RFID Readers

Survey of RFID Reader Types and Capabilities

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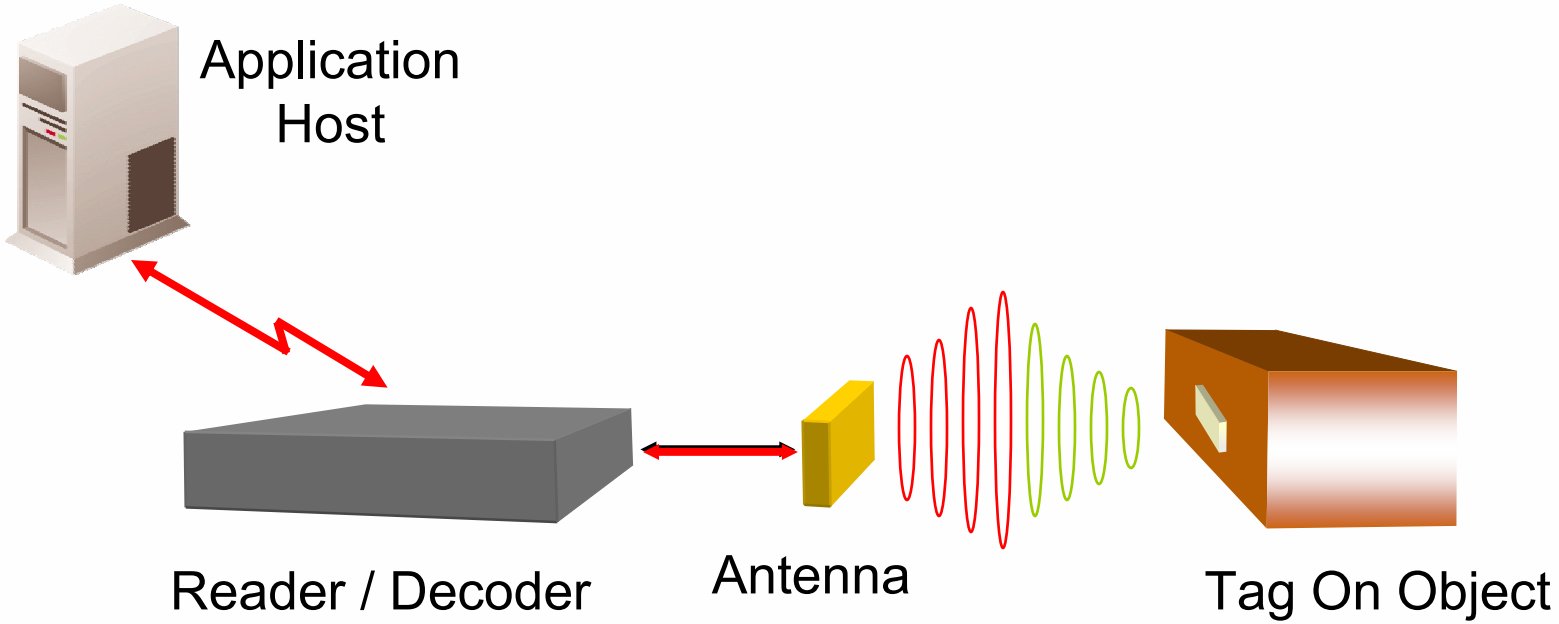
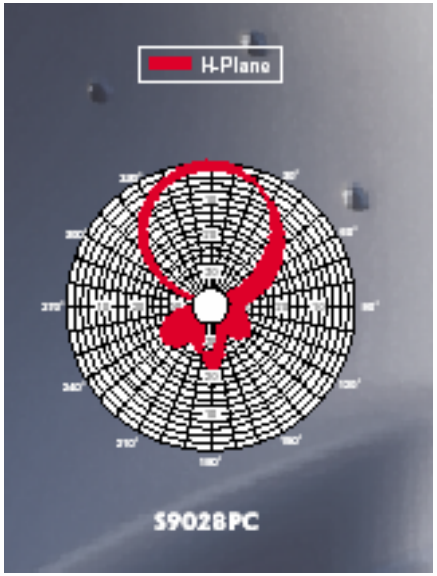
Reader Function In A System

- **The Reader / Decoder Transmits and Receives RF Energy to Identify RFID Tags Within Its Reading Range**



Antenna Function

- **RF Energy Is Transmitted and Received By the Reader Through An Antenna**
- **An Antennas Wave Pattern Radiates In Three Dimensions**
  - H Plane and E Plane
  - Mapping of A Working Field
- **No Antenna Foot Print / Pattern Is Perfect (Lobes and Nulls)**
  - Frequency / Design / Construction
  - Performance
  - Materials
- Cost Trade Offs

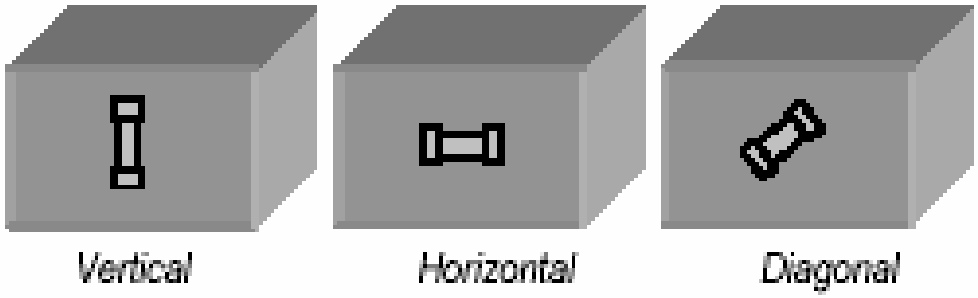


Antenna Function

- **Types of Antennas**
  - Orientation and Sense of Radiated Wave's Electric Field Vector
  - Size Geometry Is A Function Of Frequency
- **Linear Polarized**
  - RF Energy is Radiated in Linear Pattern
  - Can Have Narrower Beam Pattern
  - Best For Applications With Known Tag Orientation
- **Circular Polarized**
  - RF Energy Radiates in a Circular Pattern
  - Offers More Tag Orientation Insensitivity
  - Reduced Read Ranges.

Antenna Function

- **Antenna Selection Must Factor:**
  - Bandwidth – Defines Frequency Range over Which Antenna Meets Performance Criteria
  - Antenna Gain - A measure of The Antenna's Overall Efficiency
- **Antenna Geometry Is Critical To Reader Function and Performance**
  - Presentation and Orientation
  - Tag Antenna
  - Tag Spacing
  - Optimization of Location / Placement Required For Best Read Ranges

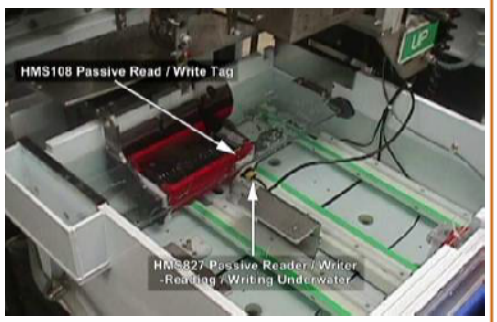


Regulations

- **FCC Rules Part 15**
  - Limits Vary by Frequency
  - Required For Operation In Un-licensed Band
  - (ISM) Industrial, Safety, Medical
  - Regulates Power at the Antenna
  - Frequency Hopping Systems Operation
  - Direct Sequence Systems Operational Bands
- **Affects Alternate Antennas**
  - Antenna and Reader Combinations Are Type Accepted As a System.
  - Users Must Use Only Compliant Antennas Or Submit New Configurations For FCC Approval
- **Electromagnetic Exposure (EME) Limits**
  - Minimum Human Distance Regulations for Extended Exposure

Interference Considerations

- **Environmental Sources of RF Noise/interference**
  - Equipment Radios
  - Wireless Computers / Phone
  - Fluorescent Ballasts



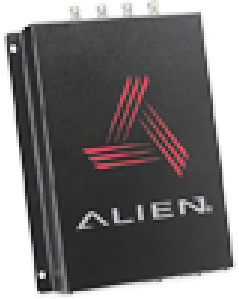
- **Loading**
  - Earth, Walls, Floors and Surroundings May Impact Antenna's Performance
  - Metals Act As a Reflector
  - Water Acts As An Absorber
- **Additive or Constructive**
  - In Phase Signals
  - Phased Array Antennas
  - Increases Range
- **Subtractive or Destructive**
  - Out of Phase Signals
  - Multipath Interference
  - Introduces Noise To Reader

Interference Considerations

- **Reader Collision**
  - Minimize Multiple Antennas From Multiple Readers In the Same Area
  - Multiple Antennas for a Single Reader Are Multiplexed and Don't Interfere With Each Other
- **Tag Collision & Anti-collision Algorithms**
  - Ability to Simultaneously Address a Number of Tags in a Given Read Zone
  - Can Influence the Read Rate (Reads Per Second)
  - Part of Air Interface Protocols
  - Varies By Frequency and Manufacturer

Reader Function

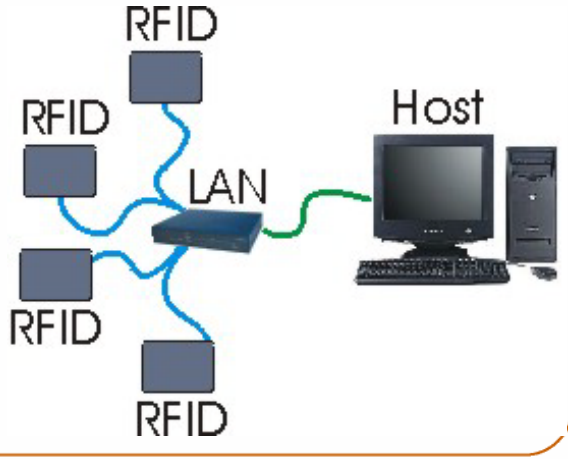
- **Receive and Respond to Host Computer**
- **Pull vs. Push Information From The Reader To The Host Application**
  - Polling By Application
  - Event Driven Execution
- **Control Unit and Command Execution**
  - Variety of Reader Modes
  - Optimization For Single Tags
  - Multiple Tags
  - Action Upon Request
  - Continuous Operation
  - Event Driven Operation
- **Middleware Solutions**
  - Provides Common Interfaces
  - Filters Data
  - Enables Interface To Current Applications



Reader Function

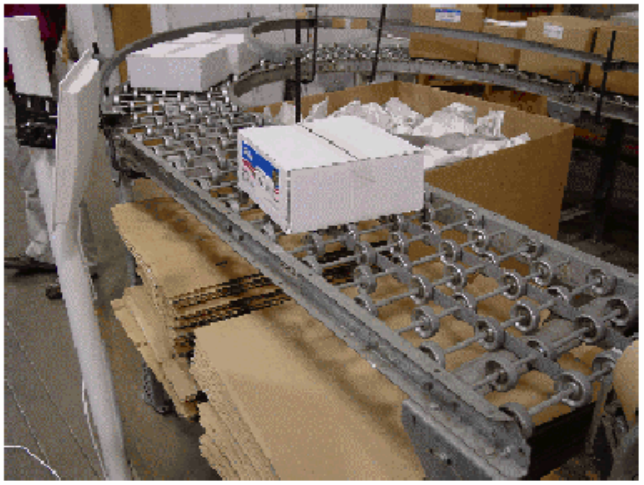
- **Data Transfer Interface**
  - Serial Commands To Reader
    - Host Computer Set Direct Interface
    - Host Computer Interprets Tag Data
    - Specific To Reader Manufacturer
    - Limits Configuration of Reader To Host (RS-232 / RS-485)

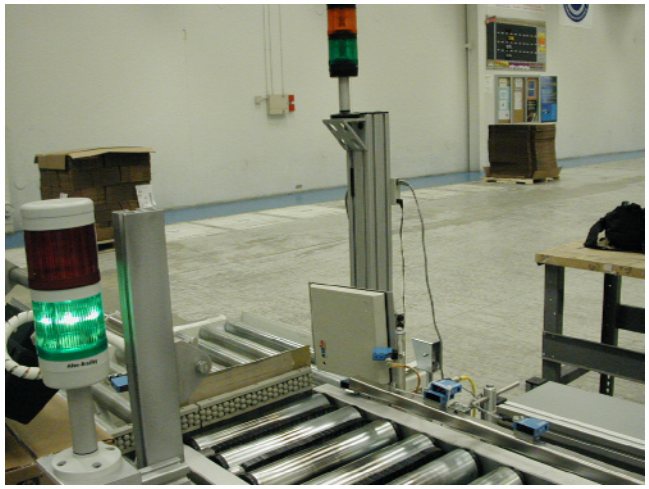
  - Network Communication TCP/IP Addressing
    - Enhanced Functionality
    - Telnet Connection (Reader Set Up)
    - Direct Socket
    - Advanced Programming Languages(XML, Etc.)
    - Allows For Multiple Readers On A Network
    - Wireless LAN
    - SNMP Administration



Reader Inputs and Outputs

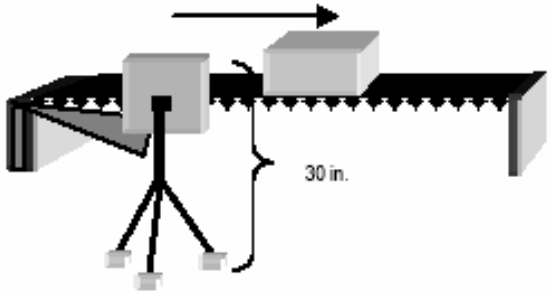
- **Business Process and Environmental Control**
  - Control Reader Activity & Timing
  - Reduce RF Noise In Environment
  - Instruct Operations (Go-No-Go, etc)
  - Automation
- **Inputs:**
  - Motion Sensors
  - Tamper Indicators
  - Presence/ Motion Detectors
- **Outputs:**
  - Visual Indicators,
  - Audible Signals
  - Actuation of Gates
  - Doors and Sortation Devices





Fixed Reader Deployment

- **Fixed**
  - Optimized For Known Presentation
- **Tunnel**
  - Variety Of Orientation
  - Size of Object A Constraint
- **Portal**
  - Distance And Orientation



Reader Selection

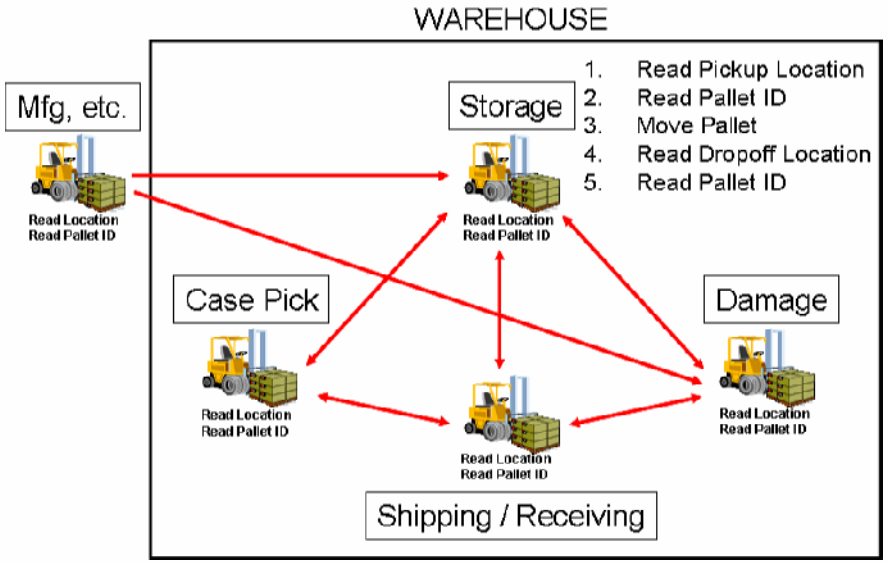
- **Fixed Reader Common Evaluation Criteria:**
  - Integral vs. Remote Antenna
  - Multi-Protocol Capability
  - Scalable Architecture
  - Firmware Upgradeability
  - Multiple Communication Interfaces
  - Networking via RS-485 and Ethernet LAN connections
  - Digital I/O Lines for Sensing and Control Functions
  - On-board status indicators

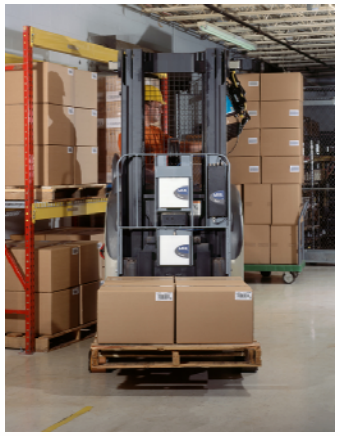
Handheld Reader Deployment

- **Exception Based Situations**
  - Damaged Goods
  - Reprogramming Tags
  - Complements Fixed Systems
  - Limited Read Ranges
- **Reader Modules**
  - CF cards
  - PCMCIA Cards
  - Small Form Factor Circuit Cards (Serial Interface)
- **Field Operations**
  - Ruggedized Hand Held
  - Water, Dust and Drop
  - Internal vs External Antenna

Vehicle-Mounted Reader Deployment

- **Reader Common Evaluation Criteria:**
  - Multi-Protocol Capability
  - Firmware Upgradeability
  - Adjustable Power Output
  - Multiple Communication Interfaces
  - Digital I/O for Triggering and UI Functions
  - Intelligent Reader Framework
- **Use Case Scenarios**
  - Pallet Picking
  - Pallet Putaway
  - Case Picking
- **Field Operations**
  - Ruggedized Reader and Antennas
  - Water, Dust, Shock and Vibration, Temperature, Power
  - Application Specific Antennas
- **Supply Chain Execution**
  - Reduction of Labor based Data Collection
  - Increased Velocity
  - Error Reduction





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