RFID

Radio Frequency Identification

What is RFID?

- Radio Frequency Identification
- The use of radio frequency readers and tags to identify real objects.
- New frontier in the field of information technology
- One form of Automatic Identification

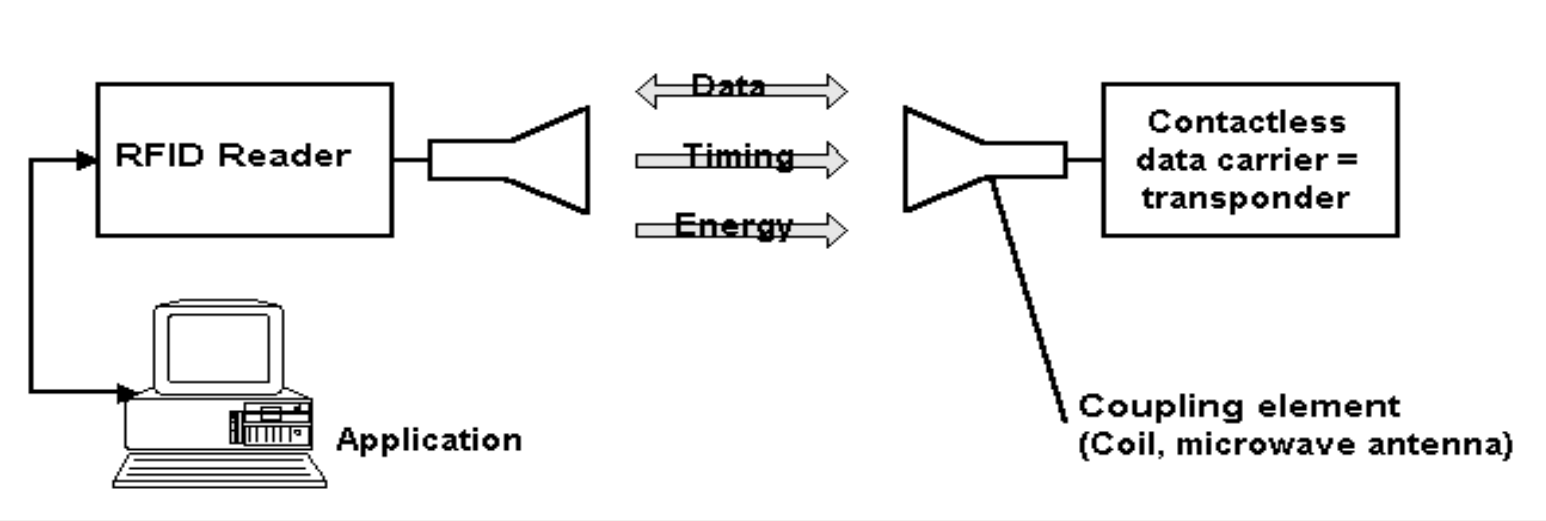
What does it mean to identify something?

Identification

- Assign IDs to objects
- Link the ID to additional information about the object
- Link the ID to complementary info
- Find similar objects

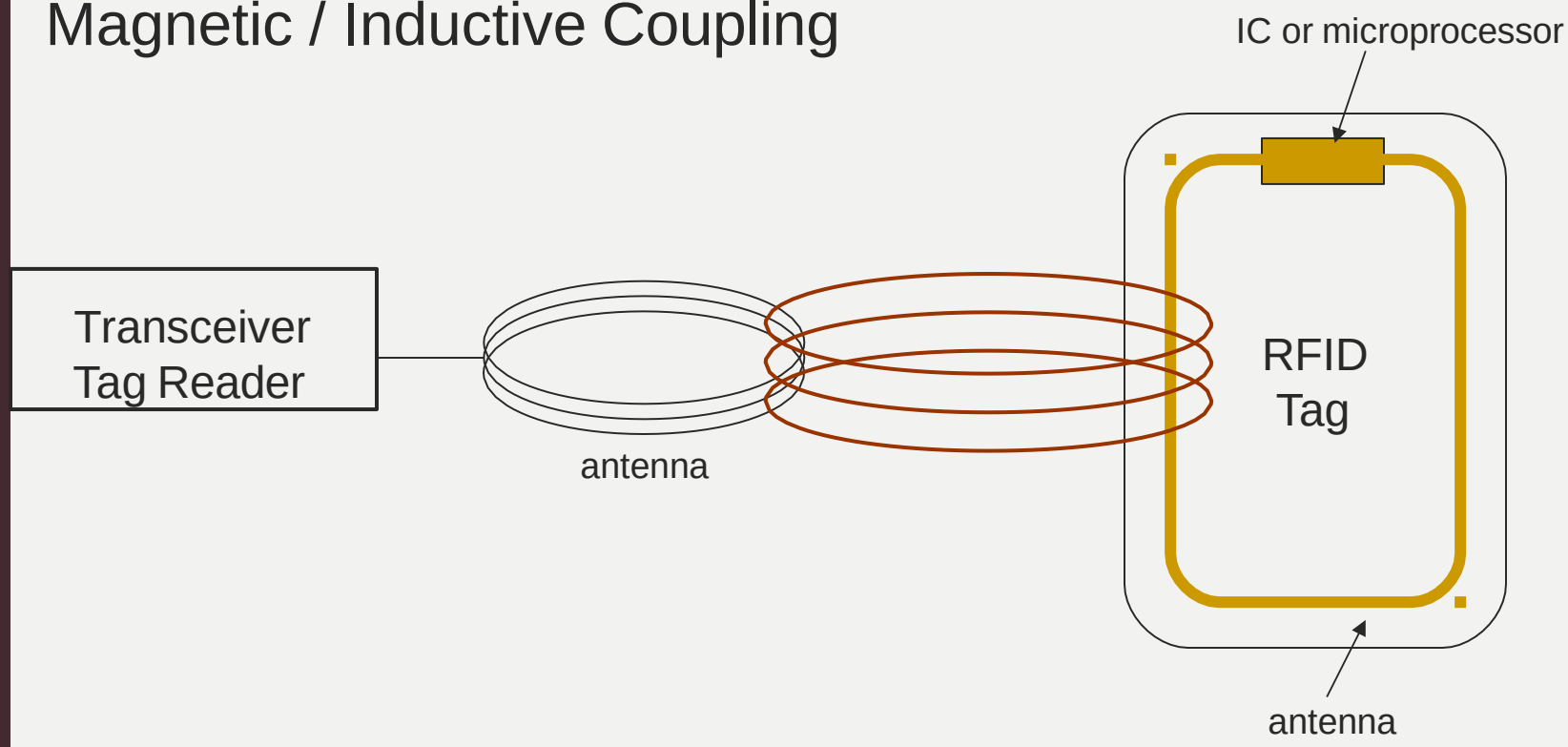
How Does RFID Work?

- 3 Components
  - Transceiver – Tag Reader
  - Transponder – RFID tag
  - Antenna



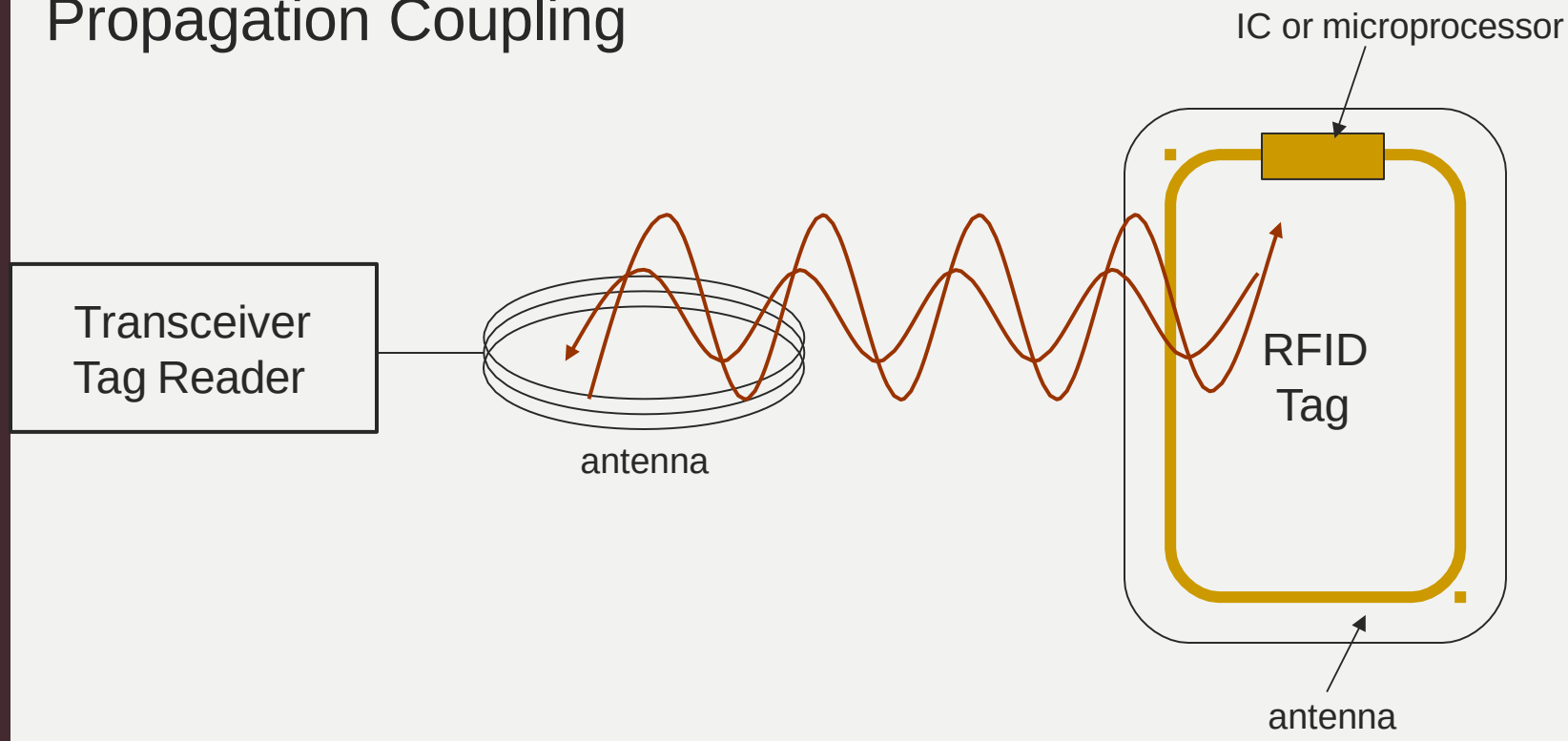
RFID Hardware

Magnetic / Inductive Coupling

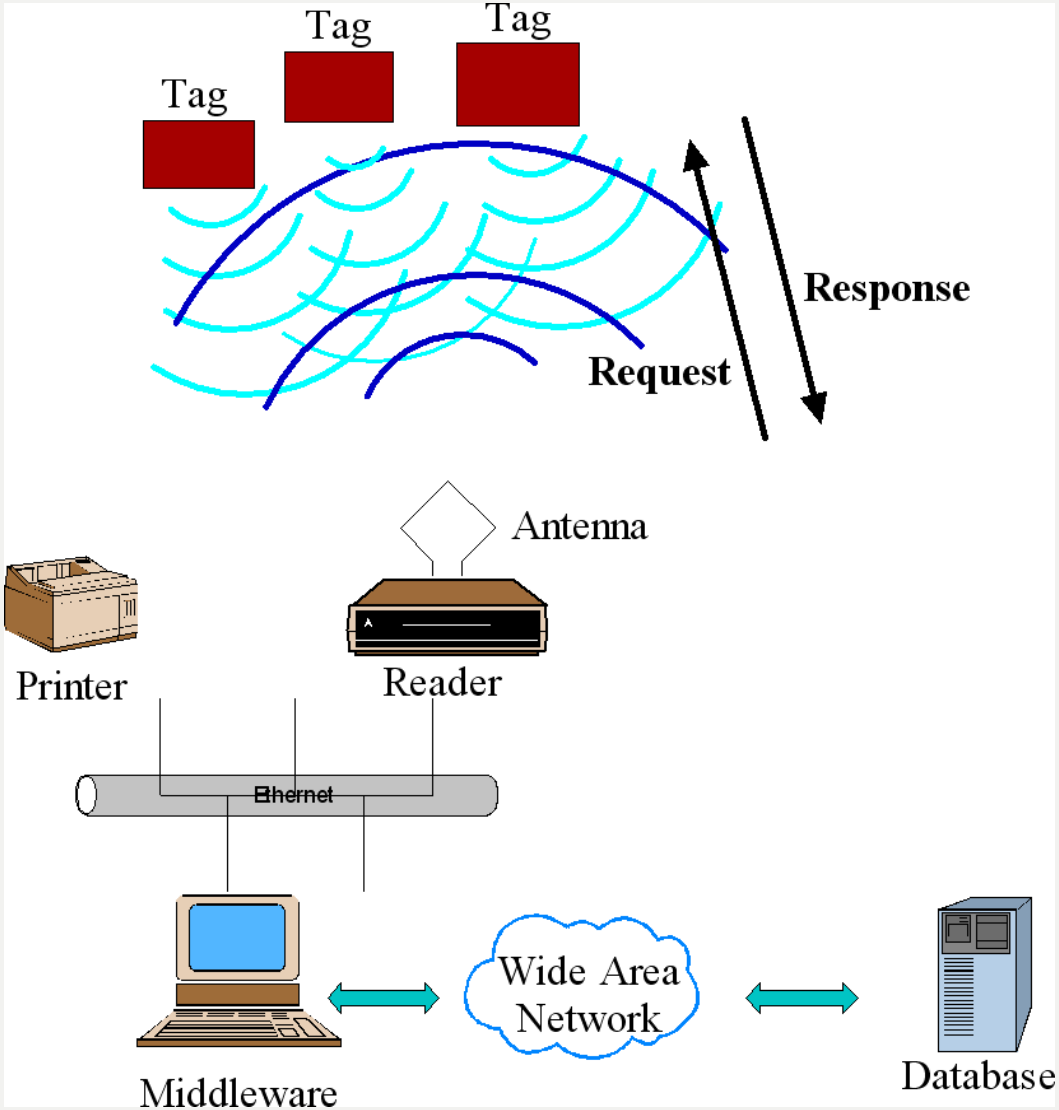


RFID Hardware

Propagation Coupling

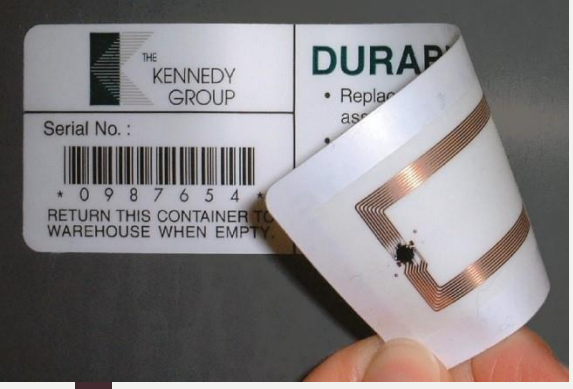


RFID system

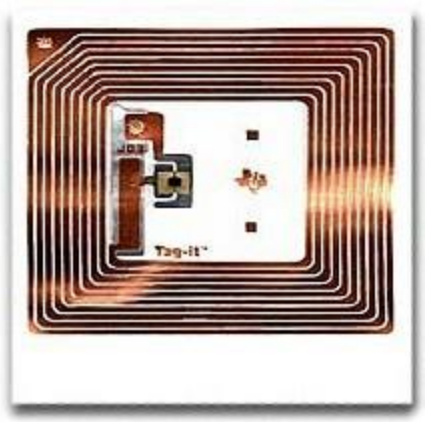

Tag
Tag
Tag
Response
Request
Antenna
Printer
Reader
Ethernet
Middleware
Wide Area Network
Database

RFID reader

- Also known an interrogator **(as it is used to interrogate an Tag).**
- **Reader powers passive tags with RF energy**
- Can be handheld or stationary
- Consists of:
  - Transceiver
  - Antenna
  - Microprocessor
  - Network interface



RFID tags



- Tag is a device used to transmit information such as a serial number to the reader in a contact less manner
- Classified as :
  - Passive – energy from reader
  - Active - battery
  - Semi-passive – battery and energy from reader

Types of Tags

- Passive Tags
  - No battery
  - Low cost
- Active Tags
  - On-board transceiver
  - Battery – must be replaced
  - Longer range
  - High cost

Types of Tags

- Read Only
  - factory programmed
  - usually chipless
- Read / Write
  - on-board memory
  - can save data
  - can change ID
  - higher cost

Real Tags

Frequency Ranges

- Low – 100-500 kHz
  - short range, low data rate, cost, & power
- Intermediate – 10-16 MHz
  - medium range and data rate
- High – 850-950 MHz & 2.4-5.8GHz
  - large range, high cost, high data rate
  - needs line of sight

Frequency Trade-Offs

- Power
- Cost
- Bandwidth
- Line of Sight

- Lifespan
- Range

General Applications used in our Day-to-Day Life

- Keyless entry
- Electronic Product Code (EPC)
- Proximity cards

General Applications(cont'd)

- Payment tokens
  - Contact-less credit cards
  - Automatic toll-payment
- Euro banknotes
- Passports

General Applications (cont'd)

- Libraries
- Security device
  - Bookstores

Current Applications

- Livestock Tagging
- Wild Animal Tracking
- Electronic Article Surveillance (EAS)
- Automated Toll Collection
- Animal Husbandry
- Vehicle Anti-Theft

More Applications

- Passive / Secure Entry
- Airline Baggage Tracking
- Postal Package Tracking
- Time and Attendance

Security Applications

- RFID used to grant entry to secure areas
- Tracks time and movement of people Dynamically change access codes Provide automated entry

Electronic Passports

Tourist/Regular Passport Cover

- Dept. of State begins issuing e-passports Aug. 14, 2006
- Contactless chip in rear cover
  - ISO 14443
  - Name, date of birth, gender, place of birth, dates of passport issuance and expiration, passport number, digital image of the bearer's photograph stored electronically
  - Digital photograph is used as biometric identifier
- Anti-skimming material in cover to prevent unauthorized reading when it is closed
- Eavesdropping prevented by reading machine readable key inside passport to unlock chip
- Randomized unique identification (RUID) to prevent tracking
- Information signed with a digital signature

Livestock Tagging

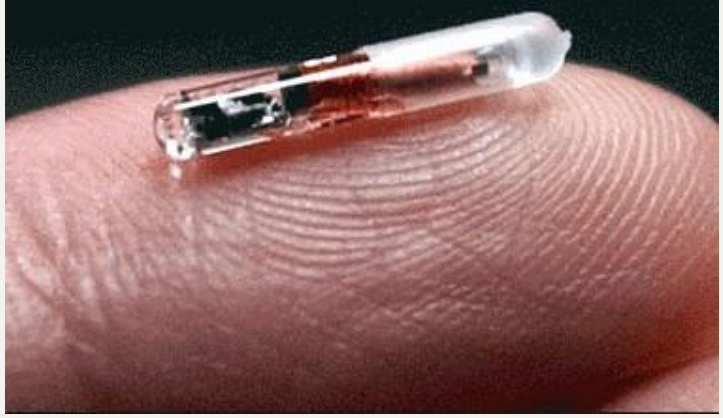
Meet Bobby the Cow

Bobby has an old fashioned ear tag for identification.

Benefits in Livestock Tagging

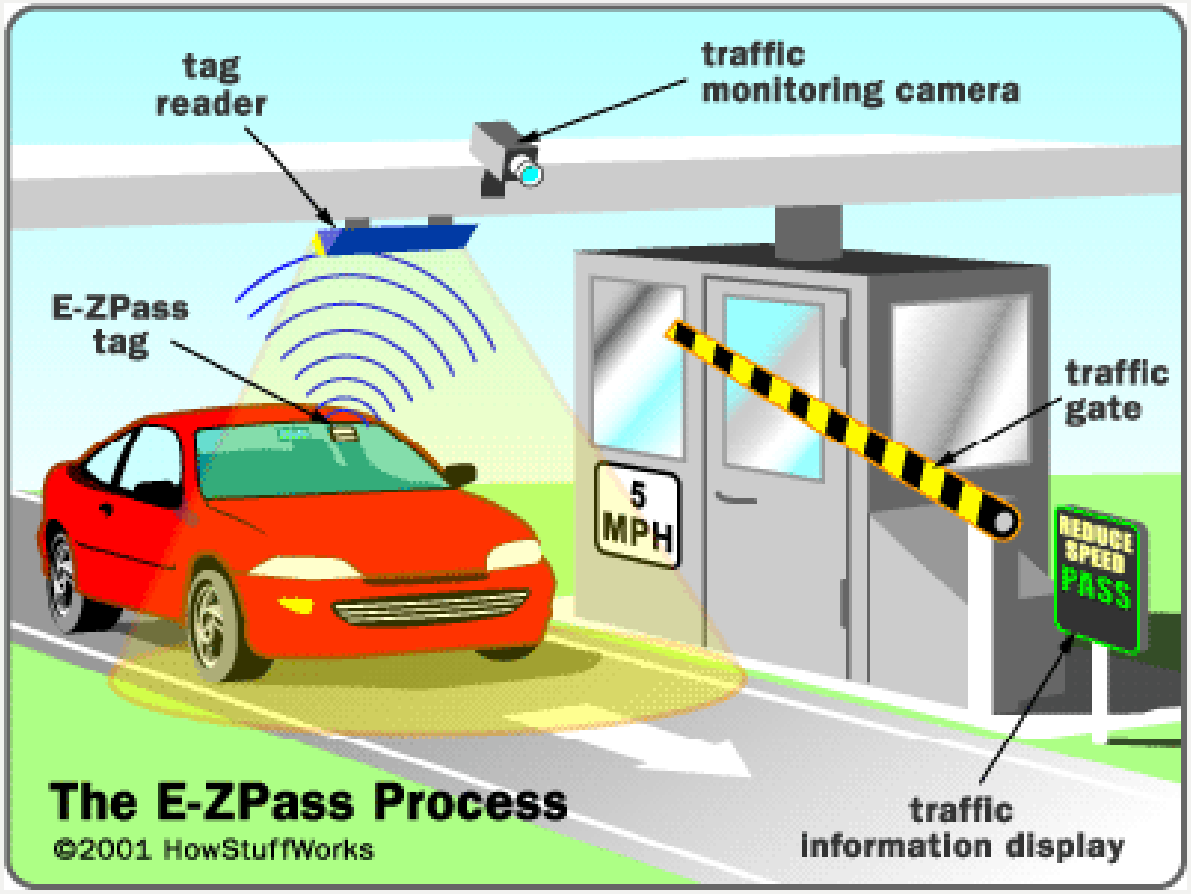
- Each one needs to be recorded
- Why use RFID tags instead of the old-fashioned tags?
  - cows get dirty
  - herds can be large

VeriChip

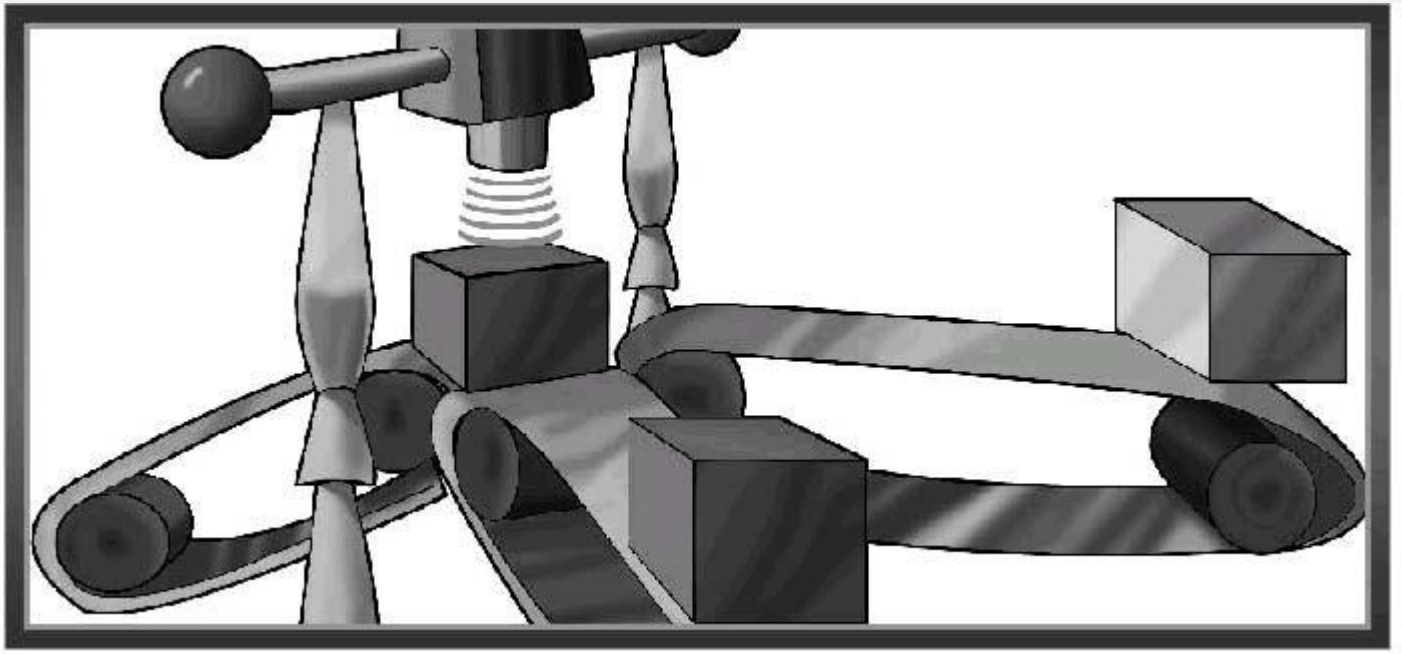


- Human implantable RFID tag operating at about 134 KHz because at these frequencies the RF can penetrate mud, blood, and water
- About the size of uncooked grain of rice
- Oct. 22, 2002 – US Food and Drug Administration ruled VeriChip not regulated device
- Oct. 2004 – FDA ruled serial number in VeriChip could be linked to healthcare information
- Healthcare applications
  - Implanted medical device identification
  - Emergency access to patient-supplied health information
  - Portable medical records access including insurance information
  - In-hospital patient identification
  - Medical facility connectivity via patient
  - Disease/treatment management of at-risk populations (such as vaccination history)

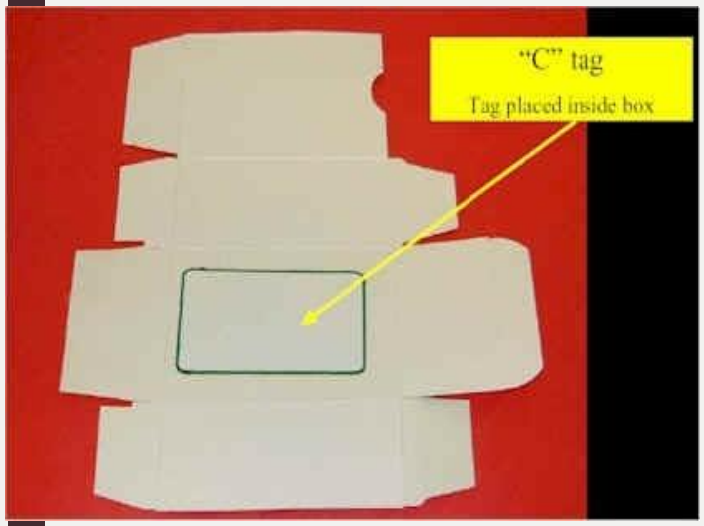
Automated Toll Collection

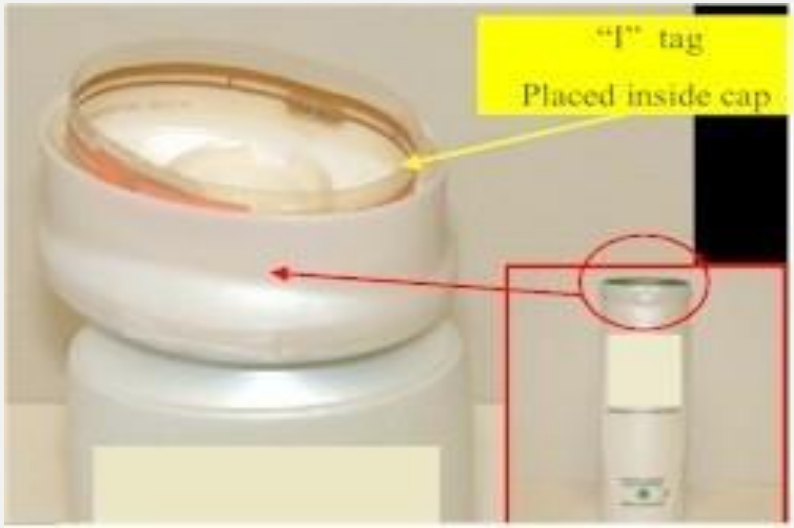


Package Tracking



Some RFID tags for consumer use





4 requirements for consumer use

- Notify the consumer
- Visible and easily removable tags
- Disabled at point of sale
- Tag the product's packaging

Barcode Vs RFID

Barcode	RFID
Barcode readers require a direct line of sight, using laser technology.	Reading is done automatically using RF waves.
Scan and read one tag at a time.	Scan and read multiple tags simultaneously.
Reading by barcode take much more time	Reader can interrogate, or read tags much faster, appx.20tags per second.
Human intervention is required to scan a barcode.	RFID tag can be detected hands-off.
It should be visible on the product for scanning.	Tags can be concealed in any non-metallic items.
The readability of barcode can be impaired by dirt, moisture, abrasion or packaging etc.	RFID tags are not affected by those conditions.
Barcode don't have read/write memory.	RFID tags have read/write memory capability.
Less read range in comparison to RFID	RFID tags have a longer read range.
Technology is old and outdated.	Scope for more advancement.
Less expensive.	More expensive.
Ability hold limited data.	More data can be stored in an RFID tag, also facility for modifying it at later stage.

Potential Applications

- Smart Grocery Store
- Smart Kitchen
- Smart Sitterson

Smart GrocerymStore

- Every item in the store already has a bar code.
- Why not use an RFID tag? Speed up checkouts

Smart Grocery Store

- Several carts this full in early evening could seriously slow down the checkout process.
- How much do cashiers cost?

Smart Grocery Store

- 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.

RFID UPC

Artist conception courtesy Motorola

Smart Groceries Enhanced

Track products through their entire lifetime.

Diagram courtesy How Stuff Works

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

RFID Chef

- Uses RFID tags to recognize food in your kitchen
- Shows you the recipes that most closely match what is available

RFID's Advantages

- Passive
  - wireless
- Store data on a tag
- Can be hidden
- Work in harsh environments
- Low cost?

RFID's Disadvantages

- Lack of standards!
- Short range
- Cost
- Authentication
- Denial of service
- More open research issues
  - Nominal read range
  - Rogue scanning range
  - Tag-to-reader eavesdropping
  - Reader-to-tag eavesdropping

Conclusion

- RFID has many potential uses
- Likely to play a key technological role
- Perceptions of privacy and security vary
- Privacy and security concerns must be addressed