



# **RADIO FREQUENCY IDENTIFICATION TECHNOLOGY**

**CDAC Mumbai**

# 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:
  - Voice Recognition Systems
  - Finger Print technology
  - Biometric Identification
  - Barcode systems
  - Radio Frequency Identification

# BAR CODE SYSTEMS

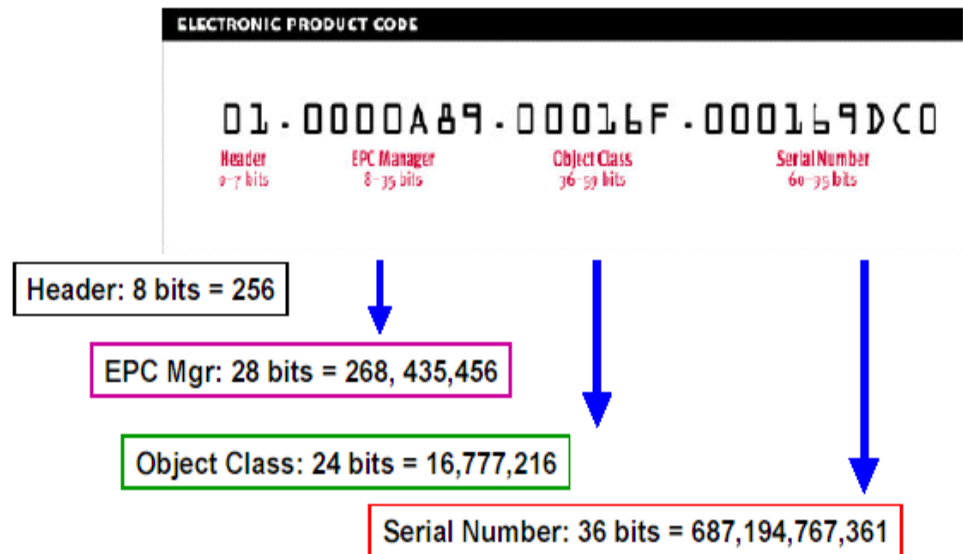
Widely used in manufacturing and retail sectors

## Anatomy of a Barcode



**Header** - Tag version number  
**EPC Manager** - Manufacturer ID  
**Object class** - Manufacturer's product ID  
**Serial Number** - Unit ID

## EPC Data Standard- 96 bit



With 96 bit code, 268 million companies can each categorize 16 million different products where each product category contains up to 687 billion individual units

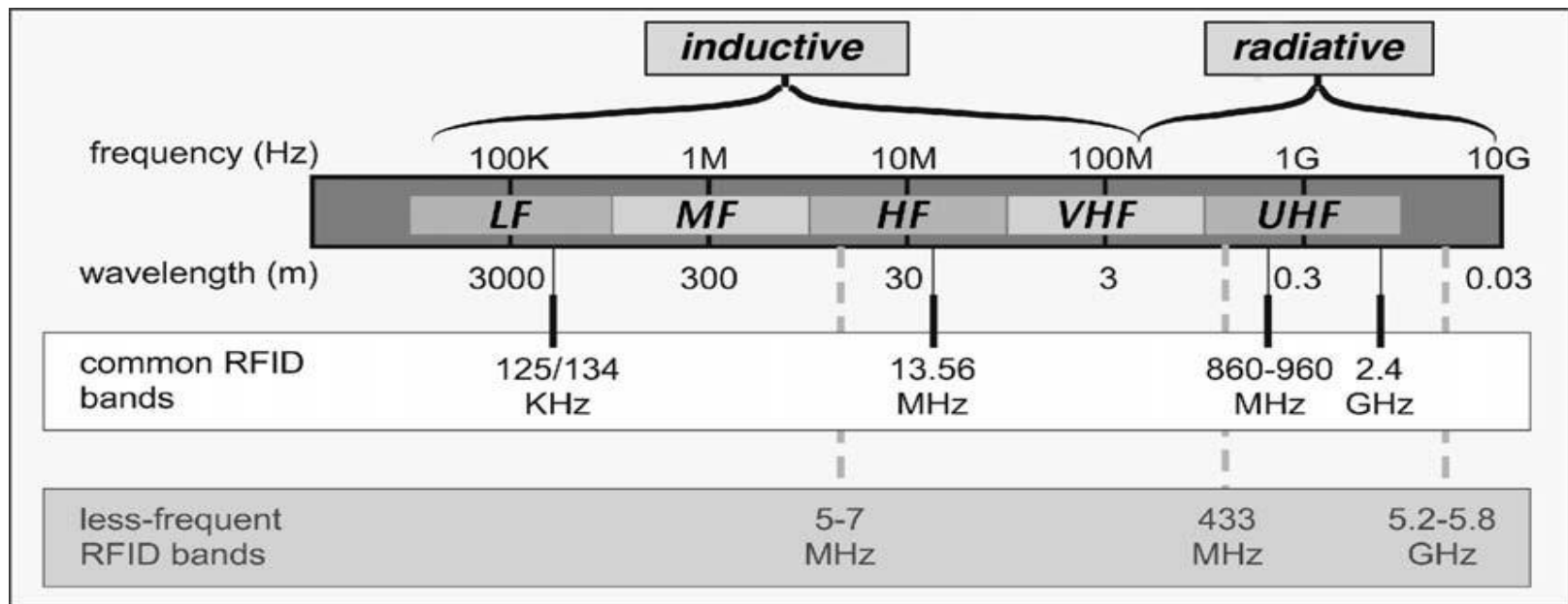
# LIMITATIONS OF BARCODES

- Read only technology
- Requires line of sight
- Limited storage of data
- Single scan at a time
- Can be easily destroyed
- Short life time
- Human Intervention
- Time consuming

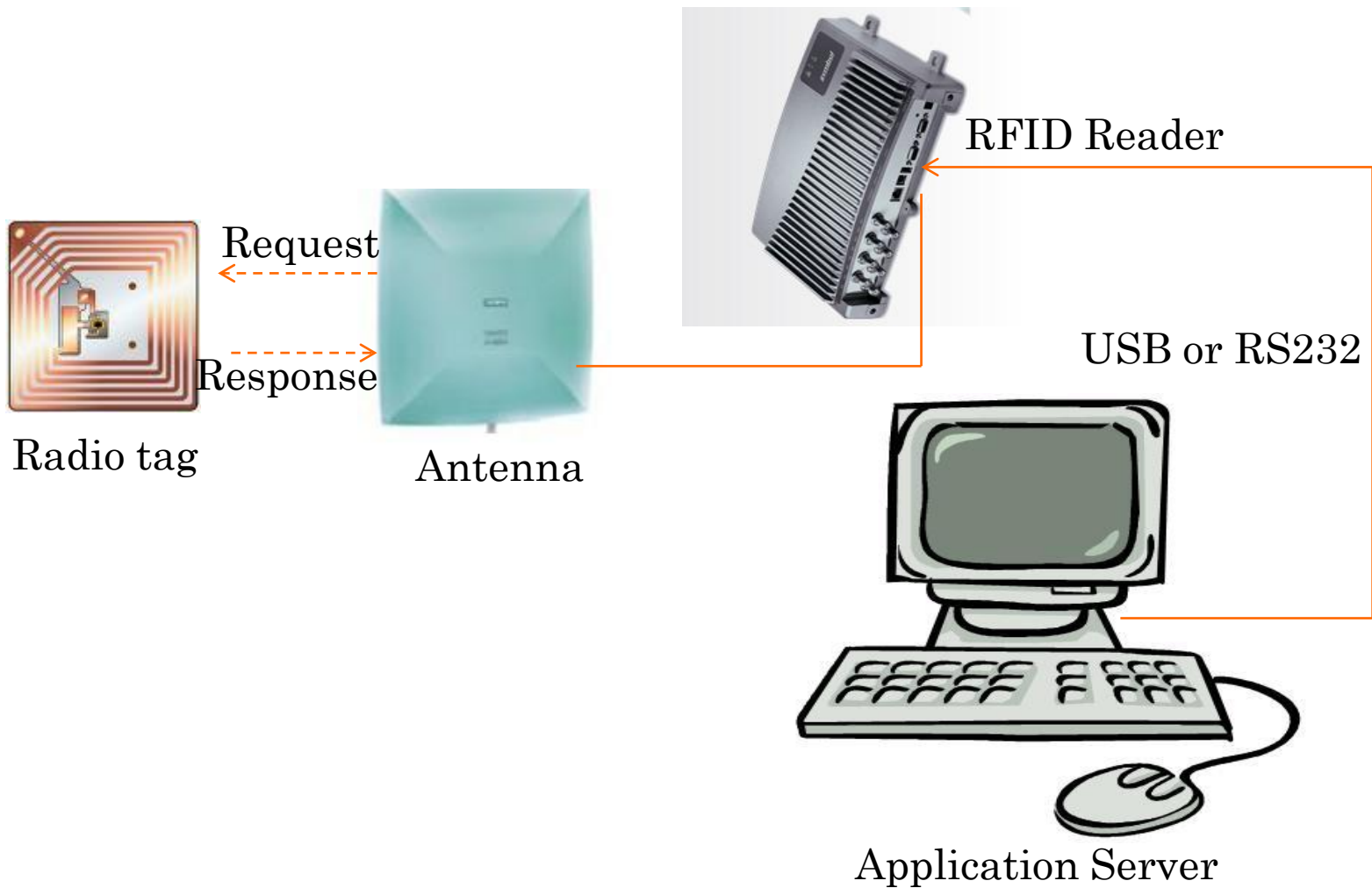


# RADIO FREQUENCY IDENTIFICATION TECHNOLOGY

- Radio Frequency Identification (RFID) is a method of remotely storing and retrieving data using devices called transponders
- Commonly used frequencies are

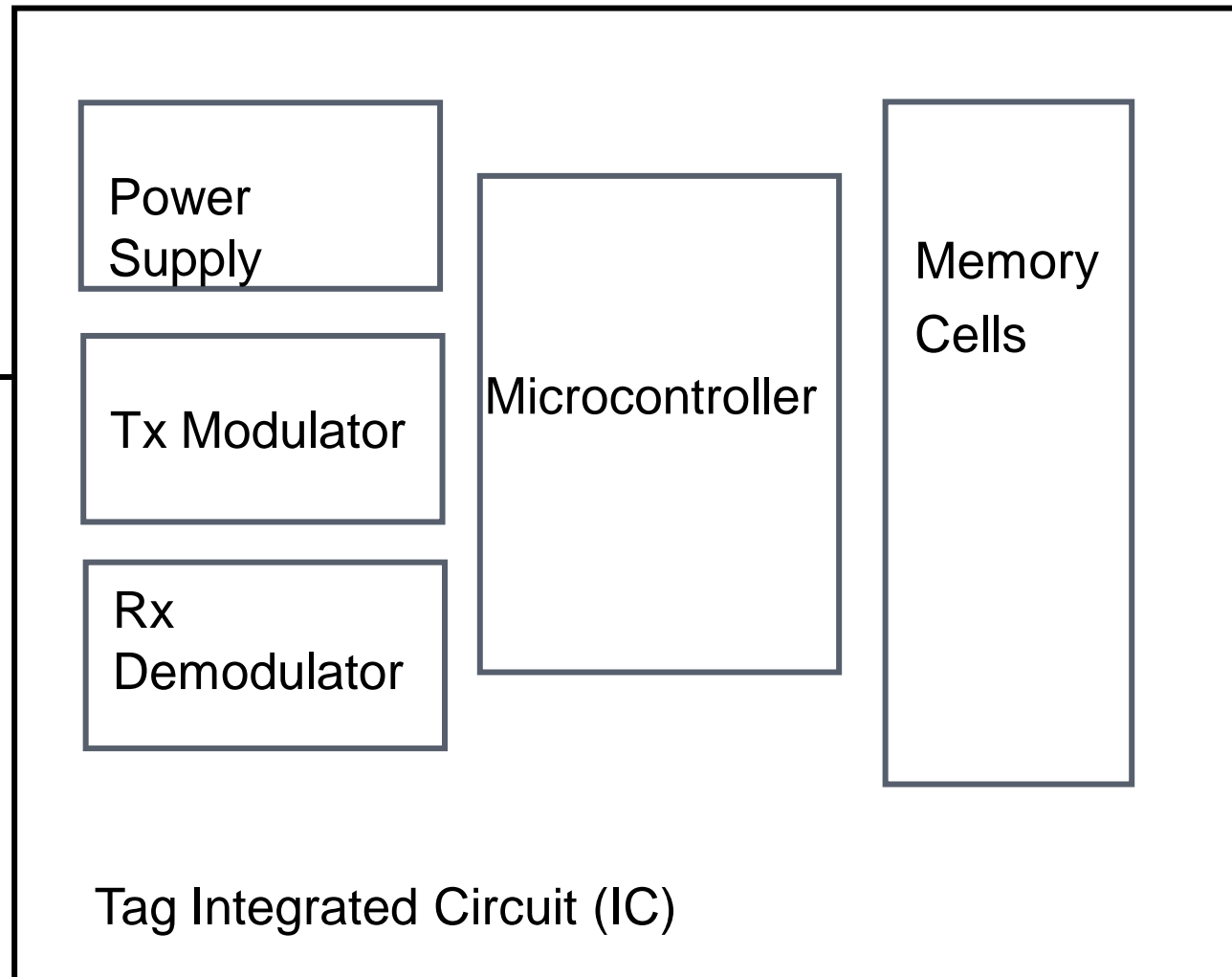
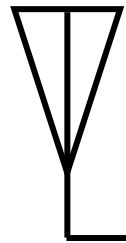


# RFID READER



# RFID TAG BLOCK DIAGRAM

Antenna



# RFID ADVANTAGES

- No line of sight requirement
- No physical contact between data carrier and communication device
- Very robust tags that can stand extreme conditions and temperatures
- Read only tag is 100% secure & can not be changed /duplicated
- Long read range
- Multiple tag Read/Write
- Tags can be used repeatedly
- Human errors can be avoided and extremely low error rate
- Tracking people, items, equipments in real-time





# CLASSIFICATION OF RFID SYSTEMS

- Range
  - Near Field Communication(NFC)
  - Far Field Communication(FFC)
- Frequency
  - LF, HF,UHF
- Operation
  - Passive, Semi-Passive, Active



# RFID SYSTEMS(TAGS)

## ○ **Passive**

- No battery
- Backscatter

- Depends on Reader

- Cheapest
- Small size
- Easy design
- upto 10m
- Short Range

## ○ **Semi Passive**

- Battery
- Backscatter

- Depends on Reader

- Costlier
- Medium size
- Less complex
- upto 30m
- Medium Range

## ○ **Active**

- Battery
- On board transmitter
- Independent of Reader

- Costliest
- Large size
- Complex design
- upto 100m
- Long range



# LOW FREQUENCY

## ○ Operating Frequency

- Frequency range: 100KHz to 140Khz
- Typical Frequencies: 125KHz and 134kHz

## ○ Advantages

- Less susceptible to the effects of nearby metals and liquids as compared to devices operating at higher frequencies

## ○ Disadvantages

- Small amounts of data
- Slow read speeds
- Large Antennas -- compared to higher frequencies
- Minimal Range
- Only one transponder can be read at a time
- More expensive and typically bulkier than HF tags
- Memory capacity of LF transponders is generally lower than HF tags



# APPLICATIONS

- Access Control & Security
- Vehicle Identification
- Parking Lot Access
- Wireless Payments
- Tree Tagging
- Asset Management
- Production Tracking
- Animal identification etc



# HIGH FREQUENCY

- Operating Frequency
  - Typically operate at 13.56MHz
- High Frequency RFID devices have anti-collision intelligence that allows hundreds of tags to operate concurrently in the same antenna field
- Advantages
  - Well suited for applications requiring reading small amounts of data and minimal distances
  - Simpler antenna design (fewer turns of the coil) and lower cost to build
  - Higher data rate (than 125 kHz--but slower than higher MHz systems)
  - Thinner tag construction (than 125 kHz)



# APPLICATION

- Access Control
- Library management
- Point Of Sale for retails
- Jewellery Management
- Textile Application
- Laundry identification
- File and Document Asset Tracking



# ULTRA HIGH FREQUENCY

- Frequency ranges from 860 MHz to 960 MHz
- Advantages
  - Effective around metals
  - Best available frequency for distances of  $>1\text{m}$
  - Tag size smaller than 13.56 MHz
  - Smaller antennas
  - Good non-line-of-sight communication
  - High data rate and large amounts of Data
  - Controlled read zone (through antenna directionality)
- Disadvantages
  - Does not penetrate water/tissue



# APPLICATIONS

- Airline baggage identification
- Warehouse management
- Supply chain management
- Transportation and Logistics application
- Container/vehicle tracking
- Asset Tracking





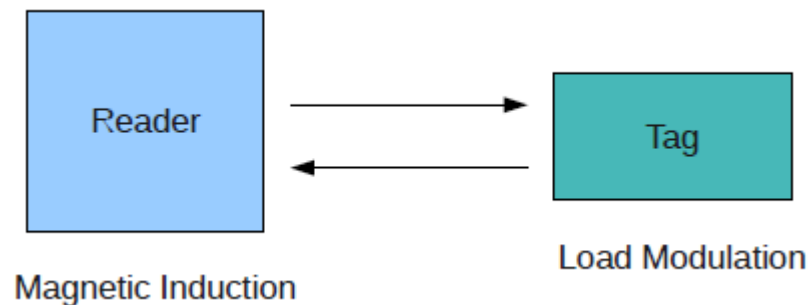
# NEAR FIELD COMMUNICATION

- Short range wireless communication
  - LF – 56 to 148.5KHz
  - HF – 1.75 to 13.56 MHz
- Range: up to 10cm
- Consumes less power
- Load Modulation
- Hardware
- NFC Controller IC with an Antenna
- Secure Element
  - Secure Element(SE) is a highly secured crypto memory chip that stores all the information



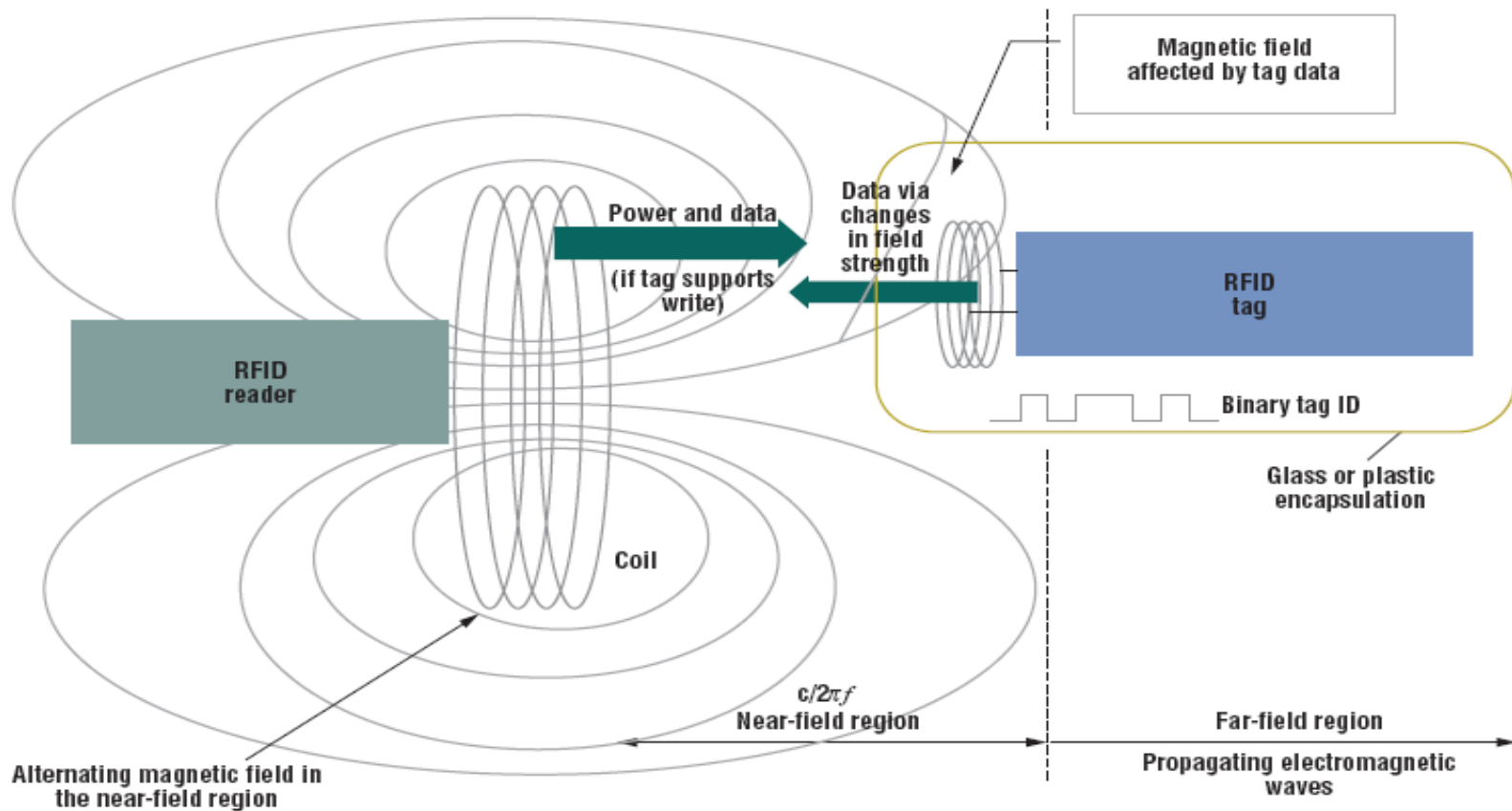
# HOW IT WORKS

Principle: If a load is applied across tag's antenna coil and varies it over time, a signal can be encoded as tiny variations in the magnetic field strength representing tag's ID



# LOAD MODULATION

Using induction for power coupling from reader to tag and  
load modulation to transfer data from tag to reader



# SOME NFC ENABLED MOBILE PHONES



Nokia 6131



Nokia 3220



Motorola L7  
(SLVR)



Samsung BenQT80  
D500E



BenQT80



Nokia 6212 Classic



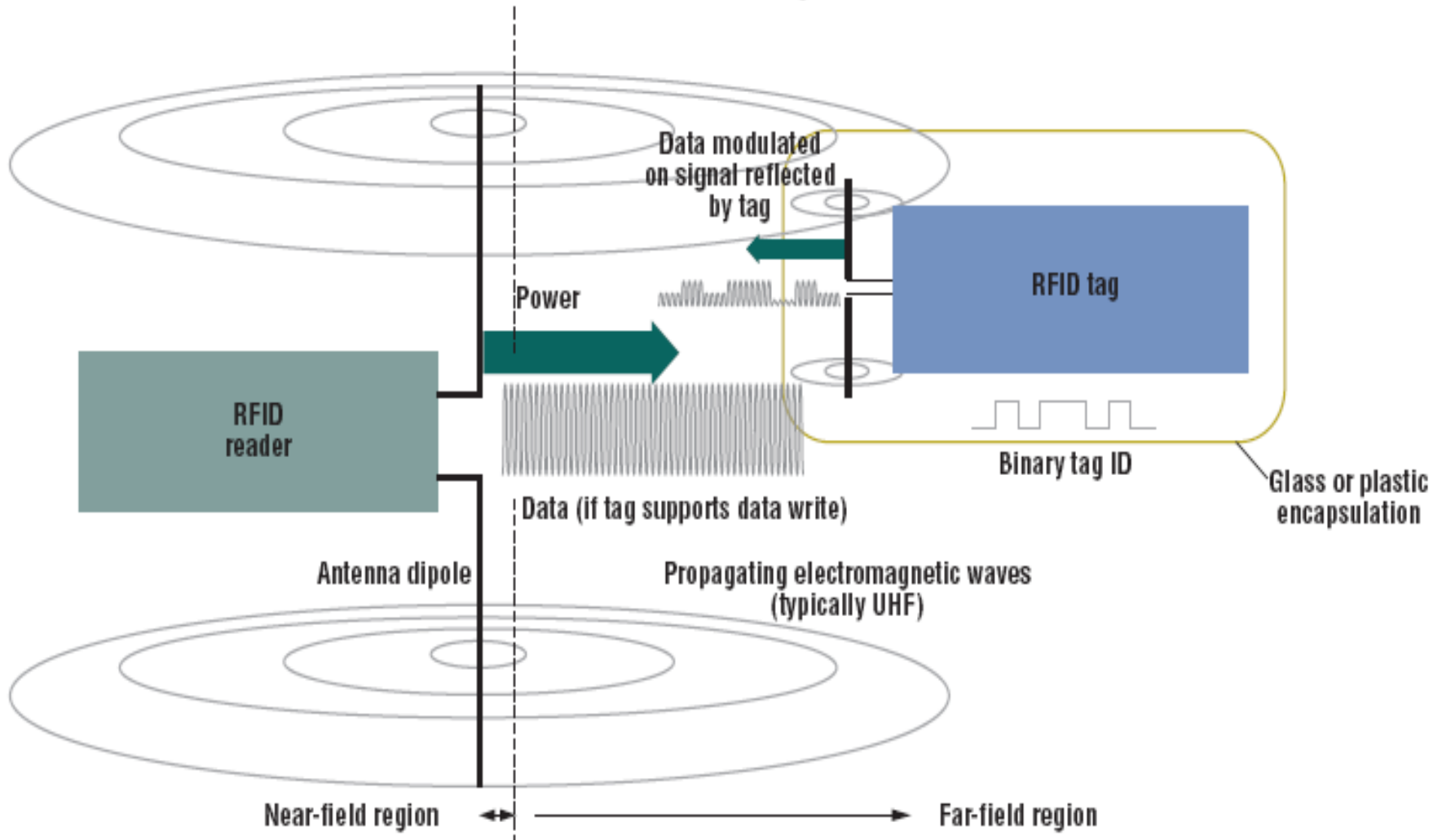
# FAR FIELD COMMUNICATION

- Long range wireless communication
  - UHF – 433MHz, 840-960MHz
  - Microwave – 2.4GHz
- Back Scatter Modulation
- Range
  - inches to 10feet for passive
  - 100's to 1000's feet for semi-passive or active
- Applications
  - Automatic toll Collection, Asset and Personnel tracking



# BACK SCATTER MODULATION

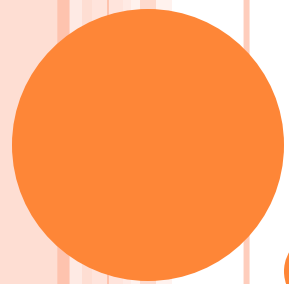
Using electromagnetic (EM) wave capture to transfer power from reader to tag  
and EM backscatter to transfer data from tag to reader



# PRINCIPLE FOR FFC

- If antenna is designed with precise precisions, it can be tuned to a particular frequency and absorb most of the energy that reaches it at that frequency
- If an impedance mismatch occurs at this frequency, the antenna will reflect back some of the energy
- By changing the antenna's impedance over time, the tag can reflect back more or less of the incoming signal in a pattern that encodes the tag's ID.





# RFID TRENDS IN INDIA



# CONTACTLESS PAYMENTS

- On June 30th Citi launched India's first NFC based contactless payment system “Citi Tap and Pay” in Bangalore
- In collaboration with Nokia, Vodafone, MasterCard and VIVOtech.
- NFC enabled 6212 Classic phones are being used
- 5,000 people use Citi’s Tap and Pay Bangalore trial



# PDS IN ANDHRA PRADESH

- Pilot Introduction of smart/RFID tags in Public Distribution Systems(PDS), Govt of Andhra Pradesh April 2009

District	Name of the Mandal	No. of F.P. Shops	BPL cards (White+ AAY/AP)	APL cards	Total cards
West Godavari	Bhimadole	26	17825	1883	19708
Guntur	Narsaraopet	113	35823	13235	49058
Prakasam	Kothapatnam	29	14244	1000	15244
Chittoor	Gudipala	48	11309	964	12273
Karimnagar	Malakondur	40	12884	1048	13932
	Total	256	92085	18130	110215



# AERO INDIA 2009

- Biggest ever event management project in India using RFID technology
- More than 500K people were tracked using a combination of UHF & LF RFID technology
- A double authentication secure system was used for tracking the persons getting entry at the event of Aero India 09



# HPCL

- HPCL, a Fortune 500 company is implementing RFID based cylinder tracking system (IBM , Oct 2008)
- Stream line supply chain from bottling plant, logistics, and distributors to the end-consumers
- US\$2.2 million deal
- 500,000 cylinders in the initial phase



# INDIA POST

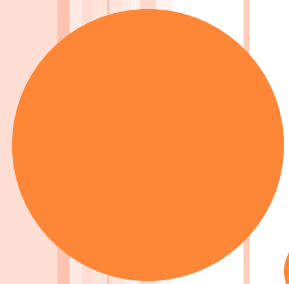
- Around 60,000 sacks of mails move across the country daily
- Difficult to manually track these sacks
- RFID can be used to track the sacks
- RFID based parcel tracking system pilot testing was done between New Delhi and Mumbai
- Postal department is planning to spend Rs 6,000 crore in technologies such as RFID, ERP etc



# INDIAN RAILWAYS

- Indian Railways has already tagged 1000 wagons
- Planning to invest up to Rs250 crore in putting RFID systems on all its 2.16 lakh wagons.





# RFID APPLICATIONS

# Tool Tracking

Request Computing  
Research Resource Center

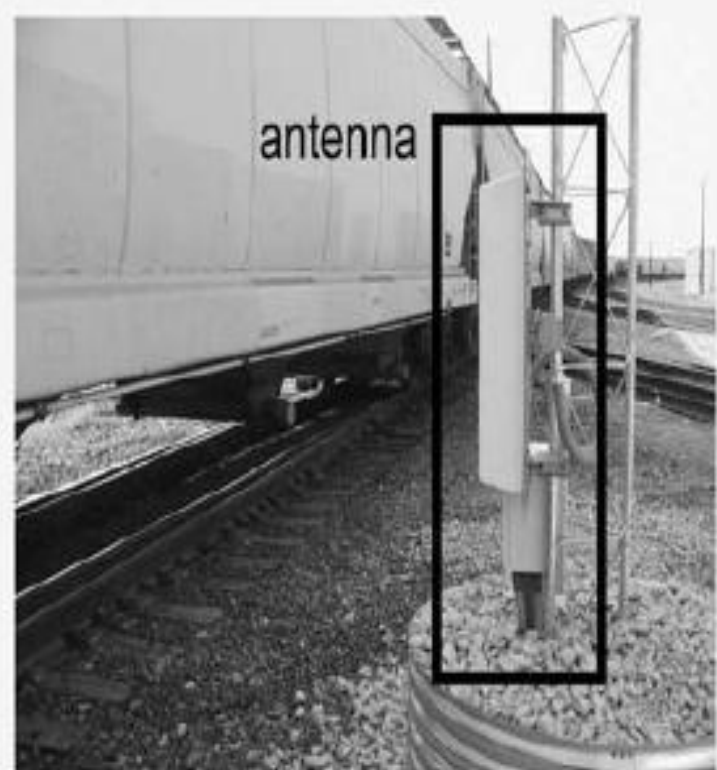


(Source: "Ford Truck with RFID tool tracker" Boing Boing on Feb06 2008)





# Railways



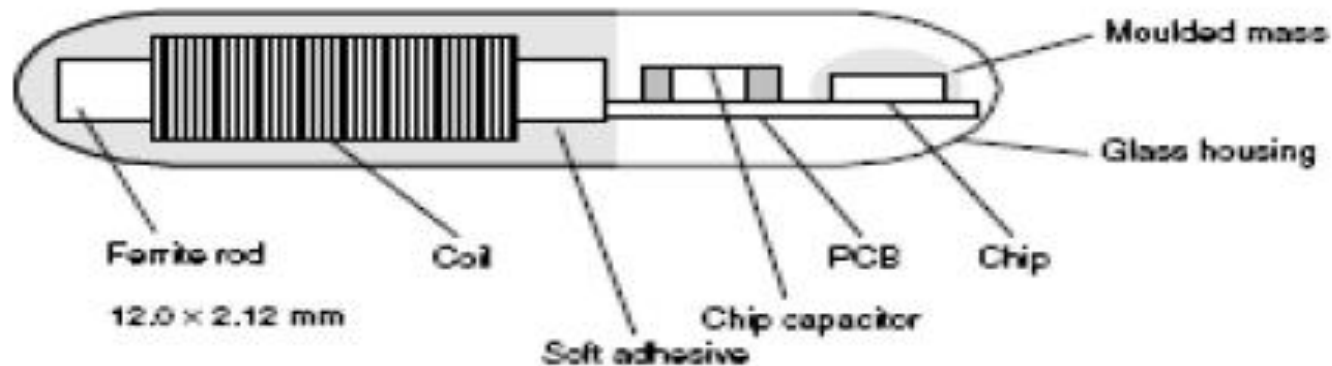
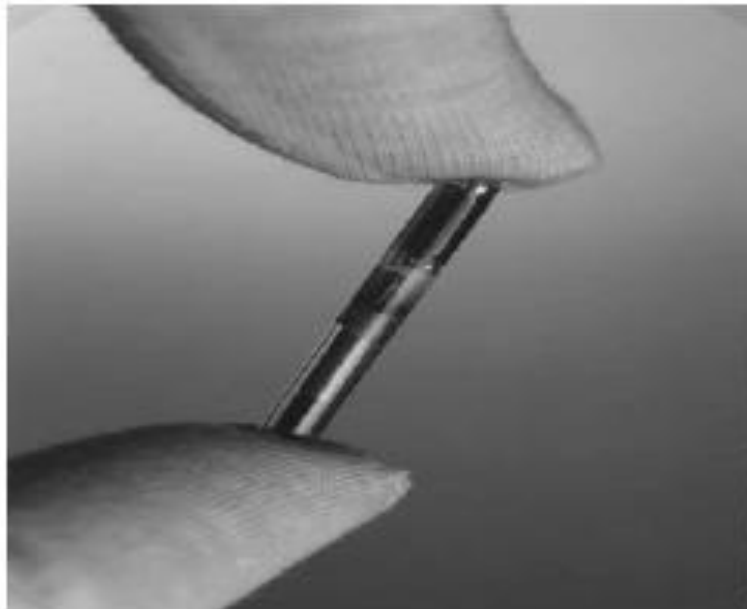
images courtesy Andrew Friend, ATBD Inc.



# RFID as anti-counterfeiting technology



# Personal Identification



# Contactless Payments



# Access Control





# Sharing Contact Details



# Animal Tracking



# Patient Monitoring





# Transportation

