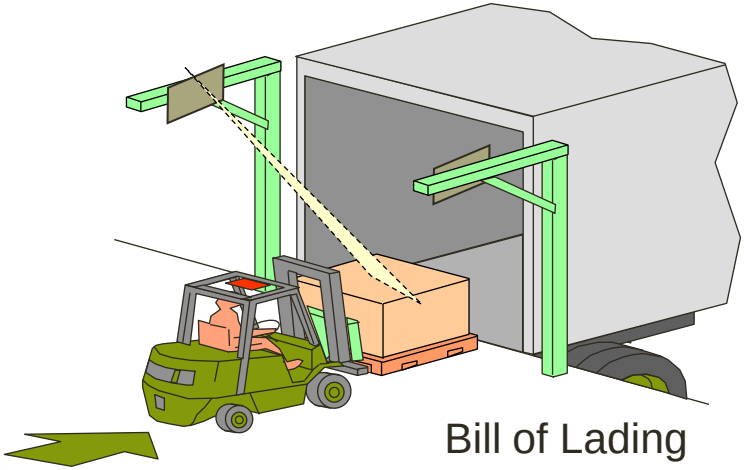


- Assembly Line



Wireless

- Handheld Applications



Bill of Lading
Material Tracking

- Shipping Portals

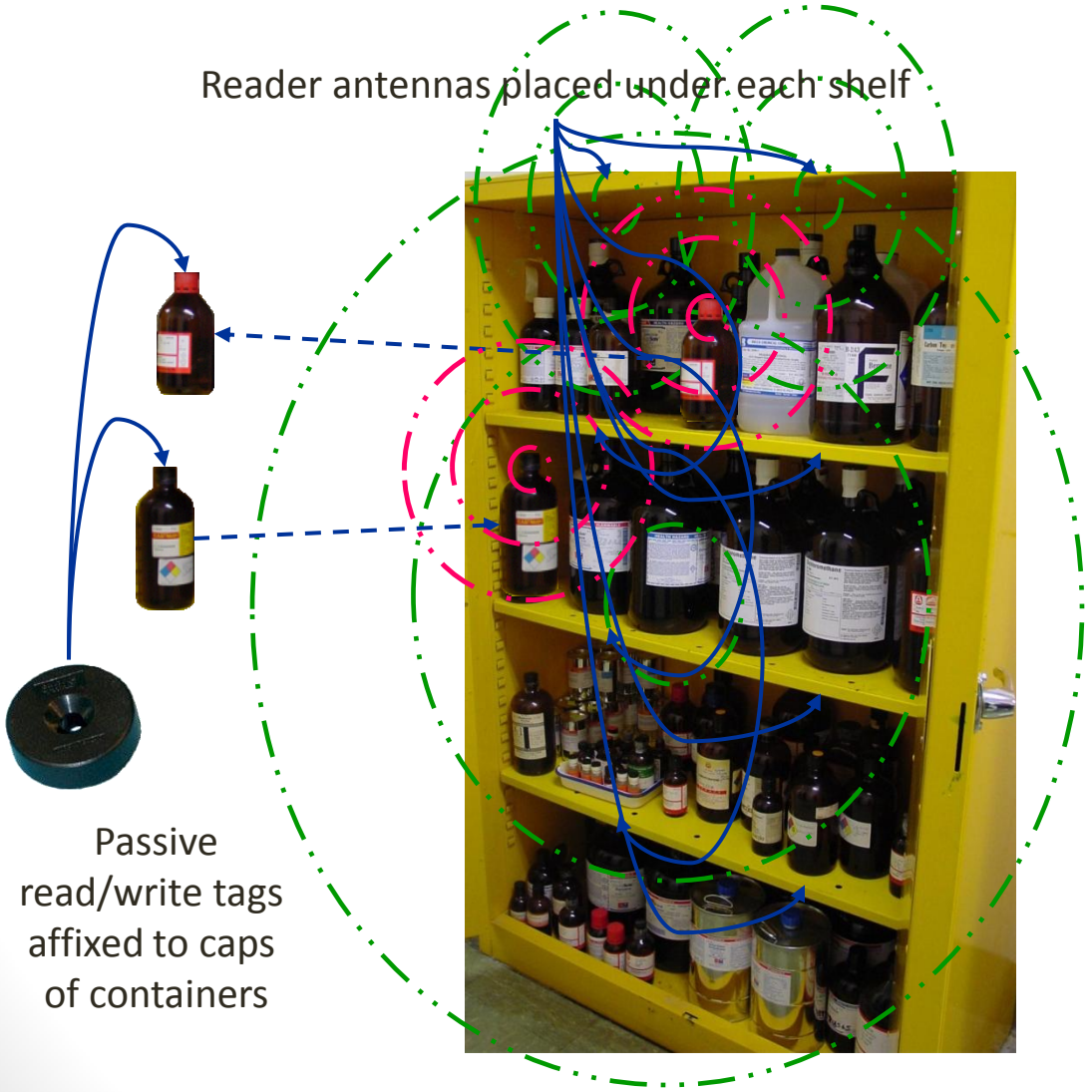
RFID Applications

- Manufacturing and Processing
  - Inventory and production process monitoring
  - Warehouse order fulfillment
- Supply Chain Management
  - Inventory tracking systems
  - Logistics management
- Retail
  - Inventory control and customer insight
  - Auto checkout with reverse logistics
- Security
  - Access control
  - Counterfeiting and Theft control/prevention
- Location Tracking
  - Traffic movement control and parking management
  - Wildlife/Livestock monitoring and tracking

Smart Groceries

- Add an RFID tag to all items in the grocery
- As the cart leaves the store, it passes through an RFID transceiver
- The cart is rung up in seconds

Smart Cabinet



1. Tagged item is removed from or placed in "Smart Cabinet"
2. "Smart Cabinet" periodically interrogates to assess inventory
3. Server/Database is updated to reflect item's disposition
4. Designated individuals are notified regarding items that need attention (cabinet and shelf location, action required)

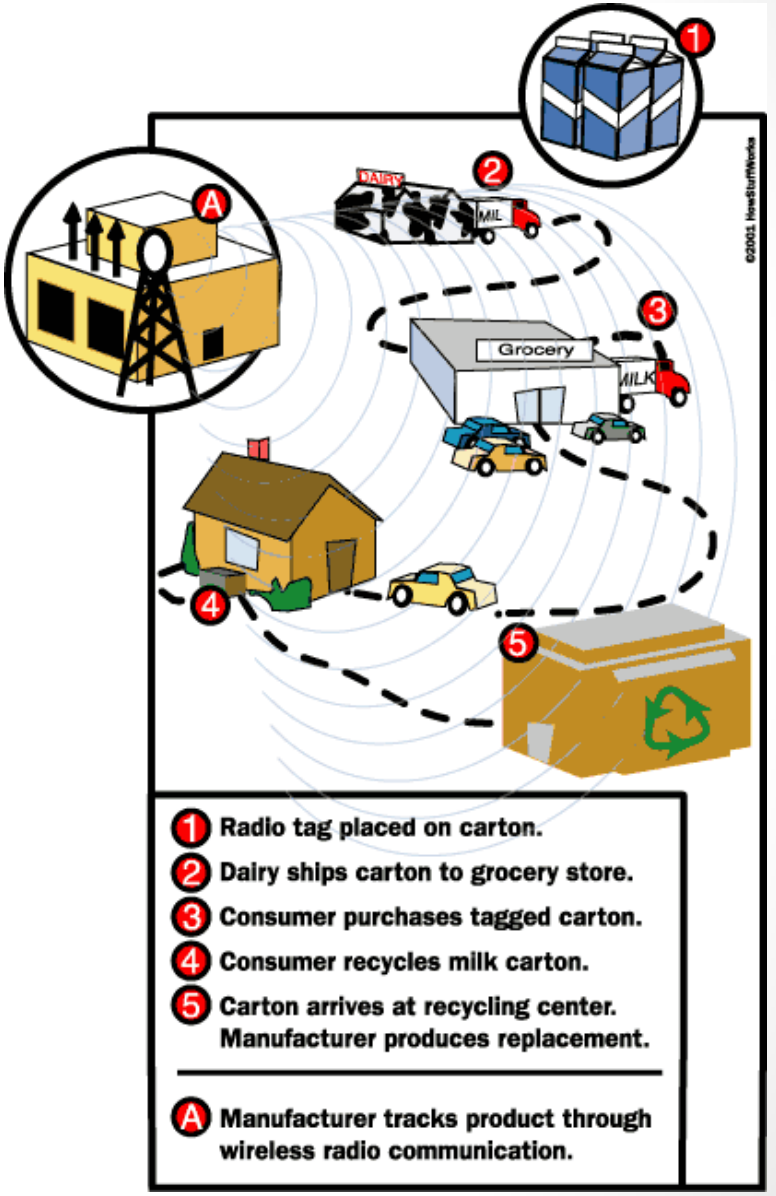
Smart Fridge

- Recognizes what's been put in it
- Recognizes when things are removed
- Creates automatic shopping lists
- Notifies you when things are past their expiration

- Shows you the recipes that most closely match what is available

Smart Groceries Enhanced

- Track products through their entire lifetime



Some More Smart Applications

- “Smart” appliances:
  - Closets that advice on style depending on clothes available
  - Ovens that know recipes to cook pre-packaged food
- “Smart” products:
  - Clothing, appliances, CDs, etc. tagged for store returns
- “Smart” paper:
  - Airline tickets that indicate your location in the airport
- “Smart” currency:
  - Anti-counterfeiting and tracking

- “Smart” people ??

RFID Advantages over Bar-Codes

- No line of sight required for reading
- Multiple items can be read with a single scan

- Each tag can carry a lot of data (read/write)
- Individual items identified and not just the category

- Passive tags have a virtually unlimited lifetime
- Active tags can be read from great distances

- Can be combined with barcode technology

RFID: The Complete Picture

- Technology which today is still more expensive than barcode
- Lost of efforts made around the price of the tag which is the tip of the iceberg
- What else need to be considered when one want to deploy a RFID system?

- Identifying Read Points
- Installation & RF Tuning
- RFID Middleware
- Connectors & Integration
- Process Changes
- Cross Supply-Chain View

Points to Note about RFID

- RFID benefits are due to automation and optimization
- RFID is not a plug & play technology
- “One frequency fits all” is a myth
- Technology is evolving but physics has limitations
- RFID does not solve data inconsistency within and across enterprises
- Management of RFID infrastructure and data has been underestimated

RFID Summary

Strengths	Weaknesses
➢ Advanced technology ➢ Easy to use ➢ High memory capacity ➢ Small size	➢ Lack of industry and application standards ➢ High cost per unit and high RFID system integration costs ➢ Weak market understanding of the benefits of RFID technology
Opportunities	**Threats**
➢ Could replace the bar code ➢ End-user demand for RFID systems is increasing ➢ Huge market potential in many businesses	➢ Ethical threats concerning privacy life ➢ Highly fragmented competitive environment

Some Links

- http://www.epcglobalinc.com/
- http://www.rfidjournal.com/
- http://rfidprivacy.com/
- http://www.rfidinc.com/
- http://www.buyrfid.com/