Global RFID Industry Overview and Case Study for System Deployment

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Agenda

- Overview for Global RFID Industry
- RFID Applications
- Challenges of Global RFID Adoption
- RFID Development Trends
- Case Study : RFID In Vehicle Tracking Applications
- Conclusion and Recommendation

Overview for Global RFID Industry

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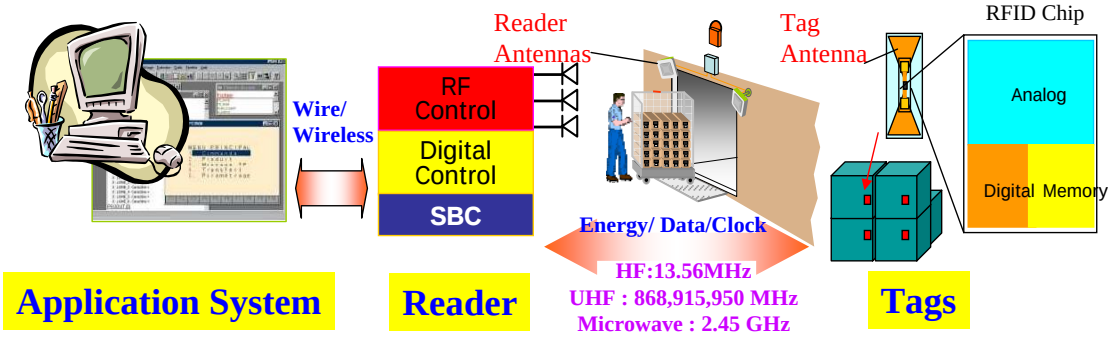
ADVANCED RFID SOLUTIONS

Passive RFID System



- RFID Systems Offer
  - Automatic identification of tagged objects
  - Contactless data capture (data entry/data collection)
  - Enabling mobile interface between merchandise flow and information and/or monetary flows in digital commerce

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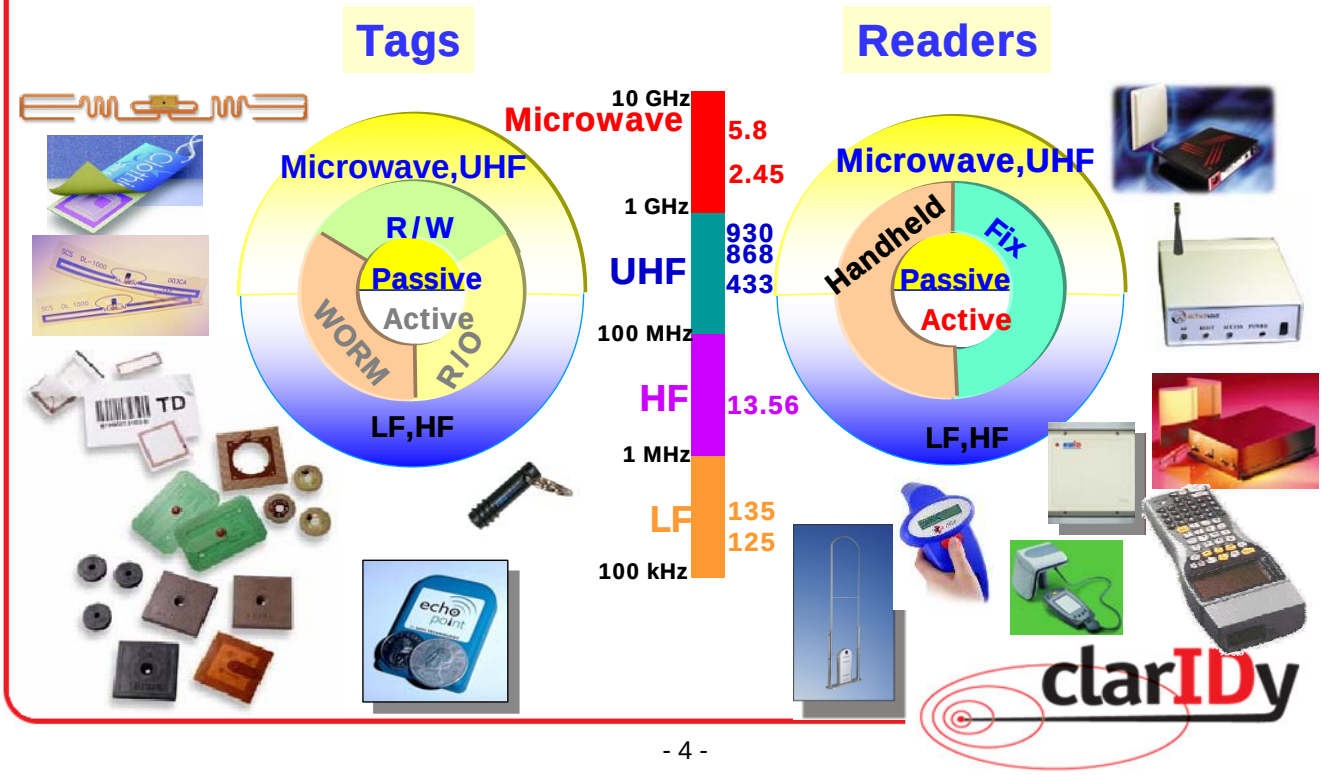
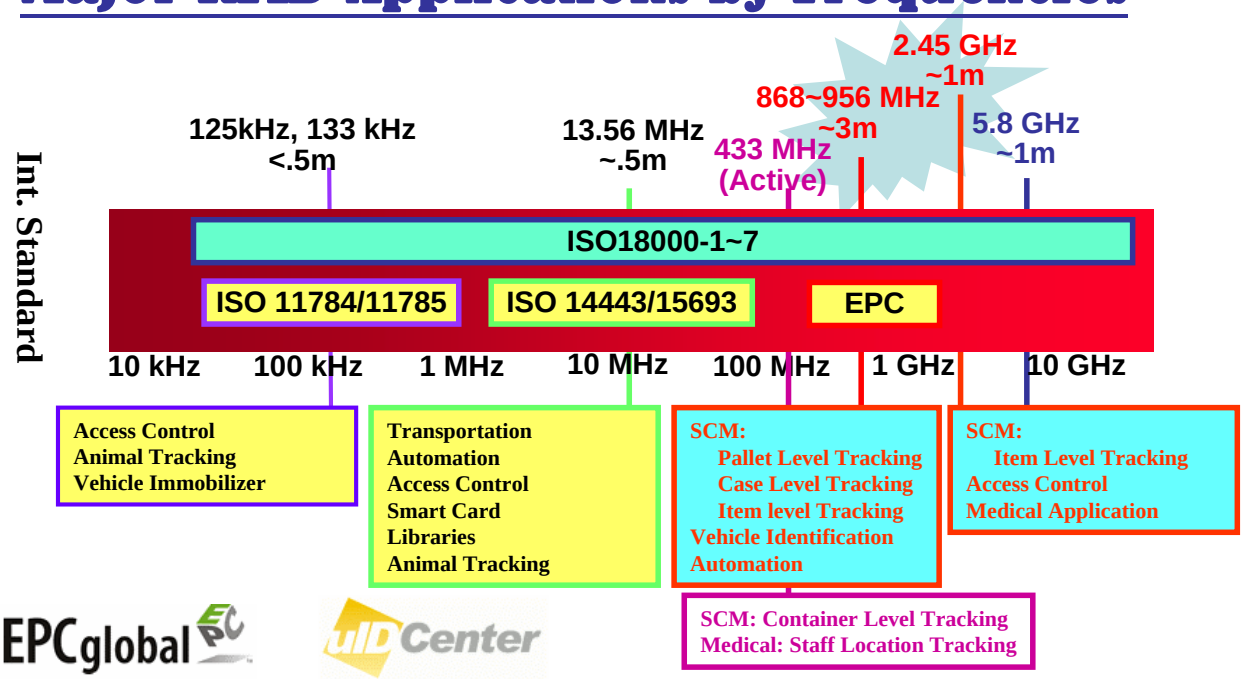
A Variety of RFID Products



Major RFID Applications by Frequencies



EPCglobal

- Content
- Air protocol (UHF)
- Network

uID Center

- Content (Barcode, 2D Barcode, RO, R/W)
- Passive/ Active
- Security

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Frequency Comparison

	125 KHz	13.56 MHz	UHF (900 MHz)	2.45 GHz
Read Distance	Short	Short	Long	Medium
Performance	Low	Medium	High	High
Tag Size	Small - Large	Small - Large	Medium	Small
Operation on Metal	No	No	Yes	Yes
Transmit through Water	Yes	Yes	No	No
Antenna Cost	High	Medium	Low - Medium	Low
Medium Sensitivity	Minimal	Minimal	Yes	Yes
Cross Interference	Minimal	Minimal	Yes	Yes
Worldwide Availability	Yes	Yes	No*	Yes

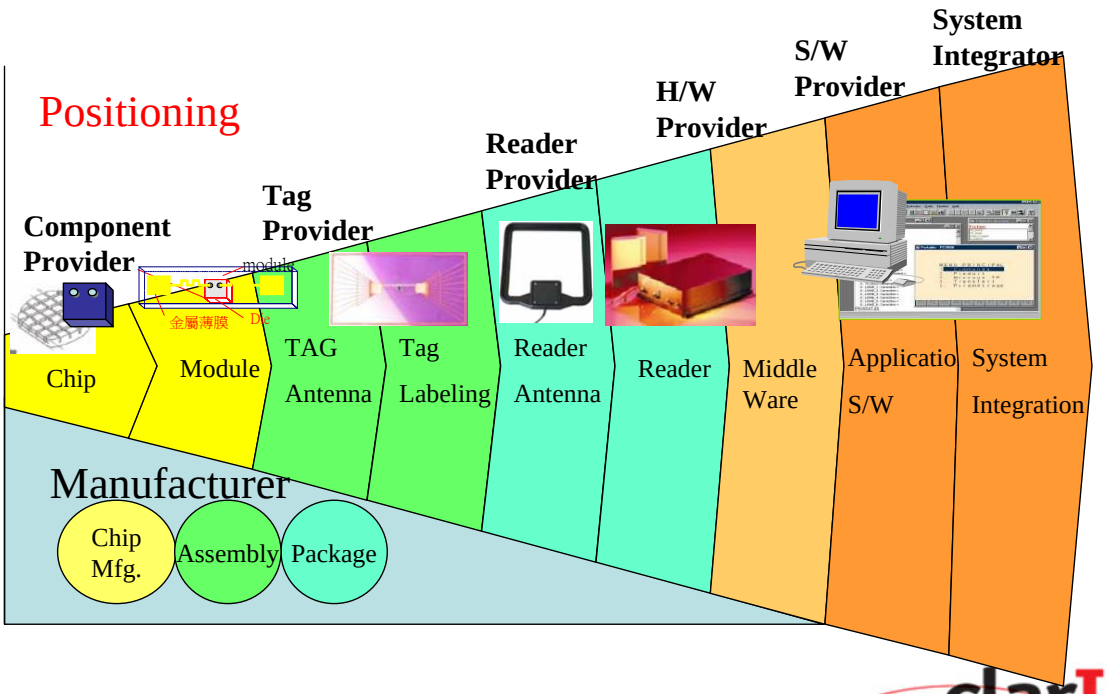
*** Regulatory authorities are presently trying to allocate similar frequency bands**

RFID Passive Vs Active

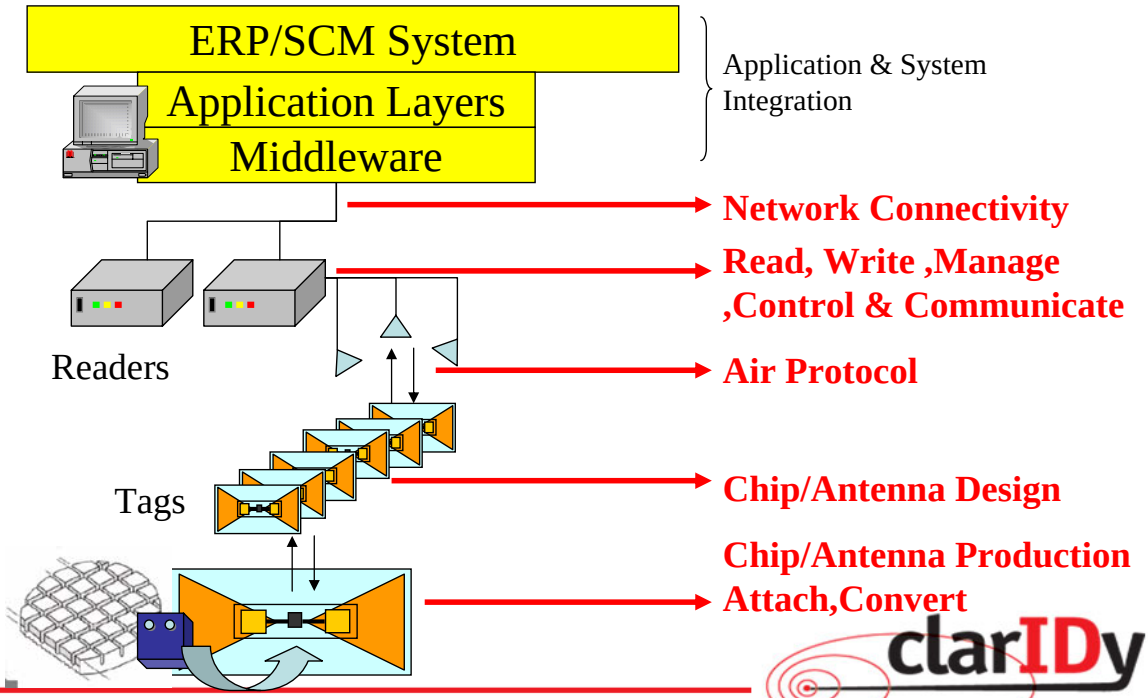
	Passive Tag	Active Tag
Energy Source	Induction or RF	Battery
Reading Distance	<~4 meter	~5-100 meter
Memory	64b – 8K	64K- 228K
Life Time	up to 10 years	~2-7 years
Technology Maturity	Medium	Low
Weight	~0,5-5 gram (excl. Package)	~50/ >200 gram
Cost	~15 cents – $3	~$20 – $70

Resource：Accenture, ITRI

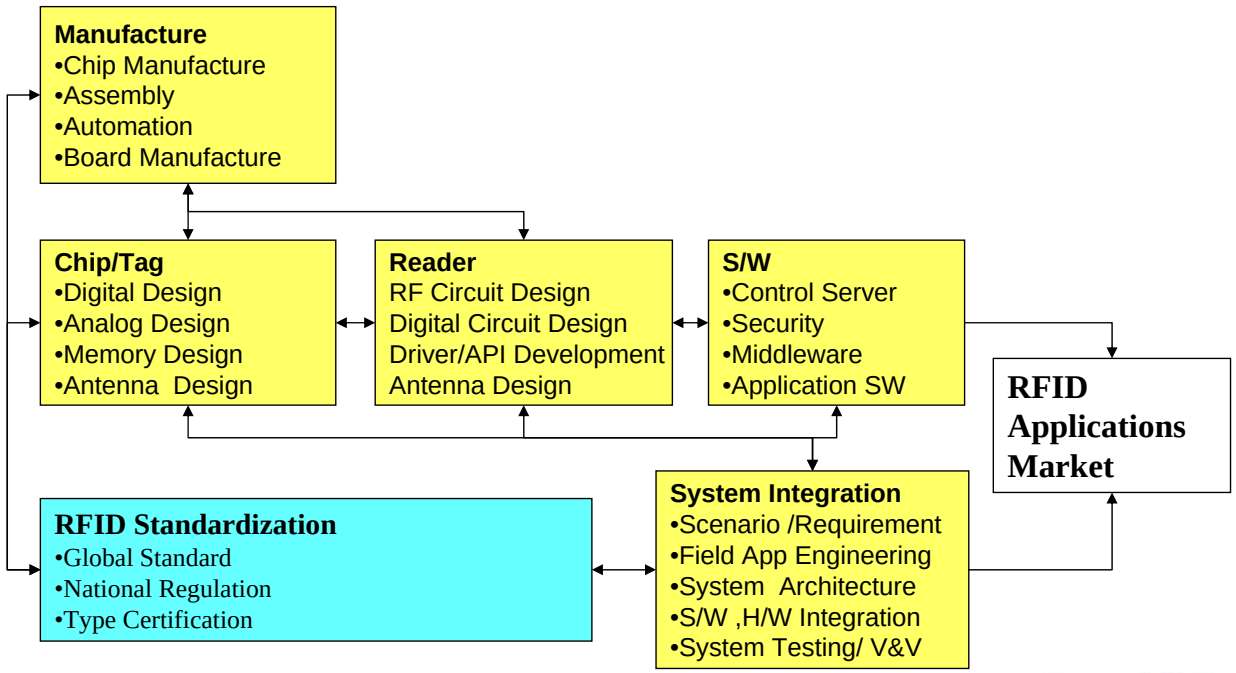
Value Chain of RFID Industry



Architectures of RFID Service System

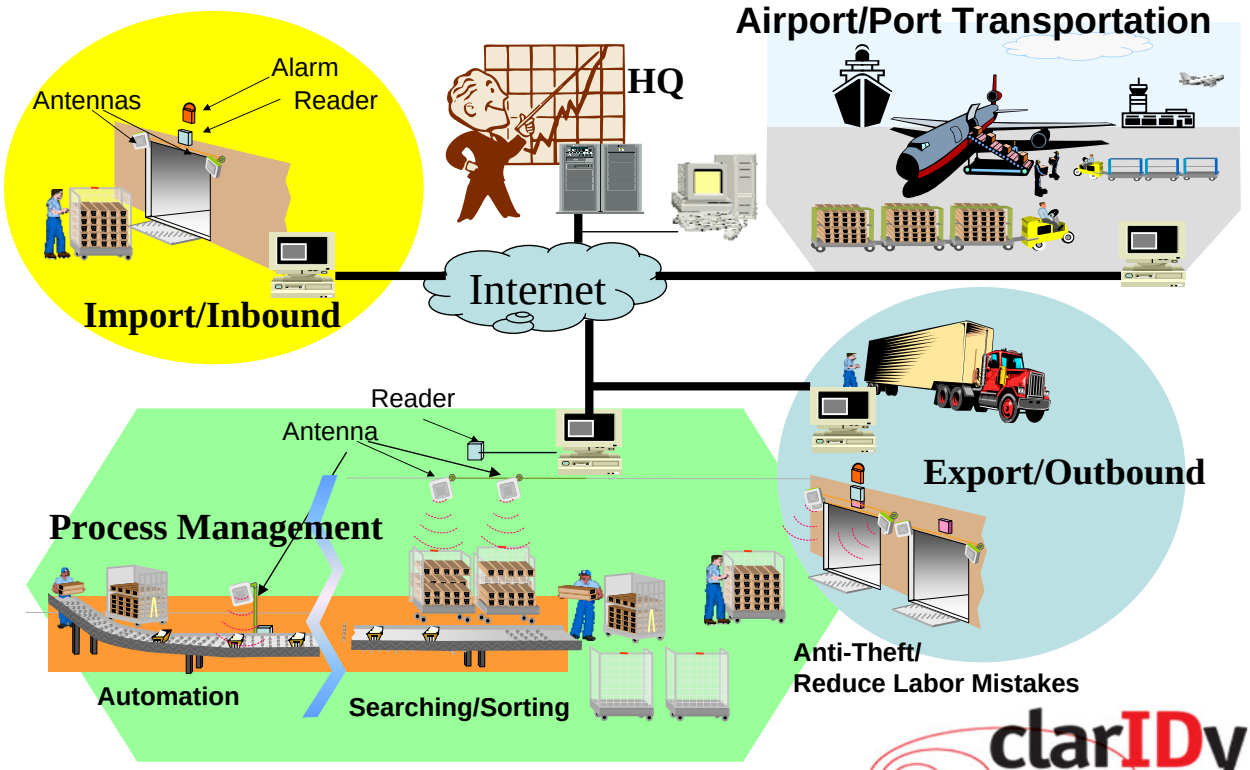


The Core Competence of RFID Player

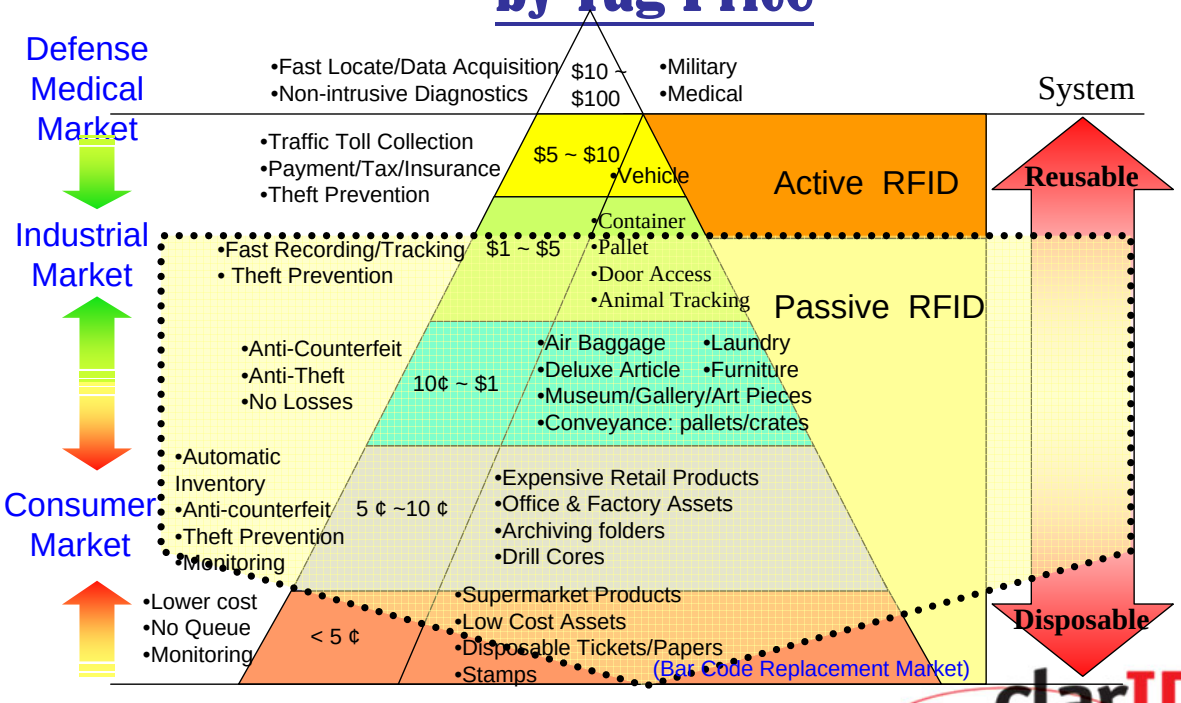


RFID Applications

RFID System Application

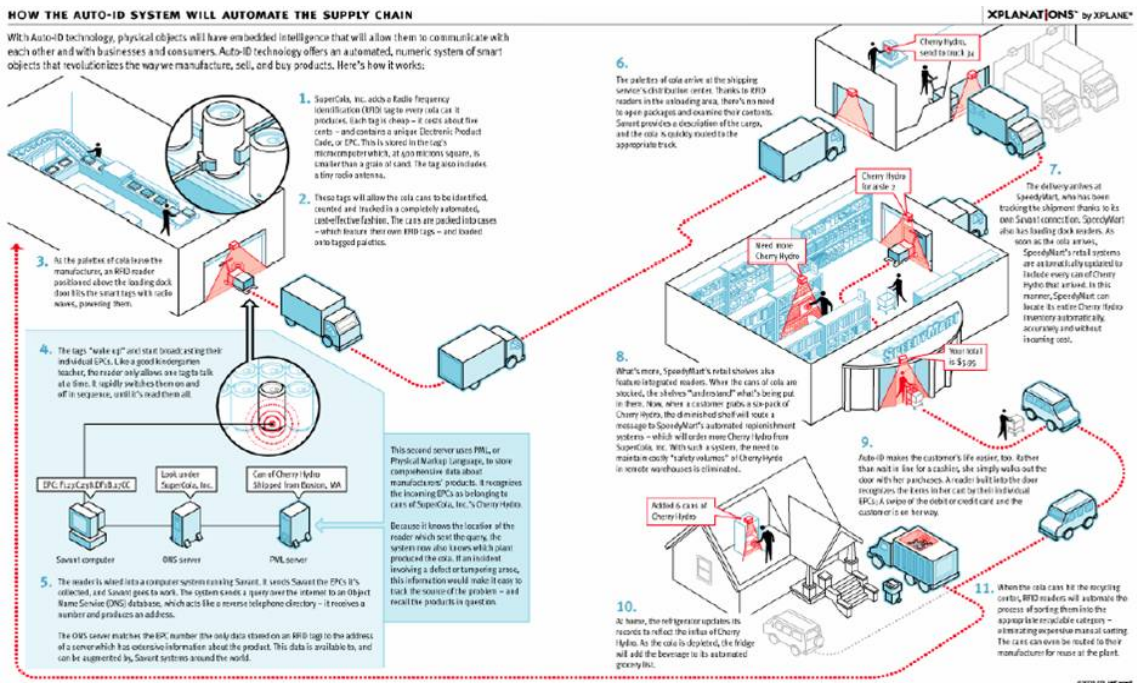


RFID Market Development Opportunities- by Tag Price

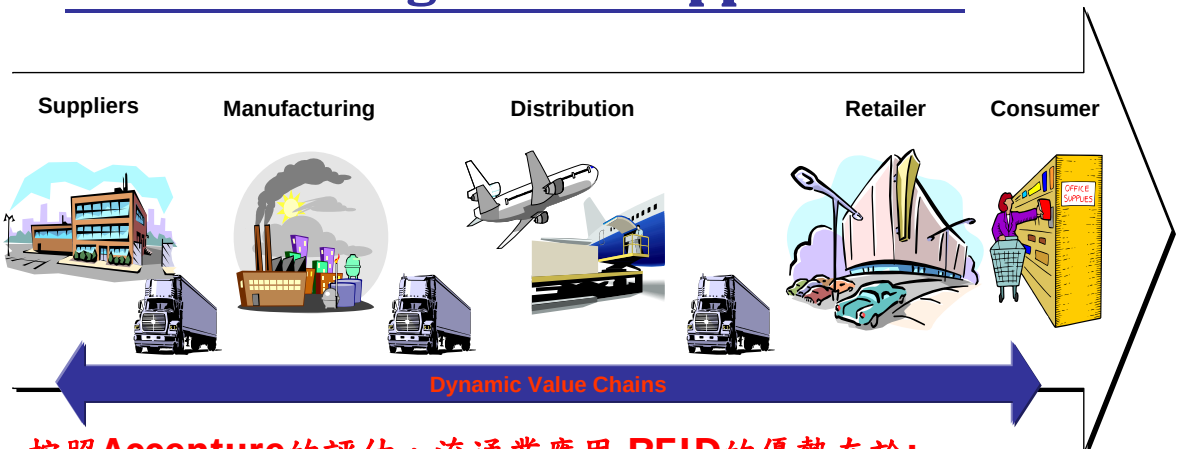


Source:IDTechEx

美國供應鍊（SCM）之RFID應用



RFID Advantage in SCM Applications



按照Accenture的評估，流通業應用 RFID的優勢在於:

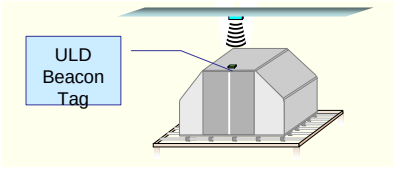
- **可增加企業營收1~2%**
- **可降低企業庫存量10~30%**
- **可降低企業人工成本5~40%**

對全球產值達 US$3600B的流通業具有極大之價值

航空貨櫃追蹤

Tag

Reader



資料來源：SAVI

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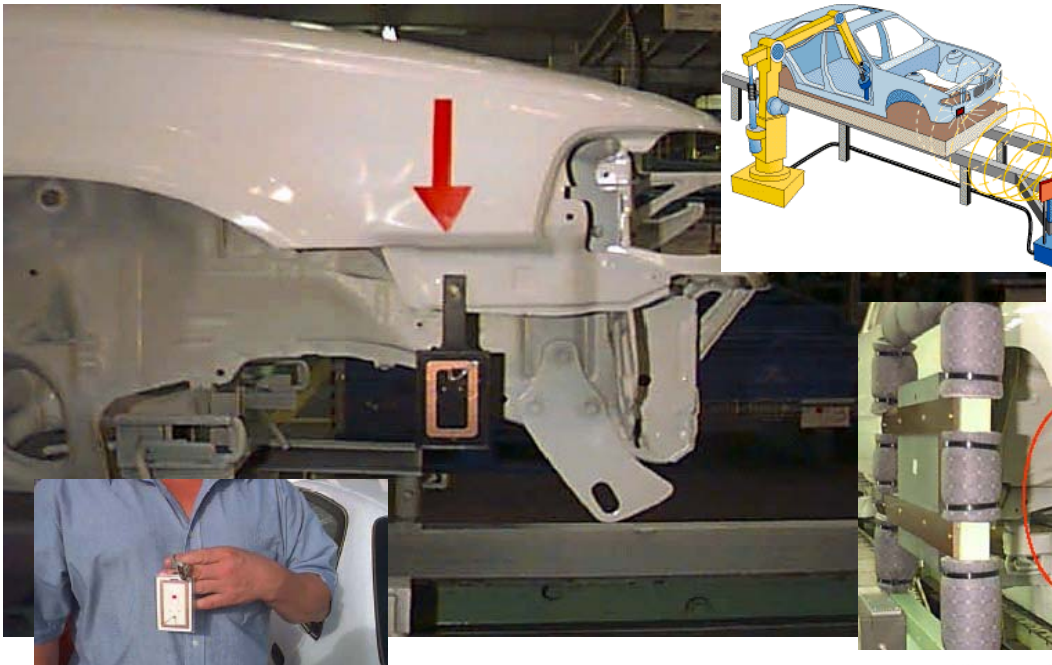
TOYOTA RFID 應用



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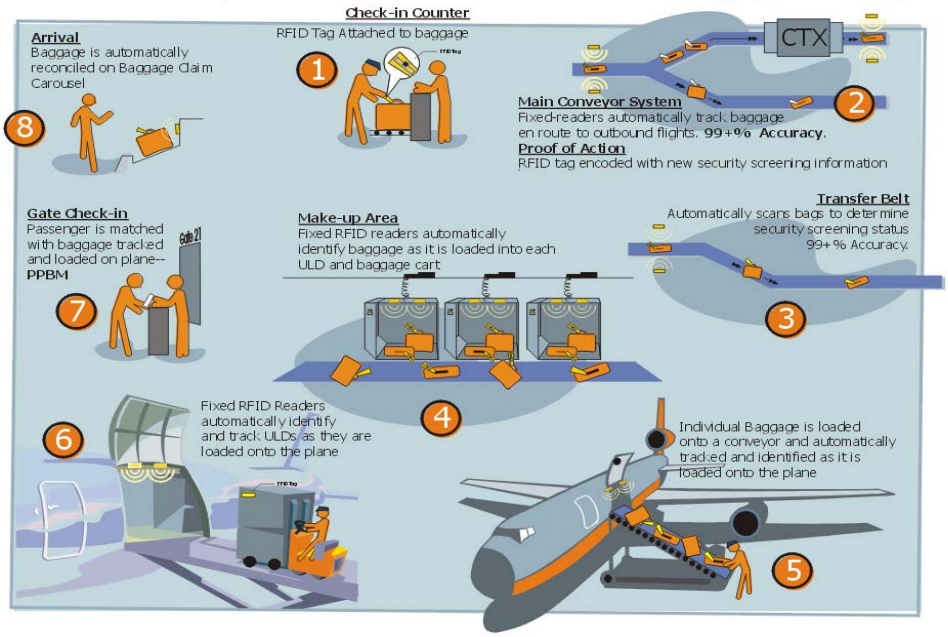
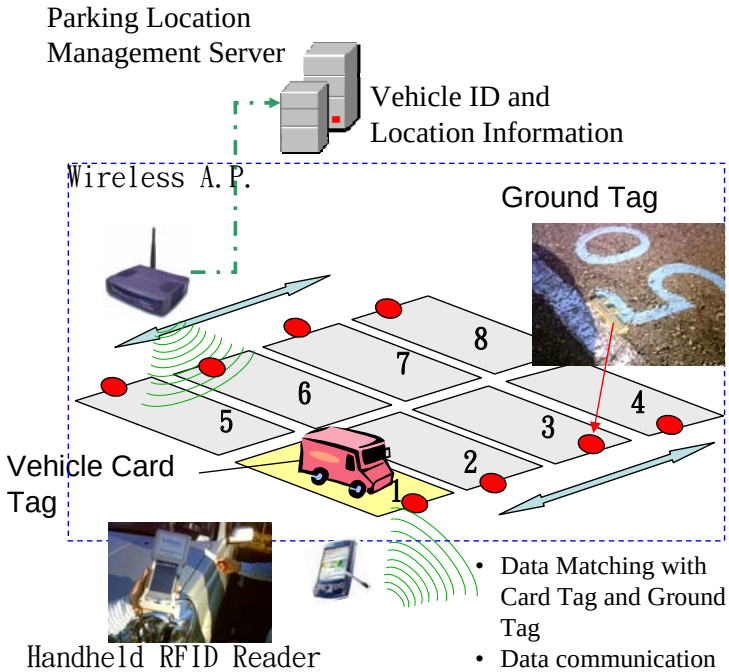
美國航空機場之RFID應用

100% Security Screening and RFID Enhanced Baggage Tracking



UHF Location/Inventory Management System



- Data Matching with Card Tag and Ground Tag
- Data communication with AP Server.

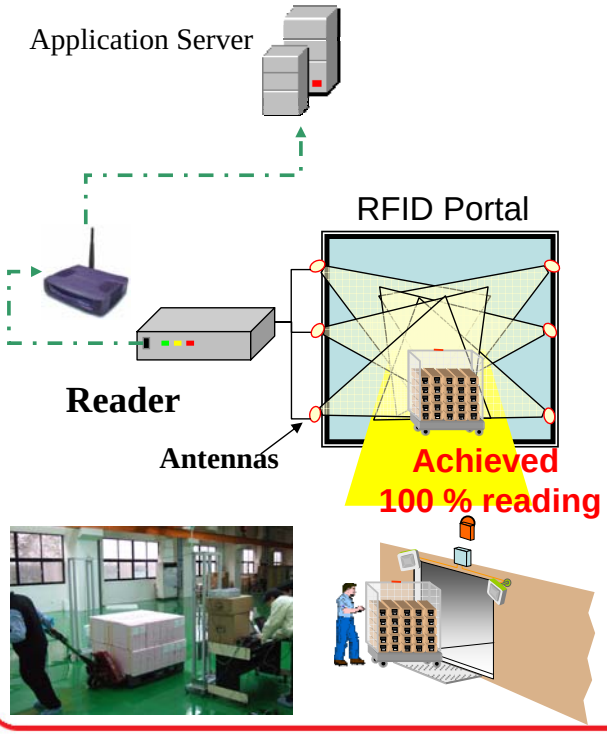
- **Technology:**
  - -EPC G2 card tag and SIT Tag
  - -EPC G2 handheld reader
  - -Positioning/Data Matching application s/w
- **Project Scope:**
  - Application Server
  - Entry site
  - Parking Area
  - -Wireless Infrastructure
- **Application**
  - Access Control
  - Location management
  - Inventory management

Portable UHF Asset Management System

已開發系統功能:

- 財產查詢/列印清冊
- 已/未盤點財產清冊
- 產生異動單據
- 列印異動差異清冊
- 補印標籤清冊
- 盤點異動財產管理
- 盤點報廢財產管理
- PDA同步作業管理介面。

UHF Portal Reader Solution



- **Technology:**
  - Customized EPC G2 tags
  - Multiple Tags Reading Technologies
  - Multiple Antennas Reader
- **Project Scope:**
  - Application Server
  - Access Control System
  - Wireless Infrastructure
- **Application**
  - Access Control
  - Inventory management
  - Box/Pallet Level Tracking
  - Air cargo

Challenges of Global RFID Adoption

Advanced RFID Solutions

RFID Industries

- Variety RFID Products (Frequencies, Power source, Chip memory types and Package types)
- Variety RFID Business Positioning and Approach Strategies
- Variety RFID Applications
- Variety Communication Protocols and Technologies
- Variety Regulations and Standards

RFID Players
•Right Timing
•Right Strategies

RFID Customers
•Right Solutions
•Right ROI

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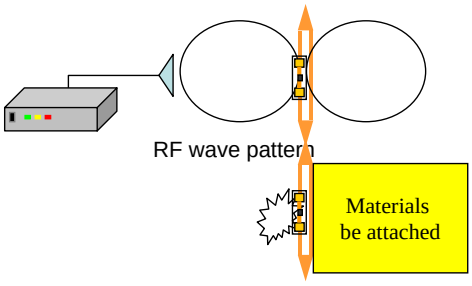
The Promises of RFID Industry

2005	2006	2007
● Some Large Users Had Announced Plans to Adopt RFID in Their Application System: ■ Wal-mart: January 2005 ■ U.S. Dept.of Defense: January 2005 ■ Albertsons: April 2005 ■ Target: Spring 2005	● Is RFID Losing Momentum? ■ The prices of hardware aren't falling quickly enough ■ The middleware and applications aren't developing quickly enough	● New Innovative Technology Converging! ■ Mobile Phone ■ Wireless ■ Security ■ Payment ■ Sensor Network

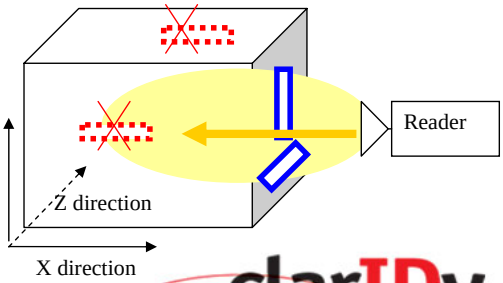
Technology Challenges

How to Achieve **High-Speed, Multiple-Tags Reading** for a 100% Read Rate.

- **Material effects on Antenna Power Pattern**
  - Reflection / Refraction
  - Absorption (loss)
  - Dielectric effects (detuning)
  - Complex propagation effects
- **Tag Antenna Orientation Affects Radio Wave Reception**
- **Collision Caused by Simultaneous Radio Transmission**



Perpendicular to reader antenna

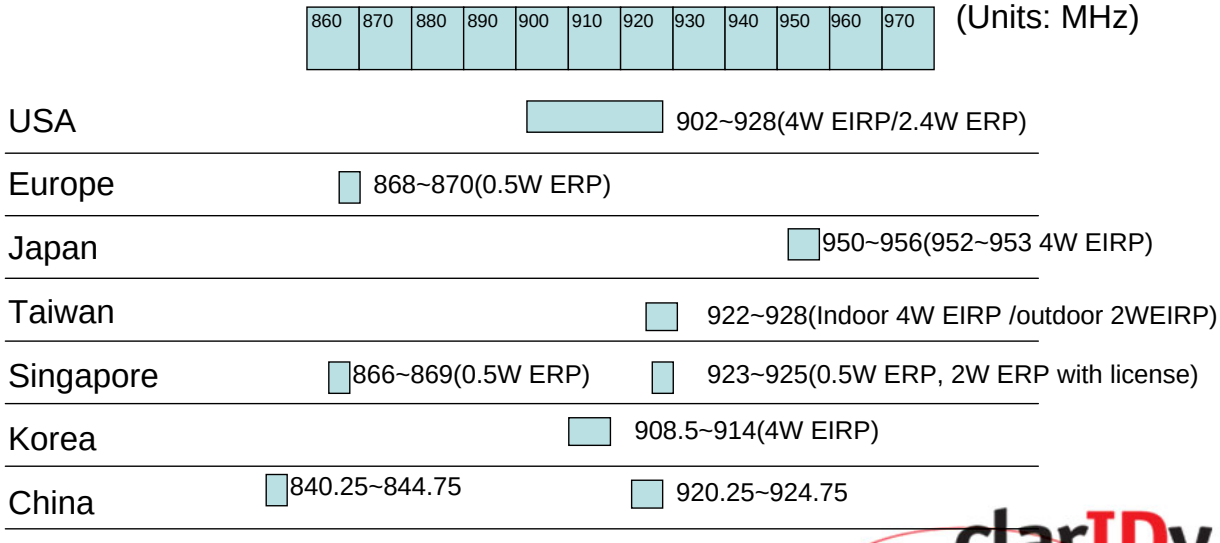


Standards Challenges

- **Advantages of Developing International Standard**
  - Interoperability among tags and readers
  - Interoperation across nations
- **Lack of a Unified International RFID Standard**
  - EPC(C0/C1/C2 G1,C1G2)
  - ISO-18000-6 Type A,B,C
  - Ubiquitous ID (class 0 ~8)

Standards Challenges

- **Lack of a Consistent UHF Spectrum Allocation for RFID**



Cost Challenges

- Manufacturing Costs (Based on Industry Marketing Reports - Instat/MDR Dec. 2004, Tag Cost Structure Can Be Broken Down as Follows)
  - Chip: Generally in The Range of $0.25 to $0.35 A piece in Quantities of Roughly 1M to 10 M.
  - Inlay/Substrate with Antenna: From $0.02 to $0.10 and Beyond, Depending on The Size and The Material Used.
  - Assembly: Typically from $0.02 to $0.04.
  - Licensing: Referencing Intermec's Licensing Plan.
- Customization Costs
  - Hardware Certification by Each Country's Regulations
  - Tag Antenna Design
  - Hardware Installation And System Integration

Other Challenges

- **Infrastructure Challenges:**
  - Cross International Borders
  - Cross Multiple Entities from the beginning to the end in SCM
- **Barcode to RFID Migration Challenges**
  - Increasing demands on system capabilities and compatibilities
  - Increasing costs on maintenance and operation of both systems.

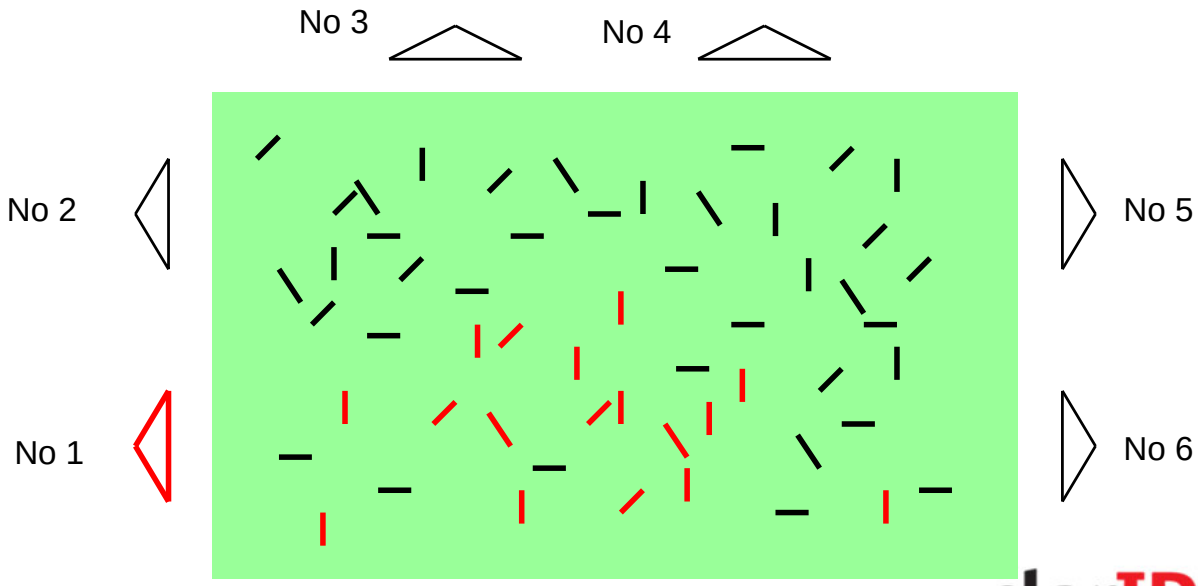
RFID Development Trends

Resolutions to Technology Issues

- To achieve 100% read rate reliability:
  - Customizing the tag antenna design
    - Item level antenna
    - NFC UHF antennas for fluid and metal material goods applications
  - Installing multiple readers/antennas to solve tag orientation issue.
  - Developing multiple tag reading technology
  - Developing ‘sleep’ enabled function-Solving redundant data, etc.

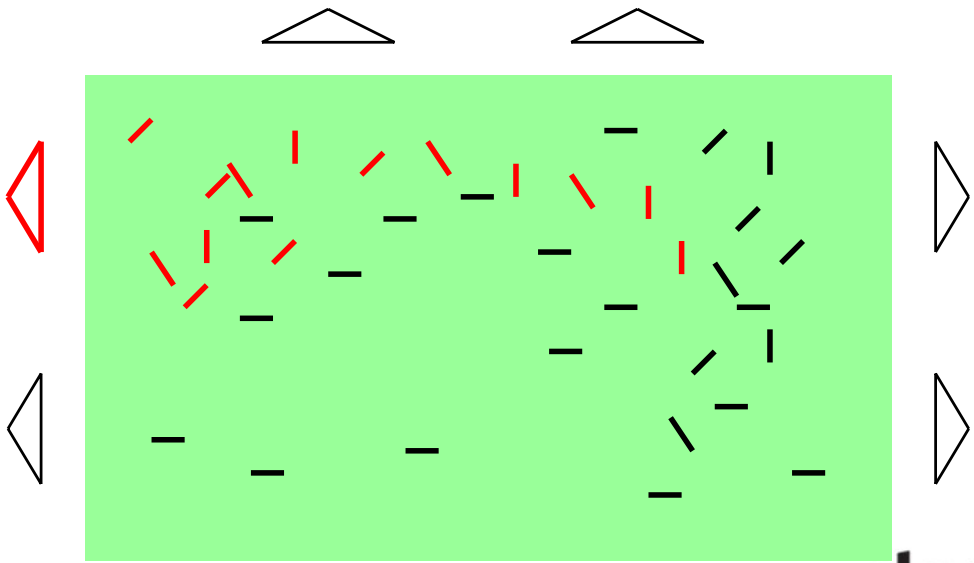
Deep Sleep Function

Tags Passing Through Portal 1 17



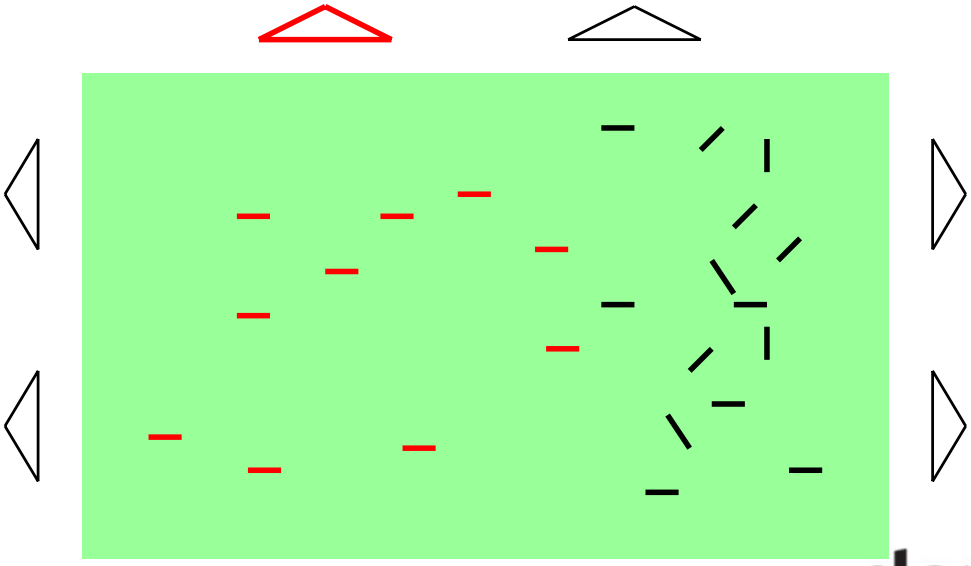
Deep Sleep Function

Tags Passing Through Portal 2 14



Deep Sleep Function

Tags Passing Through Portal 3 10



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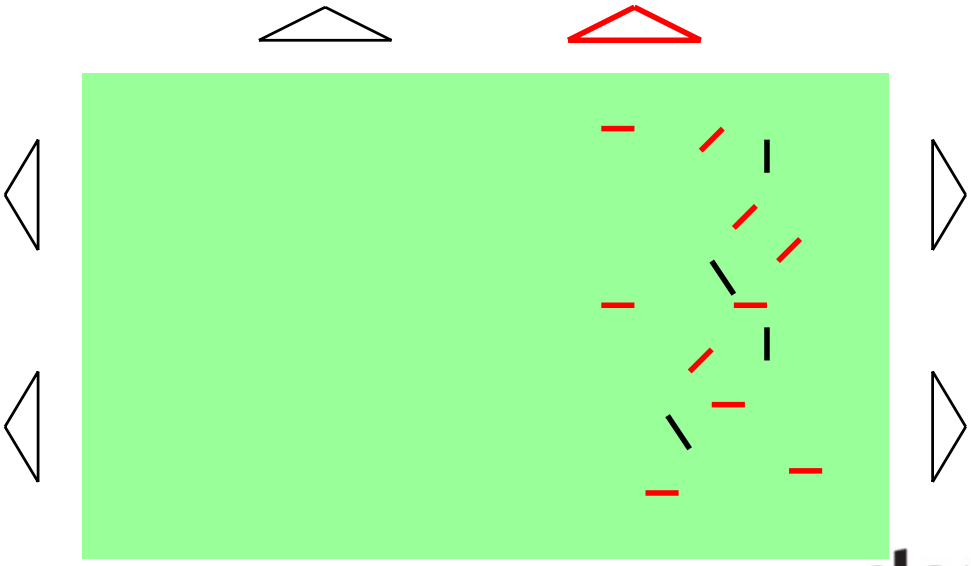
Deep Sleep Function

Tags Passing Through Portal 4 10



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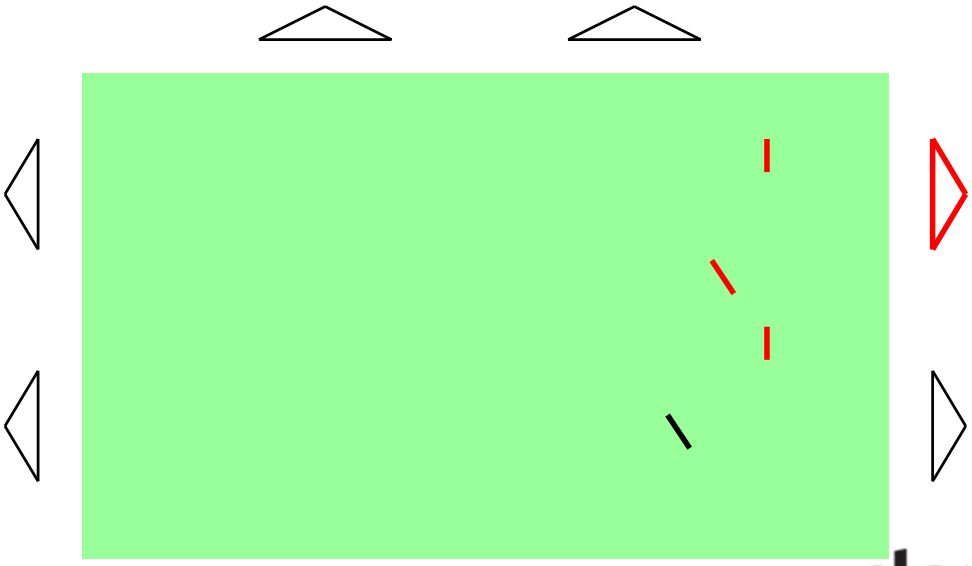
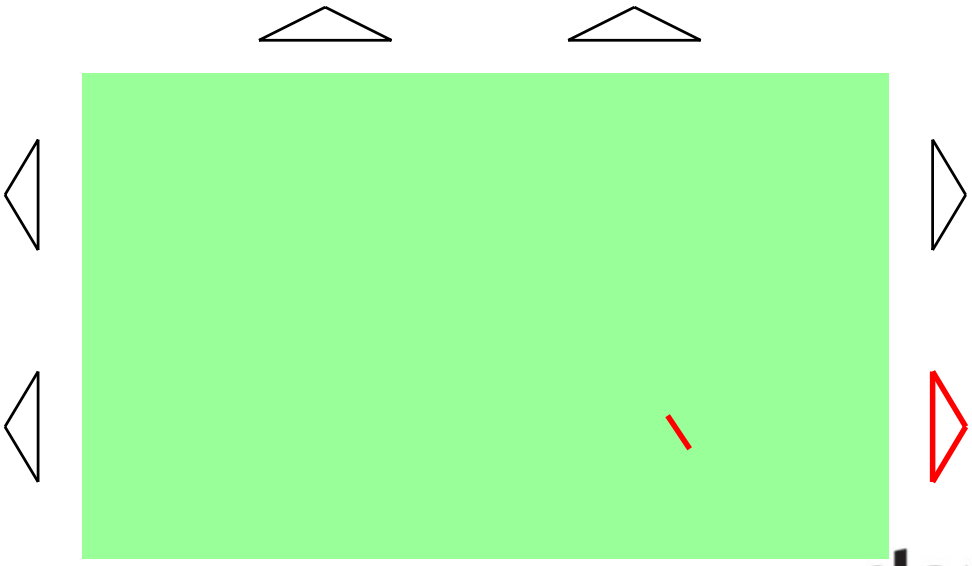
Deep Sleep Function

Tags Passing Through Portal 5 3



Deep Sleep Function

Tags Passing Through Portal 6 1

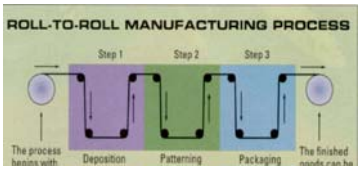


Resolutions to Standards and Regulatory Issues

- Working out national regulations and open enough spectrum for RFID industry.
- Developing Compatible Technology.
  - Broadband RFID chip with broadband antennas
  - Multiple protocol readers

Resolutions to Cost Issues

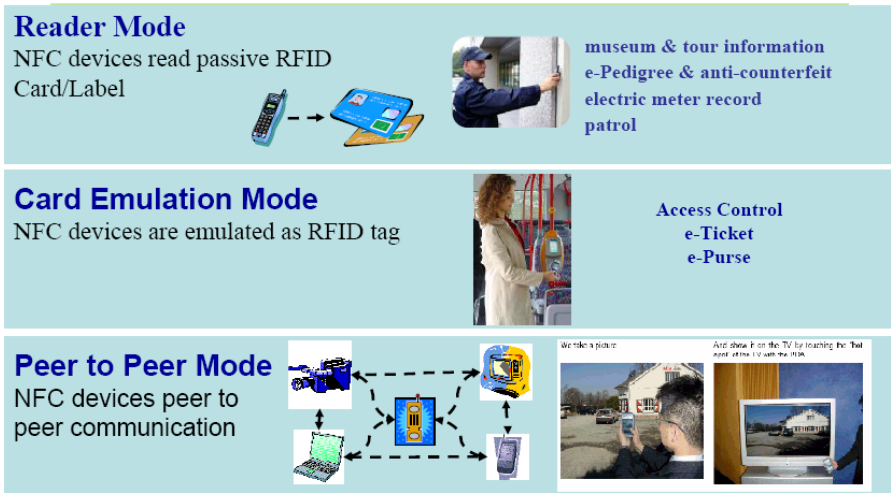
- Reduce chip size
  - Chip size down to .5mm
- High throughput and yield rate assembly/package equipment development
  - Pick-and-place assembly
  - Vibratory assembly
  - On-wafer processing
  - Fluidic self assembly (FSA)



- High throughput antenna printing equipment
  - Printing antenna

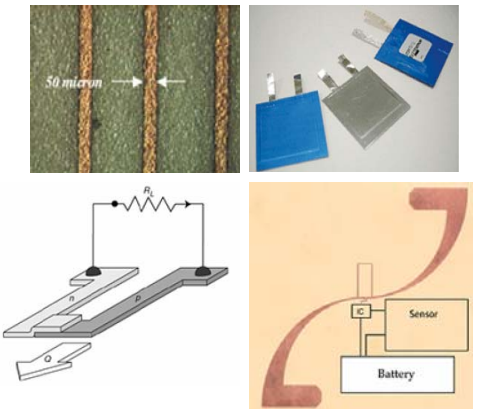
Developing Innovative Technologies 1

- NFC (Near Field Communication)



Developing Innovative Technologies 2

- Nano Printing Technology
  - Inkjet Printing Technology
  - Thin Film Batteries
  - Integrated Sensors
    - Thermo Sensor
    - Tire Sensor, etc.



Source: Athena Group,2007/11

Case Study : RFID In Vehicle Tracking Applications

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ADVANCED RFID SOLUTIONS

Advanced RFID Solutions

Available Tag Technologies

Passive Tag:

- Card Type Tag: 13.56GHz/ UHF
- Metal Tag: UHF
- Anti-Counterfeit Tag: UHF
- Glass/Windshield Tag : UHF

Autoglass Tag
Up to 8m (13x90mm)

Linear Autoglass Tag
Up to 8m (4.8x140mm)

Active Tag:

- 2.45GHz (Battery inside)
- 433 MHz (Battery inside)

Active Tag

Glass Tag

Metal Tag

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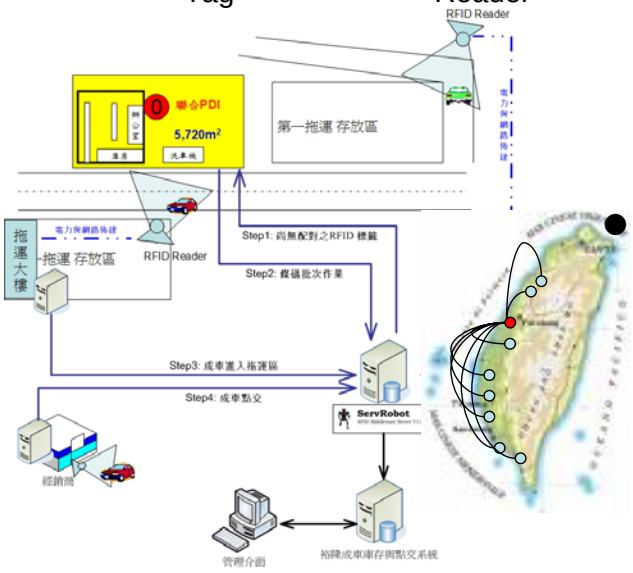
Vehicle Tracking Solution and Deployment

Tag

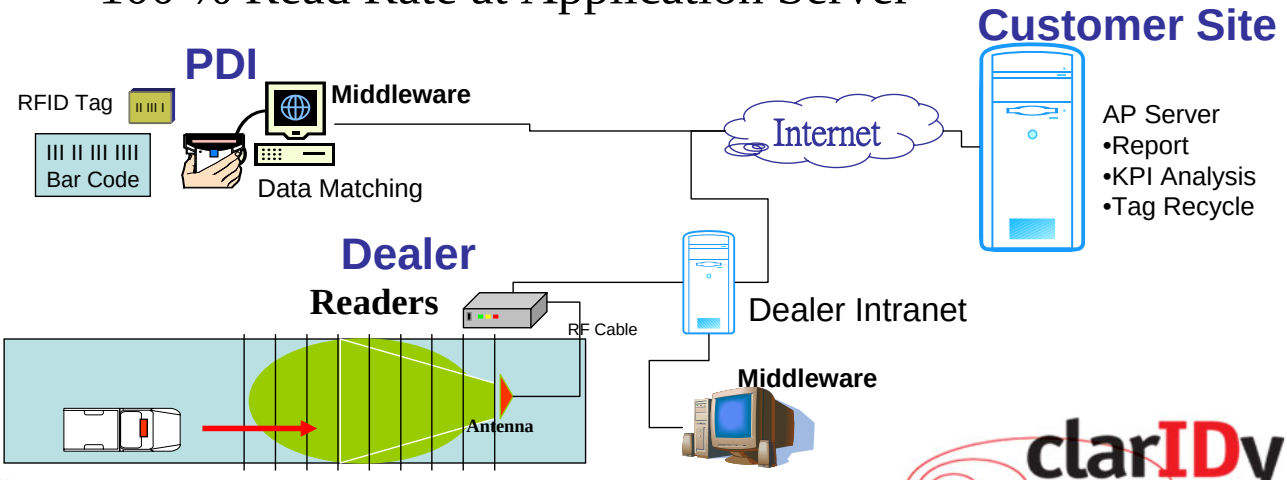
Reader



- **Technology:**
  - 2.45 GHz active RFID solution.
- **Project Scope:**
  - Application server
  - Site I: Tag initiated
  - Site P: Parking area
  - Site D: to 8 dealers
  - Site R: Recycle tags
- Application
  - New car logistic tracking (I-P-D-R)
  - Parts vehicle logistic tracking (R-D-R)
  - KPI of logistic management

Basic RFID Requirements for Vehicle Tracking

- Long Range Reading Distance: up to 40 m
- Moving Speed: up to 60m/hr
- Read Direction: One way (In)
- 100 % Read Rate at Application Server



Challenges for RFID Deployment of Vehicle Tracking System

- Technology Issue
  - Tag Battery (Response period< 2 sec, Battery life detection)
- Infrastructure Issue
  - Unstable network (Intranet and Internet)
  - Security data and IT environment (Virus and hacker protection)
- Management Issue:
  - Middleware/PC closed after work
  - Poor training for driver and user (Limited target vehicles and paths)
  - Poor incentives for participators (Individuals resistance)
- Customer's Expectation Management
  - Limited budget and economic scale in the Pilot Phase
  - Moving test criterion (Tag location, attached material and system environment)

Conclusion and Recommendation

Major RFID Product Development Trend

clarIDy's Developed Products

Phase 1 (~2003)	Phase 2 (2003~2005)	Phase 3 (2005~2006)	Phase 4 (2006~Future)
Read Only RFID	Read/Write RFID	Sensing USN	Networking USN

Identifying Product Code
- Passive Tag
- 96 bits UID
- Label/Card package

Tracking the origin
- Passive Tag
- 1 k R/W memory
- Write Protection
- Tag Customization

Sensing & Control
- Sensing Tag
- Sensor Function Interface
- 2 k R/W Memory
- Security
- Tag Customization
- Longer Read Distance

Broadband peer to peer communication
- Communication Tag
- Sensor Function Interface
- 2 k more R/W memory
- Security
- Tag Customization
- WiFi interface
- Positioning

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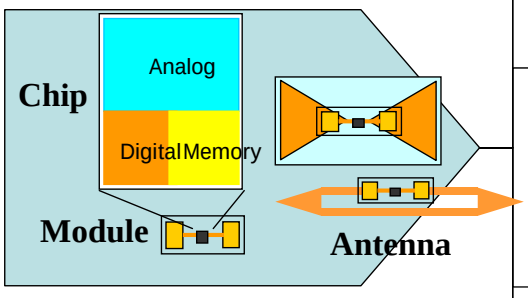
RFID Chip/Tag Development Trends

Sensors,Power,E-paper



RFID Tag

- Standardization (ISO18000, EPC)
- Cost reduction/ Down size
- Common design
  - -Frequency independent chip (13.56, 868, 915, 950, 2450MHz)
  - -Universal module/tag
- Function improvement
  - -Increasing memory
  - -Increasing data rate
  - -Power saving
  - -Increasing read distance
  - -Multiple commands(security，anti-collision, binary search, sleep, Kill .etc.)
- Convert with App. -Barcode labeling, ISO card
- Integration with sensors
  - •Temperature,pressure,light,moisture,weight, chemical,biometrical

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Developing Potential Solutions

- Far Field Communication RFID Solutions
  - Zigbee RFID/Sensor Solution
  - UHF Active RFID/Sensor Solution
  - WiFi Active RFID Tag Solution
- Near Field Communication RFID Solutions
  - NFC UHF Item Level Tag (include of liquids material and metal surface application)
  - NFC Mobile Phone and Application Solutions
- New Innovative Technology Development
  - Nano Printing

RFID System Requirement Analysis

Tag
-Pa/Ac
-Read Range
-R/O ID
Reader
-Read range
-Read/Write
Demo S/W

P.O.C. Phase

Tag
- Attached Materials
- Tag Orientation
- Read Range
- R/W Memory
- Speed
- Label/Assembly Type
- Multiple Tags Reading

Reader
-Read range
-API
-Multiple Antenna
-Antenna type

Application System
- Application S/W
- Middleware

Pilot Phase

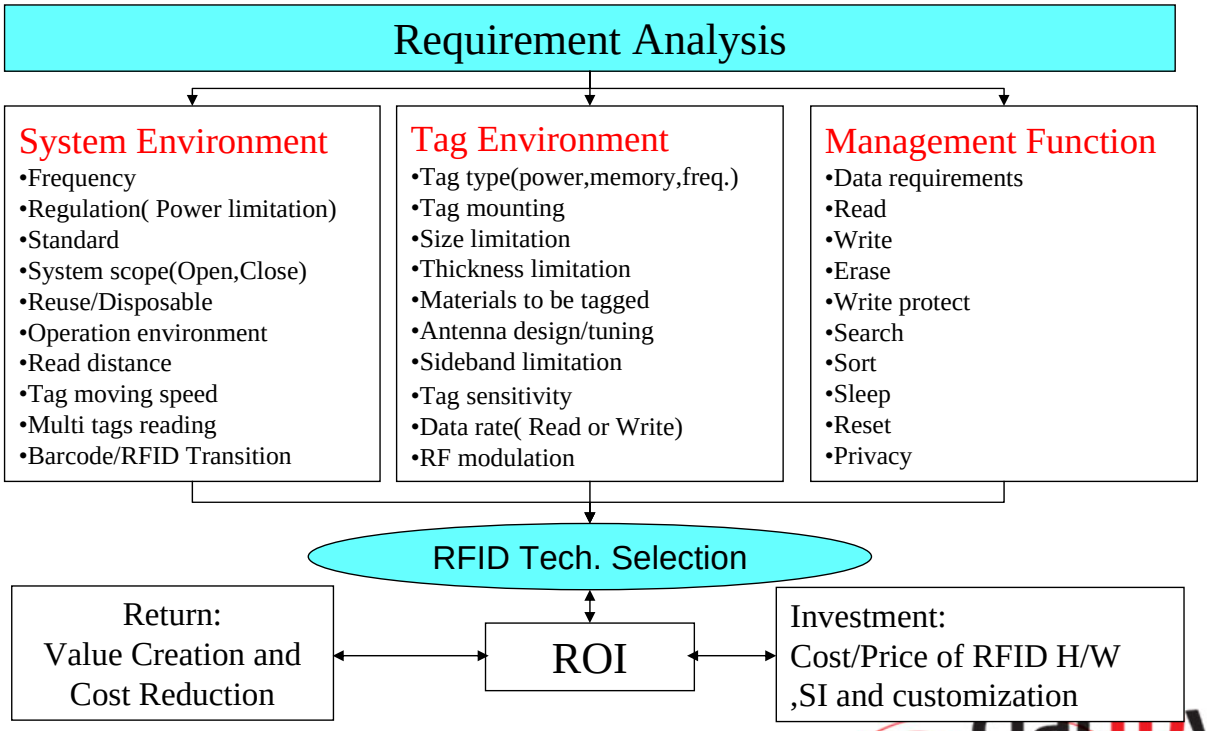
Tag
- Customization
- Item Level Tagging/Mounting
- Cross companies/ Countries
- Wide Band Antenna
- Low Cost/Yield Rate
- Anti-counterfeit/ Security
- 100% Read Rate

Reader
- Multiple Protocols
- Dense readers Mode
- Cross-Regulation
- Communication Interface

Infrastructure
- System architectural
- Application System Integration
- System Migration
- Networking
- Security

Deployment Phase

Tag Selection Strategies for RFID System



System Deployment Recommendations

- Stand Alone Applications First
  - To understand the technology limitation
  - To understand the real requirement in application system
- Pallet or Carton Level Tracking First
  - To establish successful pilot experience
  - To learn how to use the RFID technology step by step.

RFID Solution Development Recommendations

- Know real “RF” Requirement in the Application Environment.
- Learn From Foreign Strategies and Experience and Cooperate with the Right RFID Strategy Partner in RFID Value Chain.
- Focus and Take a Lead in One or Two Advantage Applications.
- System Engineering Approach.

Thank You Very Much.

Ph D. Nienchu Wu

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