

# ***A Low Cost Approach To Active Tags***

**Presented To:  
RFID 2005**

**Presented by:  
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# ARS Was Founded In 2003 And Dedicated Solely To RFID Systems

- Located in Evergreen, Colorado, USA
- Engineering team has over 25 years of passive and active RF with embedded sensing experience
- ARS provides:
  - System design services
  - RFID hardware of tags, readers & triggers
  - Application software
  - Training and field support
- Data base integration is provided by our partners

# ARS Is A Developer and Supplier of Battery Powered Asset Tracking Systems

- System is an adjunct, not a competitor, to passive tags
  - Used for higher value assets not low cost individual items
  - Incorporates far greater functionality including sensing, memory and remote reading & writing of data
  - Designed with 10+ years of battery life
- A "system" consists of a variety of tags, triggers, readers and software applications

# The ARS System is Based On Proprietary, Low Cost Technology

- Patent pending system utilizes a combination of infra-red (ir) and Radio Frequency (RF) for communications, data transfer and system configuration & control
  - Infra-red is bi-directional and can use IrDA devices
  - RF is transmit only in our lowest cost tag & 2 way other wise
  - RF typically provides 10-30m range
  - Battery is Lithium Thionyl Chloride (LTC) and provides 10+ years of tag life
  - Global frequency of 433.92 MHz (or 915 MHz)

# We Provide a Family Of Interoperable Hardware

1. RF Beacon tag (BT) - factory preset periodic transmit of ID only
2. RF Output triggered by infra-red (IRT) – “commanded” ID & additional data transmit
3. Infra-red read/write with RF output (GP) – tag read & write data via infra-red, read data through RF. Incorporates LED for “search” and operator feedback, temperature sensing, up to 2 k bytes of RAM memory.
4. RF/RF read & write (RF/RF) – Tags operates at 2.45 GHz, bi-directional RF.
5. 802.11.b tag (11b) – tags communicate directly to 802.11.b network and contain optional memory and sensing.
6. Zigbee networking tags (NT) – Tags communicate directly with other tags in an Ad Hoc network.

# We Provide a Family Of Interoperable Hardware (continued)

7. Triggers – Devices that effect bi-directional infra-red communication of data and commands tags to transmit in RF mode. Devices can be PC connected.
  1. Active RFID Systems, Inc. Device with 1m+ infra-red range
  2. PDAs or PDTs with close proximity IrDA ranges
8. Industrial Readers (INDRDR) – Devices that perform the bi-directional RF & infra-red communication.
  1. RF Receive
  2. infra-red bi-directional including data transfer and command and control
  3. 802.11.b (.g) networked secondary communications
  4. Ethernet connection
  5. Infra-red illuminator for remote triggering
    1. Automatic inventory
    2. Conduct tags “search” functions
    3. Conduct “Locate” functionality

# We Provide Sensor and Memory Options

1. Temperature on all devices
2. Temperature and humidity on tags
3. G-shock threshold sensing
4. Acceleration, 3 axis
5. Pressure (limited applications)
6. Memory
7. Data logging

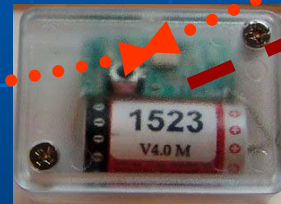
# The General Purpose System Consists of Three Essential Sub-systems

Tags & Triggers communicate through infra-red, bi-directionally

Tags & Readers communicate through infra-red, bi-directionally



Readers



Tags

Tags Transmit one way to readers via RF for automatic inventory and long distance data gathering

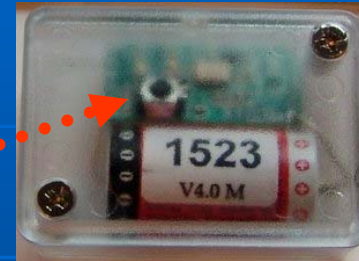


Triggers

# Triggers Can Communicate In Both Directions With Tags Via Infra-red and Issue Commands to The Tags



Triggers



Tags

Triggers control all tag functions:

1. ID Response
2. Data response
3. Mode control
  1. 1: 1 communications
  2. Beacon on/off
  3. Bulk Scan with anti-collision algorithms
  4. Search command

# The Following Slides Are Those Of A Customer And Discuss The Lessons Learned Over 24 Months Of Use Analysis

# Customer Use Context

- Company
  - Fortune 100
  - Global
  - Interested in tracking returnable metal assets
  - Metal assets are bar-coded
  - Has been evaluating RFID technologies for many years
  - Worked with ARS for > 18 months to develop unique RFID technology solution
- Cannot reveal company or industry
- Must discuss in general terms
  - Basics of approach
  - A few comments about application
- Metal returnable assets a different application than typically presented in RFID conferences
- Goals of company RFID project
  - Decrease level-of-effort to obtain asset information
  - Improve asset utilization

# System Properties and Requirements

- Properties of assets
  - Metal
  - Vary in size
  - Exposed to ambient conditions: weather of all kinds
  - Exposed to rough handling
- Requirements for RFID tags
  - > 10-year lifetime
  - Rugged to withstand industrial environment
  - Withstand cold of Polish winter and heat of Spanish summer
  - Size: small
  - Must work when installed against metal, in close proximity to liquid
- Requirements for data content and stream
  - Writable fields that can be protected
  - Can be integrated with company data base

# System Properties and Requirements (continued)

- Requirements for readers
  - Portable and fixed
    - Convenient (simple, usable, trustworthy)
    - Cannot add complexity to operators' work
  - Read/write distance: minimum of 1 cm, maximum of 3 meters
  - Can be integrated with company database and current practices
- Costs: defined by cost-benefit case that includes
  - Impact of Operational savings
  - Impact of enhanced business practices
  - Impact of improved asset management
  - Impact of company's reputation as innovative
  - Impact of improved asset tracking for customers

# Essential Question for RFID Development Project

- How to efficiently retrieve information from metal assets and pass to Enterprise database
  - Such that
    - Realistic hard and soft savings can be demonstrated
    - Real process improvements can be developed
    - Operators buy into the enhancements
    - Future, unperceived needs can be met (growth capability)

# Principles for Studying the Processes

- Take the time to study the details of all scanning nodes
  - More suited to R&D mentality than to IT or Supply Chain
- Need a cross-functional team, otherwise won't happen
  - R&D, Supply Chain, IT, Operations, Distribution
  - Executive sponsor with vision
- Engage operational supervisors and operators in the study
  - Only they really know what is done on the shop floor or the delivery dock
  - Surfaces real problems and pain, on-the-spot brainstorming of potential solutions
  - Starts the change management process at the users' level
- Be flexible: perceptions change as understanding grows
- Keep an open mind: "We don't know all the potential applications."
- Understand company requirements before engaging vendors
  - Vendors not likely to understand your requirements
  - This deficiency not likely to deter them from trying to sell you a system

# Paradigm Shifts in Understanding That Resulted from Studying the Processes

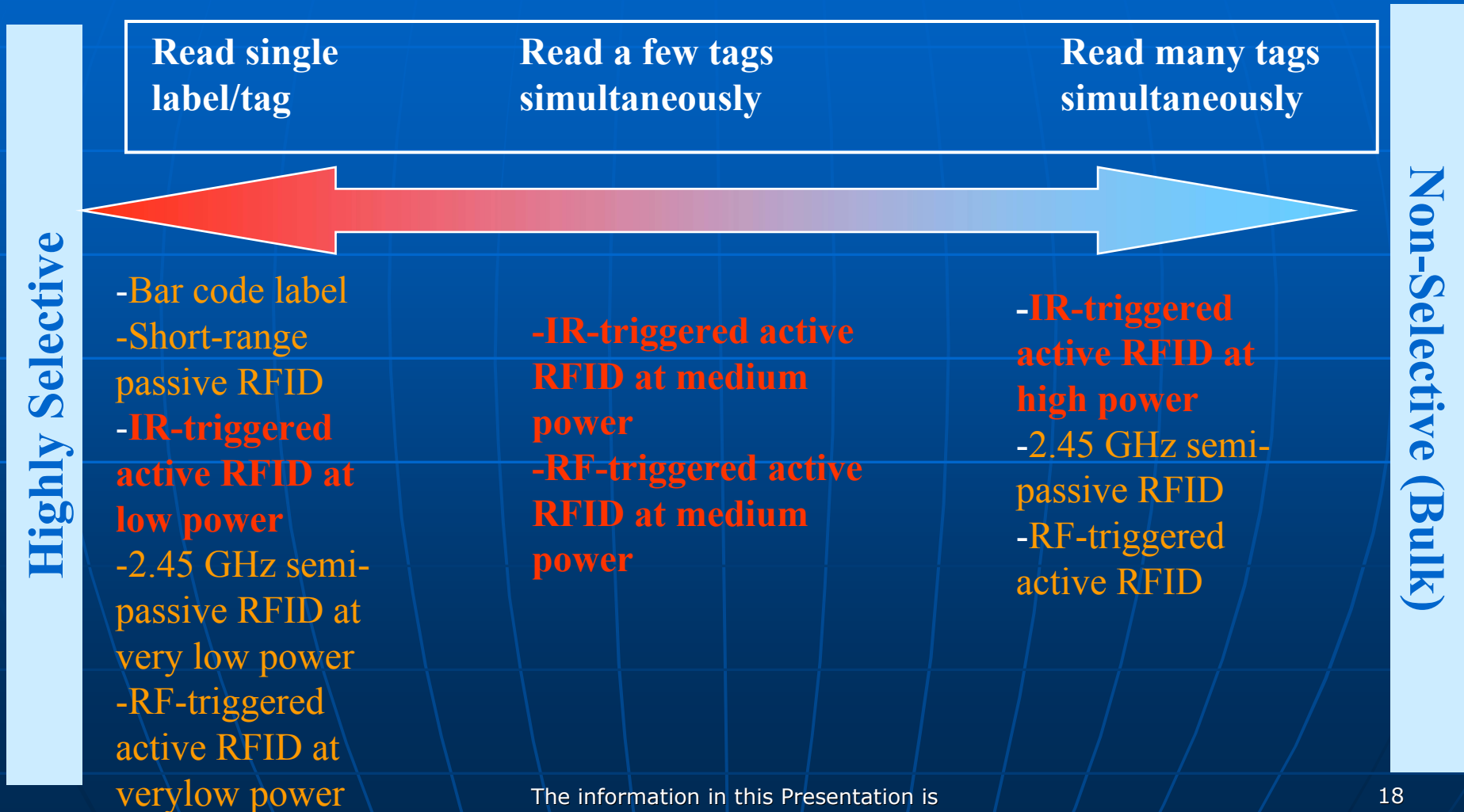
- Selectivity continuum
  - Initially, our model required only bulk or non-selective, non-discriminating scanning techniques
    - Many tags read simultaneously at a single point
  - During study of scanning nodes, highly selective scanning appeared to predominate
    - One tag to only a few tags read simultaneously, at many points
- “Dark matter”
  - Many non-Enterprise processes performed by operators in normal course of their work
  - Visual scanning of bar code labels: how to replace with RFID?
- Inability to integrate readers with on-line ERP processes
  - We were unaware in the beginning that certain current hardware was incapable of supporting RFID readers
  - This forced us to consider the possibility of replacing the current hardware, thus adding significant cost to the project

# Highly Selective vs Non-Selective (Bulk) Scanning Definitions

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- “Neighboring non-target tag” :
  - Tag on neighboring asset (10-100 cm distance)
- “Negative read”: target tag not read
- “False positive read”: neighboring non-target tag inadvertently and unknowingly read

# Highly Selective vs Non-Selective (Bulk) Scanning Examples



# Highly Selective vs Non-Selective (Bulk) Scanning Context

Read single label/tag

Read a few tags simultaneously

Read many tags simultaneously

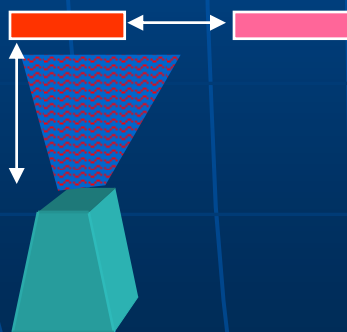
Highly Selective

-No neighboring non-target tag within scanning/reading beam: 3-10 cm

-No neighboring non-target tag within reading beam: 5-10 cm

-No neighboring non-target tag within reading beam: 100-? cm

Non-Selective (Bulk)



# Highly Selective vs Bulk Scanning: Summary

- Need to understand each scanning node and its requirements for selectivity.
  - Fundamental rule: The operator must be perfectly certain that he collected data only from the target assets, and read them all.
- The physical reality of each scan node must determine the scanning technology.
- Asset “counting” cannot be done by non-discriminating RFID unless
  - No non-target tags are in the reader field
  - All tags are accessible to the reader field
- Balance between control and selectivity
  - The more control required, the higher the selectivity
  - The less control required, the lower the selectivity

# Advantages of Adjustable Range of IR Trigger

- IR trigger permits flexibility in selectivity from same reader
  - High selectivity
    - Short-range reading
    - Decrease “power” to the LEDs
  - Lower selectivity
    - Mid- to long-range reading
    - Increase “power” to the LEDs
- Other
  - Automatic long-range inventory control possible
  - Inexpensive, rugged, “consumer” technology
- By contrast:
  - RF trigger field more difficult to “shape” for selectivity

# Unexpected Benefits of On-board Visible-Light LED

- Locate specific storage bins in stock area
  - “Find” function
    - To find specific assets in stock requires manual searching, looking at bar code labels
      - Approximately 3 assets have to be moved for each target asset
- The on-board visible-light LED of specific tags flash when IR trigger poses a code-specific query to the tags
  - More than 1,000 asset types
  - Use RF and IR to query site inventory system
  - On-board visible-light LEDs flash to show target bin
- Large time-savings benefits due to these features

# Conclusions

- ARS IR/RF RFID technology appears to have advantages for our industry
  - Small footprint of tag
  - Short- to long-read range
  - Works on metal and in close proximity to liquid
  - Insensitive to weather
  - Portable and fixed reader installations possible
  - Open-ended technology can accommodate unforeseen future opportunities
- Disadvantages
  - Potential costs
    - Need thorough benefits case study that includes Operations, Distribution, Customer Service, and Sales/Marketing to develop realistic ROI
    - Need to consider future of business
    - Need to consider customer applications and requirements
  - “Pioneering” a new technology requires shift in thinking for conservative company

# The ARS System Enables Process Change

- Each Transaction (communication) records ID of Trigger or Reader; Time and Date
  - Data recorded on tag
  - Process or operator action always recorded
- System can automatically accumulate inventory and location
- System enables both customer Issue and Receipt functionality
- System enables a “search” and “locate” by any selected stored tag data field
- Tag has visible LED for location and operator feedback
- RF silence mode enables air transport
- Infra-red mode from existing equipments minimizes infrastructure costs

# ROI = Process Simplification

- Each Transaction (communication) records ID of Trigger+Tag+Reader+Time and Date
  - Data recorded on tag & reader
  - A record of all process or operator action is automatically created
    - **Data accuracy and timeliness improves Enterprise performance**
- System can automatically accumulate inventory and location
  - **Daily, accurate + no cost inventory**
  - **No operators required**
- System enables both customer Issue and Receipt functionality
  - **Time reduced, accuracy enhanced**
- System enables a “search” and “locate” by any selected stored tag data field
  - **Significant operator time reduction**
- Infra-red mode from existing equipments minimizes infrastructure costs
  - **Forklifts, racks, portals all enabled**
  - **Data can be written to tags and checked from process equipment**