Dr. Erick C. Jones, PhD, PE, CSSBB
University of Texas at Arlington
RFID & Auto-ID Deployment (RAID) Labs

420 Woolf Hall, Arlington, TX 76019
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September 12th, 2011

Presentation Outline

- Who We Are
  - Presenters Background
  - RAID Labs
    - Future I/U CRC
    - Previous Research
  - Current Research
    - NSF IRES
    - RFID in Healthcare
- Questions

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Industrial Experience

- Industrial Experience (10 years)
  - Companies: UPS – Industrial Engineer Specialist
  - Academy Sports – Industrial Engineering Manager, Director of Engineering, Interim Director of Operations
  - Tompkins Associates – Senior IE Consultant, Project Manager
  - Arthur Anderson, LLP – Executive Manager
- Worked with, managed, and directed engineering teams to execute business goals and make profit
- Led operations with over 300 personnel
- Worked with C-level executives to design and implement complex systems and strategies

Academic Background

- Education
  - Texas A&M B.S. Industrial Engineering
  - University of Houston MS and PhD Industrial Engineering
- Academic Appointments
  - University of Nebraska-Lincoln, Assistant Professor
  - University of Nebraska-Lincoln, Associate Professor
  - University of Texas Arlington, Associate Professor
- Research Positions
  - University of Nebraska-Lincoln, Director – RFID Supply Chain Lab
  - University of Nebraska-Lincoln, Director – Transportation Logistics Lab
  - National Science Foundation, Director – Centers for Engineering and Logistics Distribution Nebraska Site
  - University of Texas Arlington, Director – AutoID
  - University of Texas Arlington, Director - RFID Labs

Academic Awards

- Research, Teaching and Service Awards
  - Innovative Use of Instructional Technology Teaching Award, 2007
  - College of Engineering Teaching Award Assistant Professor, 2007
  - College of Engineering Service Award Assistant Professor, 2006
  - College of Engineering Research Award Assistant Professor, 2006

- Other Awards
  - Alfred P. Sloan Underrepresented Minority PhD Program Fellow, 2001
  - NACME Undergraduate Award, 1990, 1991, 1992
  - Presidential Achievement Award (Undergraduate), 1988-1992

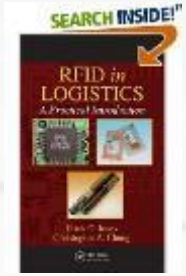
NACME

National Appointments

- Current
  - Fulbright Specialist Grantee/Academic Leaders Program – Queretero, MX
  - Accrediting Board for Engineering and Technology (ABET) Program Evaluator (PEV)
  - Alfred P. Sloan Minority PhD Program Director
  - International Supply Chain Education Alliance (ISCEA) RFID Certification Program Board Chair
  - ISCEA International Technology Committee Board Chair
  - Editorial Board International Journal of Six Sigma and Competitive Advantage (IJSSCA)
- Previous
  - Previous National Science Foundation I/UCRC Center Site Director
  - University of Nebraska's Certified Six Sigma Black Belt Program Chair/PI
  - University of Nebraska's Logistics Certification Chair/PI
  - Institute of Industrial Engineers (IIE) Senior Chapter President (Houston) – 3 years
  - IIE and National Society of Black Engineers (NSBE) Undergraduate Advisor
  - ASEE Engineering Management former Chair, Program Chair, Secretary

Research Highlights

- Funding
  - Over $3.06 million in research awards
  - Articles and Books
  - **2 co-authored textbooks**, 1 edited industry certification book, and 46 conference and speaking transcripts
  - Published 79 transcripts of which 20 were peer reviewed journals, 5 magazine publications, 1 textbook chapter,
- Advised and Graduate over 42 Students



Dr. Erick C. Jones, PhD, PE, CSSBB
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RFID & Auto-ID Deployment (RAID) Labs

Introduction to Radio Frequency Identification & Auto-Identification (RAID) Center

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September 12th, 2011

Introduction

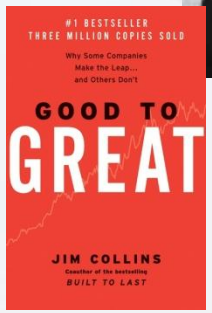
IMSE THE DEPARTMENT OF INDUSTRIAL & MANUFACTURING SYSTEMS ENGINEERING

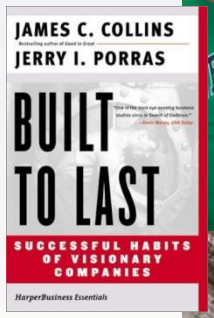
THE UNIVERSITY OF TEXAS AT ARLINGTON

The University of Texas at Arlington's College of Engineering provides one of the most comprehensive engineering programs in North Texas and the nation, with eight baccalaureate programs, 13 master's and 9 doctorates. It is the fourth largest engineering college in Texas, with about 3,900 students

RAID Labs Team "The Best in the World"

- Faculty
  - Dr. Erick C. Jones (Director)
  - Dr. Richard Billo
  - Dr. John Priest
- Post Docs
  - Dr. Vettrivel Gnaneswaran
- Phd Students
  - Maurice Cavitt
  - Gowthaman Ananthakrishnan
  - Shernette Kydd
  - Restu Sunarto
- **MS Students**
  - Hamid Ghorashi
- **Undergraduates Students**
  - Juan Robles
  - Chidebe "Stanley" Ugoji
  - Mohammad Siddiqui

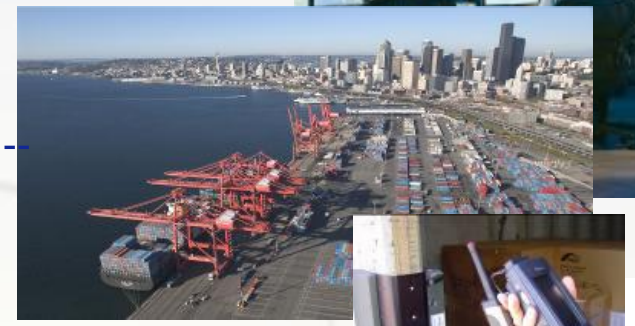




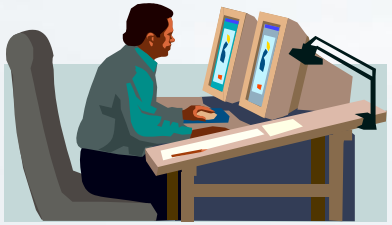
Research Vision

Everything Will be Tracked Wirelessly in 10 Years

- **Every Conveyance and Mobile Asset Will be Tracked Using Some Type of Automatic Identification and Data Collection Technology (AIDC)**
  - Connect People with Things
  - Interoperable Networks Leveraging Bar Codes, Passive and Active RFID, GPS
- **Networks Will Be Integrated with Complete Solutions, Services and Apps**
  - RFID is the Technology Enabler within the Network
  - Once Networks are Deployed, 'Push Button' Solutions Linked with Asset Management and Security Software Apps Will Provide Greater Decision-Making
- **Dynamic Management of Supply Chains**
  - Tracking Conveyances and – by Association -- Their Contents (Inventory)
  - RFID's Real Value is Tracking and Securing Assets End-to-End – Not just within The four walls or point-to-point



Research Vision

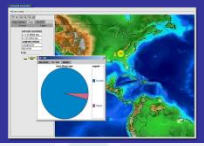


Web Based Services

Alert Services

Data Services

The Internet of Things



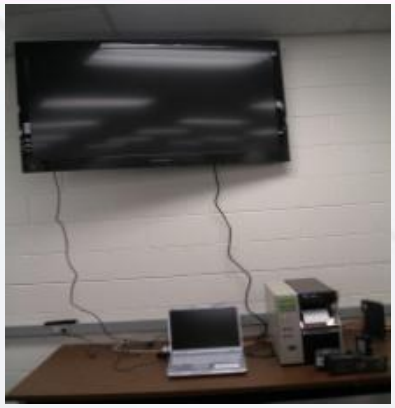
RAID (RFID & AutoID) Labs Goals

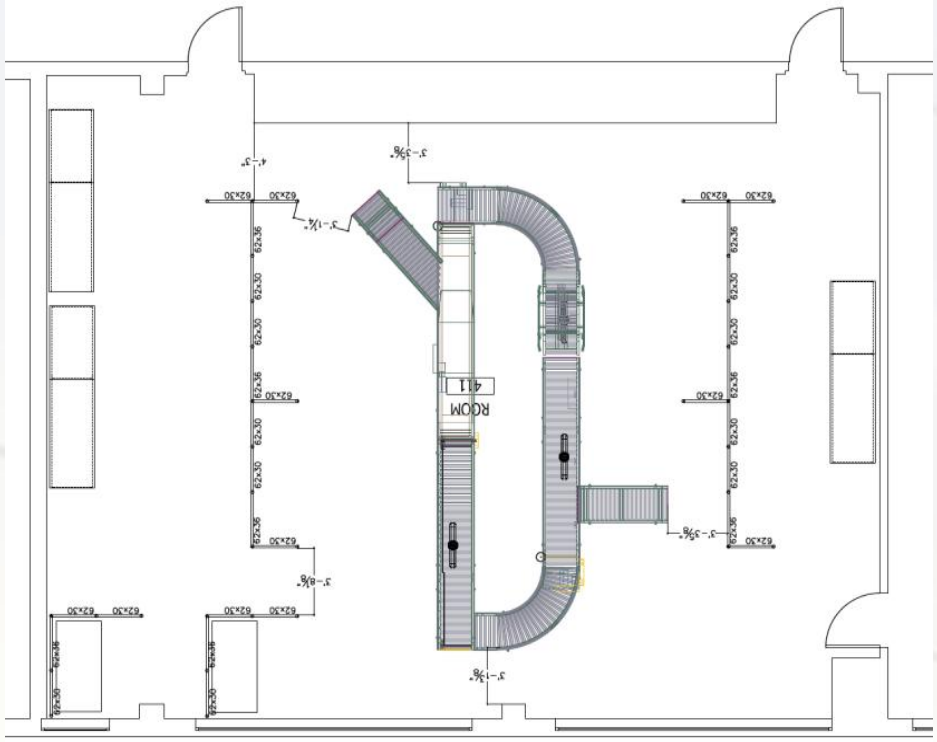
- Facilities:
  - RFID Lab - Room 411/413 Woolf Hall
  - AutoID Lab - 309-Engineering Research Building
- Mission:
  - *"Providing integrated solutions in logistics and other data driven environments through automatic data capture, real world prototypes, and analysis"*
- Objective:
  - *Attract Recognized Funding from notable federal agencies and nationally recognized organizations*
  - *Provide a research facility that inspires future STEM researchers from K-12 and undergraduate students*
  - *Attract national attention from academic rankings and research recognition*

RFID Lab Facilities

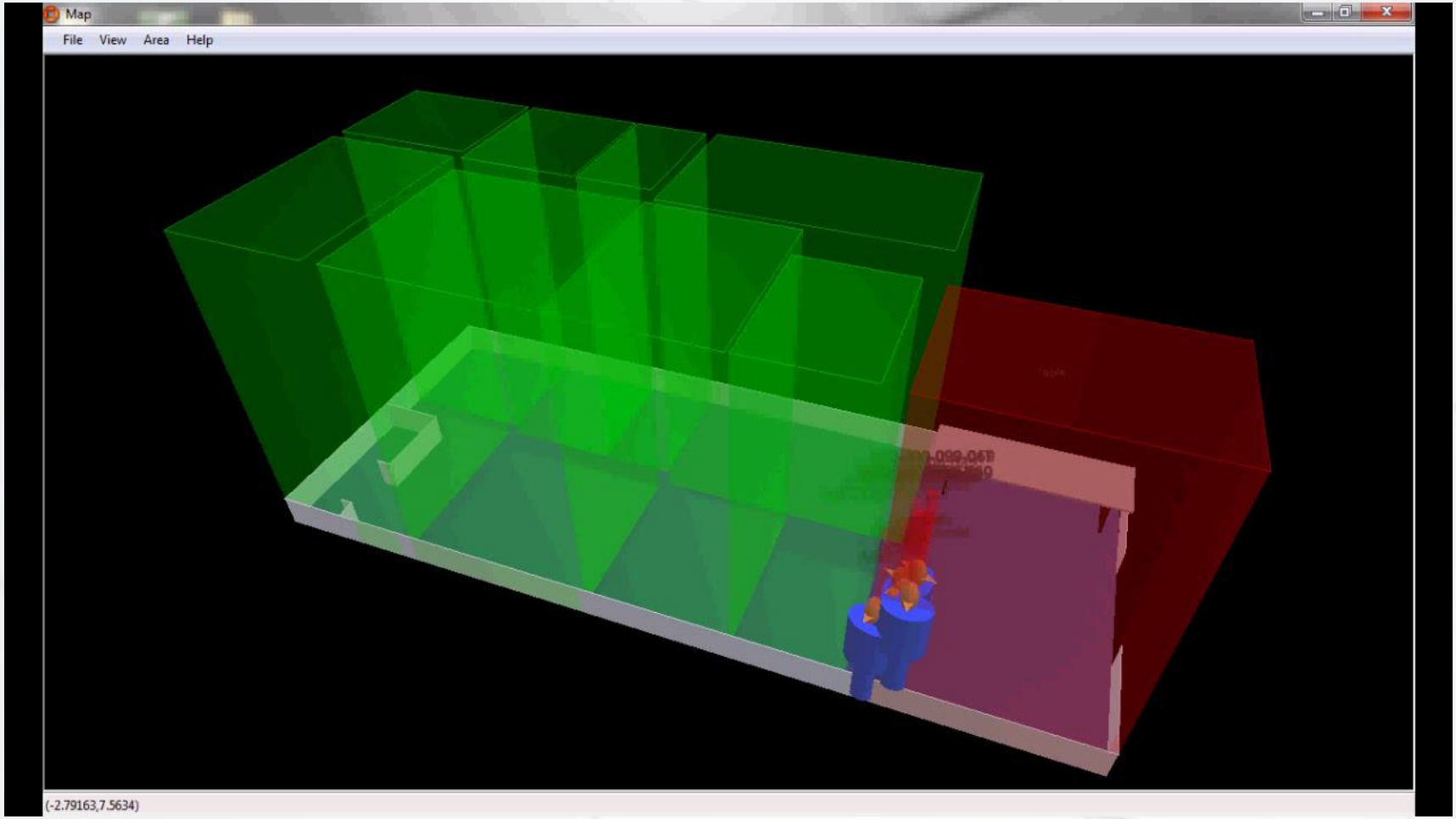
Equipment/

- Military grade Fixed and Mobile Active RFID Systems (Savi technologies, RF Code)
- Industry grade high speed automated conveyor (Hytrol conveyor)
- Industry recognized RFID edgeware, ERP and WMS systems, (Global Concepts)
- Walmart/DOD mandated standard fixed and mobile passive RFID systems (Alien Technologies, Matrics)
- Hospital tracking location systems (Ubisense Ultra Wide Band Real Time Location System)
- Automated locks with MavID

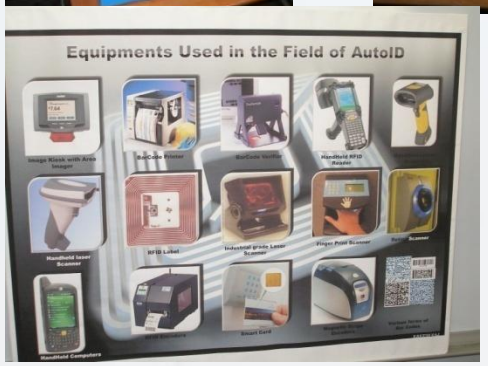




RFID Lab Facilities Real-Time Location Tracking



AutoID Lab Facilities

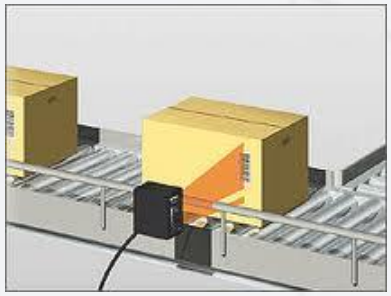


Equipment/

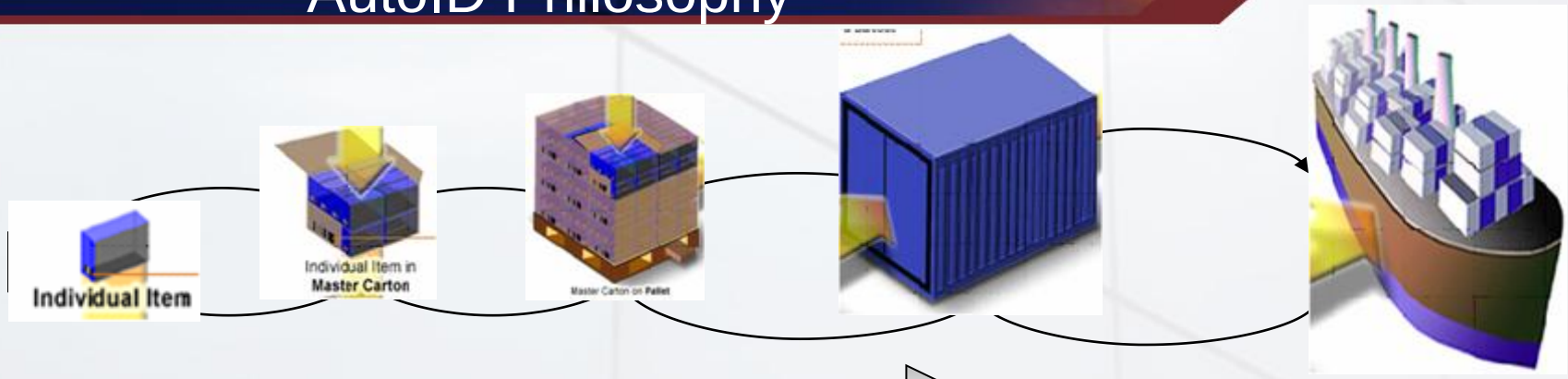
- Barcode Readers
- Optical Character Recognition
- Satelitte Tags
- 2-D Barcode Etching Machines
- Industrial Antenna enclosures

Types of Automatic Data Capture Technologies

- RFID
- Bar Codes (Linear/2D Barcodes/UID)
- GPS
- Satellite tags
- Smart Cards
- Biometrics (fingerprint, facial, iris, palm)
- Contact Memory Buttons
- Optical Memory Cards



AutoID Philosophy



Increasing net value

Barcode

Passive RFID

Active RFID

GPS & SATCOM

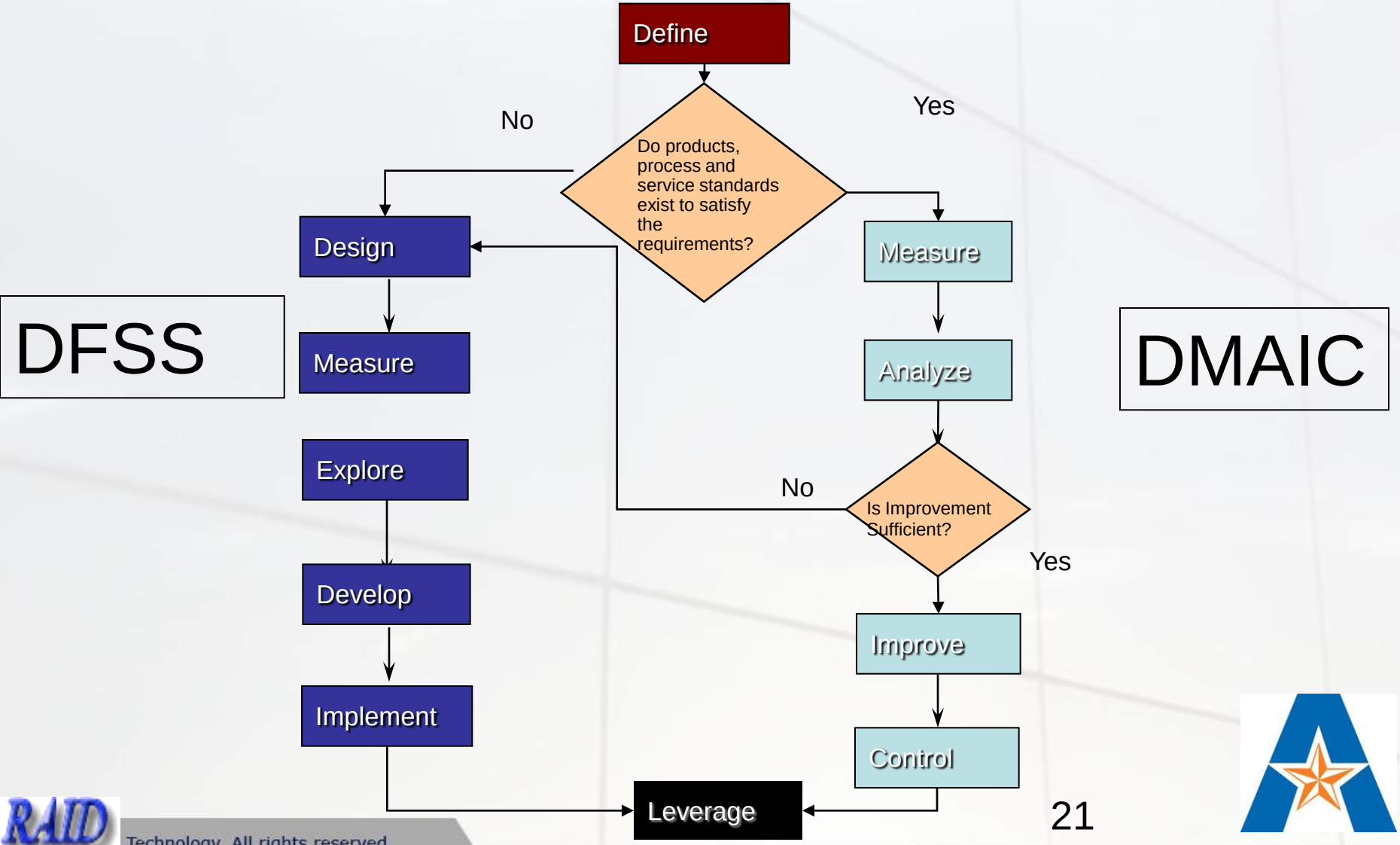
Increasing net investment

Similar nesting for:

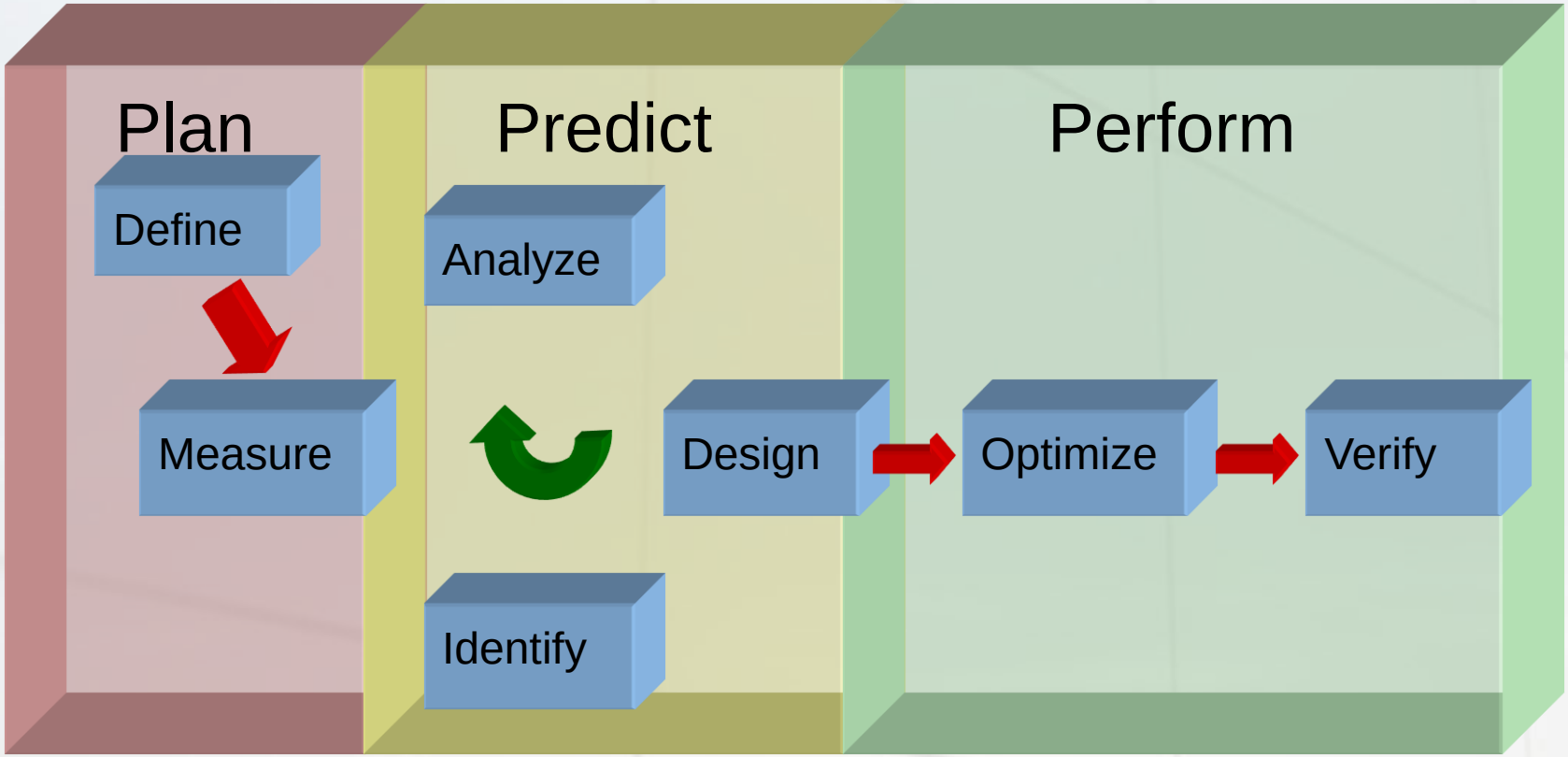
- Retrograde
- Manufacturing, kitting, assembly
- Remanufacturing, disassembly, demilitarization

Design Six Sigma- Research

Our lab uses a modified Six Sigma Communication Strategy



DFSS-R , Research Methodology



Future NSF Industry/University Center

- National Science Foundation sponsored Industry/University Cooperative Research Center

- Create a new collaborative multi university research center in Radio Frequency Identification (RFID), Automatic Identification, Material Handling Systems Engineering, and Security (RAMHSES)
- **Industry Partners are the key** – Let me know of interest
- *Importance*
  - *Our Research is Based Upon solving Real-World Operational Problems that required Industry Buy in and investment*

Procurement & Logistics Previous Projects

- Procurement & Logistics
  - Grain Terminal Supply Chain Network Analysis for reducing minimizing procured costs and auctioning effect of a Co-Op
  - Strategic Procurement Strategies for Centralized Procurement to reduce Obsolete Inventory for Large City Material Management Group
  - Predictive modeling of City's Materials Management Branch Commodities to Optimize Procurement Pricing
  - Evaluating plant transportation to prevent Plant closing
  - Attracting Foreign Manufacturer to move operations domestically
  - Supply Chain Network modeling for a city government
  - Strategic Information Technology Initiatives and Department Re-Alignment
- Engineering Management
  - Predicting Knowledge Worker Job Turnover

Previous Projects

- RFID and AutoID
  - Integrating RFID into Healthcare Manufacturing Plant
  - Cost analysis for implementing RFID in Libraries
  - RFID impact on enforcing the use of collaborated tools at a defense manufacturer
  - Integration of RFID and GIS system for ticket/seat location
  - Applying RFID technology to sports timing in a marathon
  - RFID testing of consumables in NASA Space Center (ISS) storage containers
  - Integration of Animal ID into systems for Cattle Tracking
  - RFID in the Operating Room with surgical tags
  - RFID in Construction
  - RFID economics of automated checkout for retail companies
  - RFID for Roadside Safety
  - Imbedded RFID License Plates
  - Right of Way Underground and Above Ground RFID tags for property disputes
  - Automated sensing RFID systems for location of inventory for Astronauts on current and future missions
  - Evaluation of RFID for linear roadside assets

Current Projects

RFID and AutoID

- Intelligent Environments for Large Cities
- NASA Game Changing Science and Technologies
- Cost reduction of tags through micro manufacturing process design for Health Care Drug Delivery for dosage level samples and ingestible Bio enabled pills
- NASA Gen 2 RTLS
- RFID Reader for WMS direct to Cloud (CiC)
- NSF International Research Experiences in Science for undergraduate students in Mexico
- I/UCRC Planning Research Center for Automatic Identification Technology

NSF IRES Mexico Student Projects

- The IRES Program in Mexico will consist of an intensive **six-week** research program comprising a series of activities for students
- These activities have been planned to engage students in the context of an international research experience preparing them for a future in global cooperation. The basic activities of the summer research experience are:
  1. Pre-trip and on-site orientation;
  2. International language instruction;
  3. Research methods seminar;
  4. Graduate student development seminars;
  5. **Field research projects**;
  6. Oral and written presentations; and
  7. Assessment and evaluation.

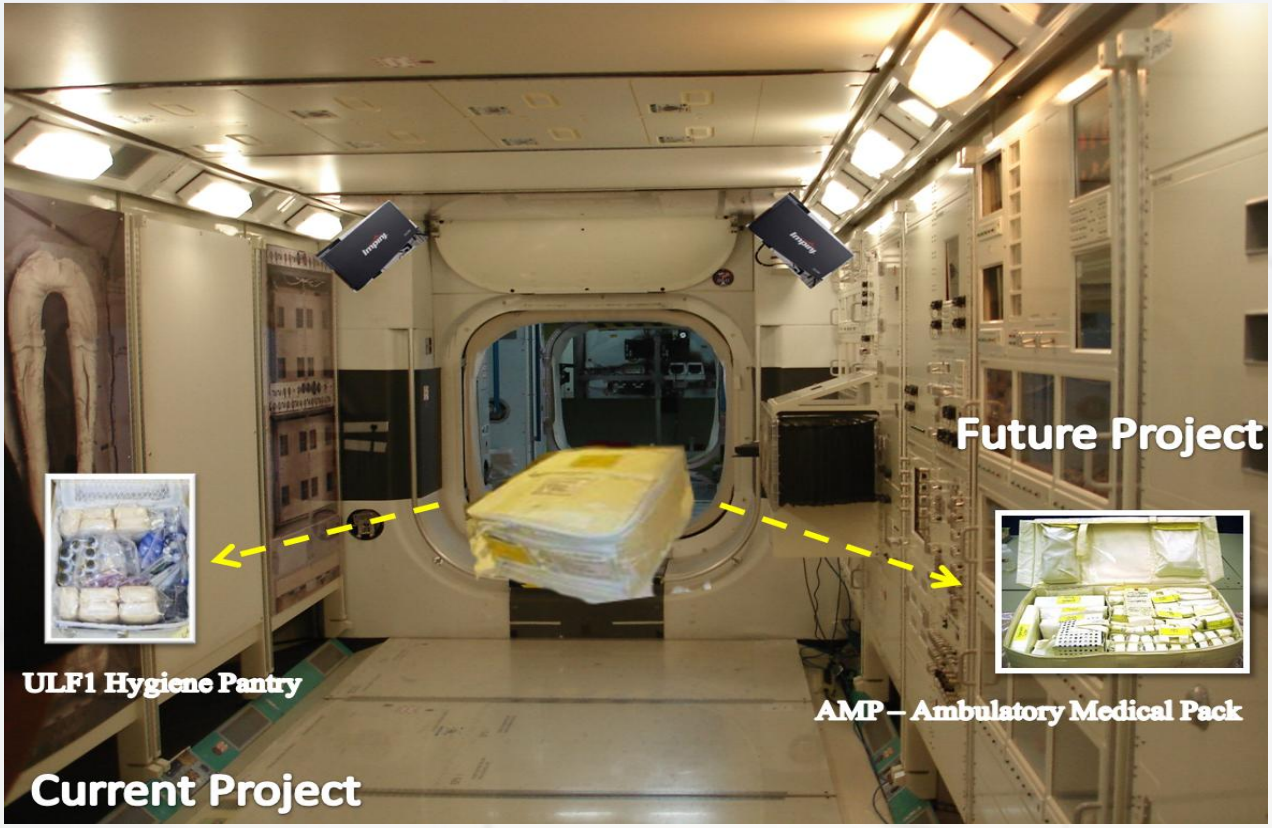
NSF IRES Mexico Student Projects

- **Research Projects Summaries and Goals.** research projects will be related to the PI's current work centered on the creation of the dynamic supply chain.
- ***Continuous Process Improvement Management Using RFID Technologies:*** Investigating how automated tracking can confirm the impacts that specific manufacturing processes has on product defects. *Partnering Researchers* Beatriz Murrieta Cortés, Associate Professor of the industrial Engineering Department at ITESM Campus Querétaro. *Partnering Industry Partner: TRW Automotive Plant Querétaro*
- ***Reducing Backorder Costs and increasing throughput using RFID inventory control.*** In food manufacturing the spoilage and loss of inventory has a major impact on throughput, backorders and sales. Reducing backorders through automation was investigated. *Partnering Researchers:* Beatriz Murrieta Cortés, Associate Professor of the industrial Engineering Department at ITESM Campus Querétaro. *Partnering Industry Partner(s)*: InterDeli Corporation
- ***Using a Web Based Web Portal to reduce Carrier Errors.*** The need to use more than one transportation mode in order to cost effectively have products delivered from suppliers to customers is more important than ever. With high gas prices, companies are seeking to reduce transportation costs in every possible way. *Partnering Researchers:* Erick Jones, Associate Professor at the University of Texas Arlington. *Partnering Industry Partner(s)*: Werner Global Logistics

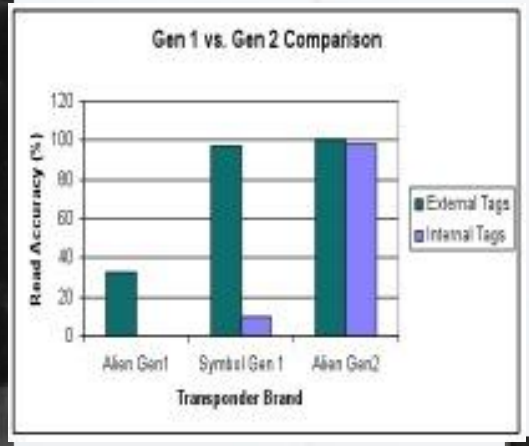
Capture Data Dock Side

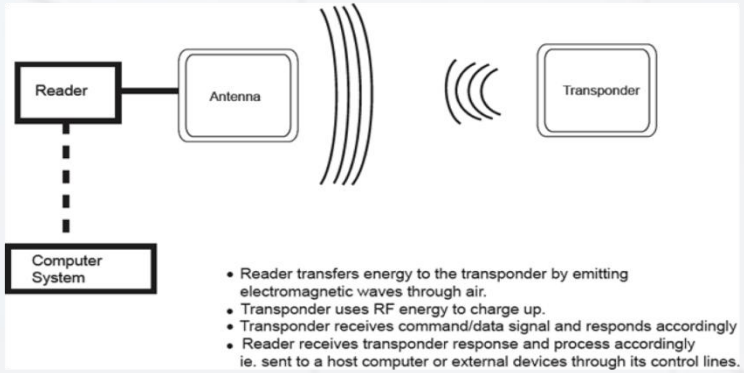
Chain of custody control through confirmation of physical movement and container status at process points like the port crane operations

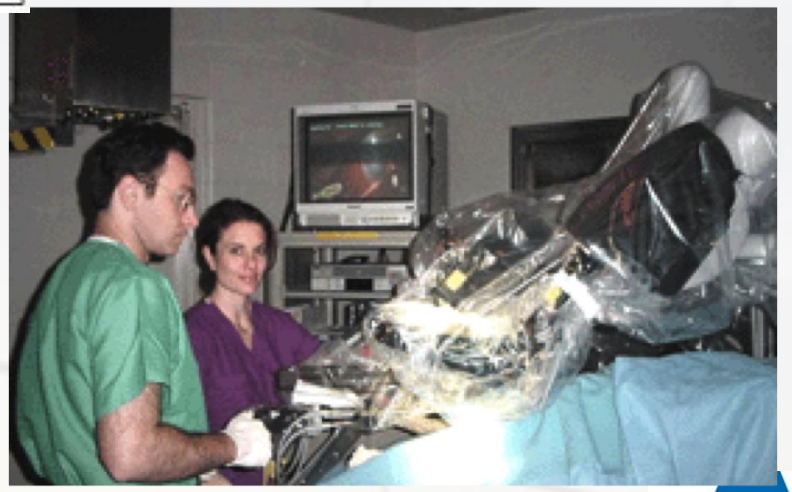
Smart Backpack Concept (Future)



RFID Application in Operating Room







Smart & Secure Containers

Automatically Capture Data, Accurately and Reliably

Data
- Container ID
- Location
- Date, Time
- Tag ID
- Battery Status
- Security Status
- Environmental Status
  - Temp, Humidity, Shock

Savi Reader SR-650

Wireless Reading up to 100 meters

SaviTag - ST-676

Capture Data Dock Side

Chain of custody control through confirmation of physical movement and container status at process points like the port crane operations

What is RFID and How Does it Work?

RAID

Radio Frequency Identification (RFID)

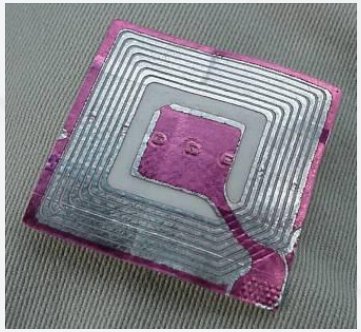
Radio Frequency Identification is an automatic data capture (ADC) that identifies physical objects through a radio interface.

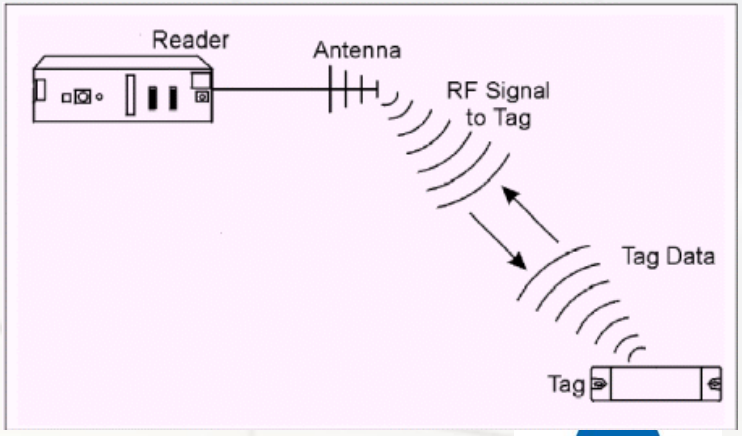
Main Components of RFID

- Readers
- Antennas
- Tags

How RFID Systems Work

1. The antenna of the interrogator (reader) emits radio signals
   - EM field transmitted can be continuous
   - Antennas come in a variety of shapes/sizes
     - Can be built-in or external
     - Circular polarization of reader antenna allows any tag antenna orientation
   - Range: 1 inch to 100+ feet
2. Transponders (tags) respond with their unique code
   - Microchip / Integrated Circuit
   - Antenna: copper or aluminum coil
   - Encapsulating material: glass or polymer
3. Reader receives and decodes tag information and sends it to a computer via standard interfaces
   - Fixed or portable
   - Software available to filter data and monitor the





RFID Capabilities

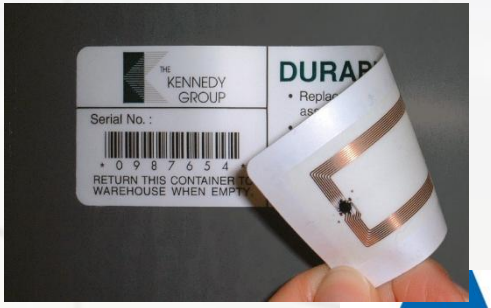
- Non operator intervention
- Non line of sight
- Large simultaneous read capability
- Large unique numbers
- Read/Write Capability
- Rugged and reliable

RFID Tags aka Transponders

Visual only

Machine readable

Human and machine readable



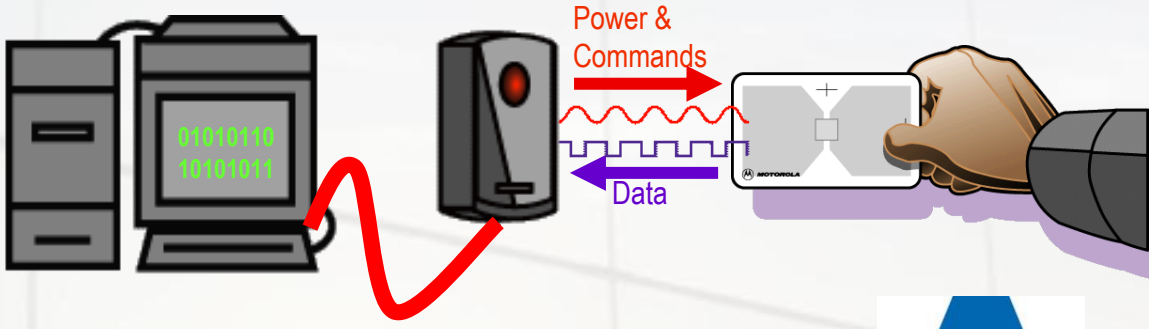
RFID Tags aka Transponders

Barcode identification

- A scanner reads reflected light from barcodes and then discerns a sequence of numbers
- The numbers are arranged according to a prescribed format, like UPC or EAN, and describe attributes about the item.

RFID identification

- Upon power and command from a reader, the RFID tag emits data, and the reader discerns a sequence of numbers
- The numbers are arranged according to a prescribed format, such as EPC's 96-bit, which also describes attributes about the item.



Types of Tags

Passive

- No on-board battery to power the tag. Relies on the reader's energy to power the tag (interpret) and respond
- Lowest range and accuracy of the three types
- Least costly
- Specified by Wal-Mart, US DoD, Metro

Active

- Older technology. Uses on-board battery to power the tag and respond to a reader
- Battery could last several years based on usage
- Higher accuracy and range compared to Passive tags
- Costliest
- Used by U.S. Dept of Defense, industrial applications

Semi-Active

- Newer technology combines best of both above tag types
- On-board battery powers the tag, but reader energy is used to respond back
- Lasts longer than active tag; provides higher range and accuracy than passive
- Cheaper than active
- Used in various toll collection systems

Commonly Used Frequencies for Tag – Reader Communication

Frequency	Key Characteristics	Typical Applications
LF (Low Frequency) 135 kHz or less	• Widely deployed • Works best around metal and liquid • Lowest data transfer rate • Read range measured in inches	• Animal identification • Industrial automation, • Access control
HF (High Frequency) 13.56 MHz	• Enjoys worldwide standard acceptance • Longer read ranges than LF tags (up to 4-5 feet) • Lower tag costs than LF tags • Poor performance around metal • Other frequencies used: 6 – 8 MHz, ~ 40 MHz	• Payment & Loyalty Cards (Smart Cards) • Access Control • Anti-counterfeiting • Item level tracking applications for books, luggage, garments, etc. • Smart Shelf • People identification and monitoring

Courtesy: RFID Field Guide

Commonly Used Frequencies for Tag – Reader Communication

Frequency	Key Characteristics	Typical Applications
UHF (Ultra High Frequency) 433 MHz & 860 to 960 MHz	• In use since late 1990's • Longer read ranges than HF tags (more than 4-5 feet) • Very long transmit ranges for active 433 MHz systems (up to several hundred feet) • Gaining momentum due to worldwide retail supply chain mandates • Potential to offer lowest cost tags • Incompatibility issues related to regional regulations • Susceptible to interference from liquid and metal	• Supply chain & logistics at case and pallet level such as: – Inventory control – Warehouse management – Asset tracking
Microwave 2.45 GHz & 5.8 GHz	• In use for several decades • Fast data transfer rates • Typically operate in semi-active mode • Read range similar to UHF	• Access Control • Electronic Toll Collection • Industrial Automation

Courtesy: RFID Field Guide

RFID Overview

RFID becomes a Reality

- From these early starts RFID has expanded into new markets

Logistics

• Real time package receiving, shipping, picking, tracking and tracing.

RFID Overview

RFID becomes a Reality

- From these early starts RFID has expanded into new markets

Security

- Controlled access
- Protect assets

RFID Overview

RFID becomes a Reality

- From these early starts RFID has expanded into new markets

Smart Shelves

- Vendor managed inventory
- Improve turns
- Avoid stock-out
- Real-time product velocity

RFID Overview

RFID becomes a Reality

- From these early starts RFID has expanded into new markets

Smart Cards

- Wireless commerce
- Customer loyalty programs
- Automated check-outs

RFID Overview

RFID becomes a Reality

- From these early starts RFID has expanded into new markets

Toll tags, parking lot access

Livestock, asset tracking

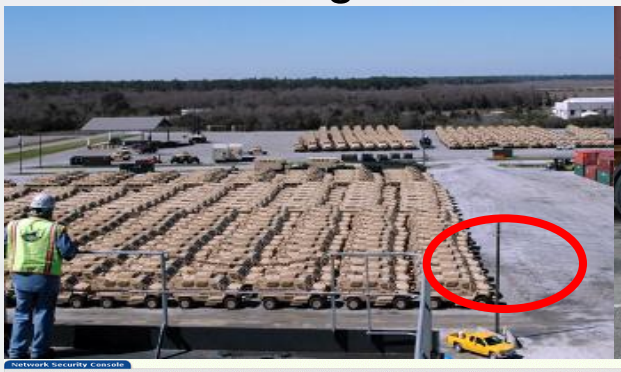
Event access, ticketing

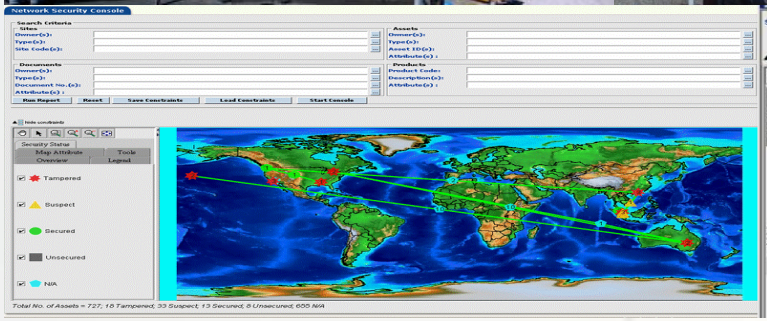
Anti-theft for automobiles

RFID in Manufacturing

- RFID Manufacturing includes
  - Maintenance Parts Management
  - Automated Bill of Material Scheduling
  - Identification of Scrap Parts
  - Management of Vendor Scheduled Parts (VMI)

Yard Management





Aircraft Parts Tracking