RFID
Radio Frequency Identification

11 February 2004

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RFID Components Block Diagram

- RFID Tag
- RF Antenna
- Network
- Workstation
RFID Concepts

- Define a non-contact system that can monitor and track items or individuals
- Provide unique identification that allows for a wide range of applications
- Perform the operation using unobtrusive, low cost components
- Use Wireless Communications techniques to facilitate the system design
RFID Applications

Telemetry or Wireless Data Capture
- Active transmission of information
- Flat Tire Indication

Security
- Individual Access Control
- Electronic Article Surveillance (EAS)
- Theft Prevention

Position and Location Tracking
- Wildlife monitoring and tracking
- Automobile Tracking

Manufacturing and Processing
- Material and Process Monitoring

Supply Chain Management
- Inventory Tracking Systems
RFID Technical Design Considerations

- Operating Frequency
  - Available Frequency Bands
  - RF Signal Propagation (range, reflections, and material transmittance)
  - Interference

- Communication Signal
  - Interrogation Signal with command and control
  - Response Signal with unique identification and data

- Tag Design
  - Antenna Design
  - Integrated Circuit Design
  - Passive or Active Battery Power

- Reader and Reader Antenna

- Networking Requirements

The physics of RFID, Matt Reynolds, ThingMagic

An Invited Paper, RFID Privacy Workshop @ MIT: November 15, 2003
## Operational Frequency Tradeoffs

<table>
<thead>
<tr>
<th>Frequency Ranges</th>
<th>LF 125 KHz</th>
<th>HF 13.56 MHz</th>
<th>UHF 868 - 915 MHz</th>
<th>Microwave 2.45 GHz &amp; 5.8 GHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical Max Read Range (Passive Tags)</td>
<td>Shortest 1”-12”</td>
<td>Short 2”-24”</td>
<td>Medium 1’-10’</td>
<td>Longest 1’-15’</td>
</tr>
<tr>
<td>Tag Power Source</td>
<td>Generally passive tags only, using inductive coupling</td>
<td>Generally passive tags only, using inductive or capacitive coupling</td>
<td>Active tags with integral battery or passive tags using capacitive storage, E-field coupling</td>
<td>Active tags with integral battery or passive tags using capacitive storage, E-field coupling</td>
</tr>
<tr>
<td>Data Rate</td>
<td>Slower</td>
<td>Moderate</td>
<td>Fast</td>
<td>Faster</td>
</tr>
<tr>
<td>Ability to read near metal or wet surfaces</td>
<td>Better</td>
<td>Moderate</td>
<td>Poor</td>
<td>Worse</td>
</tr>
<tr>
<td>Applications</td>
<td>Access Control &amp; Security; Identifying widgets through manufacturing processes or in harsh environments; Ranch animal identification; Employee IDs</td>
<td>Library books; Laundry identification; Access Control; Employee IDs</td>
<td>supply chain tracking; Highway toll Tags</td>
<td>Highway toll Tags; Identification of private vehicle fleets in/out of a yard or facility; Asset tracking</td>
</tr>
</tbody>
</table>
BlueGranite and Global Berry Farms Partner with WMU to Develop RFID System

For Release: 1/28/04

KALAMAZOO, Michigan, 1/28/04 – BlueGranite, a Kalamazoo-based software development firm, has partnered with long-time client Global Berry Farms and Western Michigan University to develop a Radio Frequency Identification (RFID) pilot system to track flats of fresh berries from local growers, through cold storage, and to specific retail establishments.

“In the near future, RFID technology will not only benefit our customers, who are beginning to request the use of these tags, but will also increase our internal efficiency while significantly enhancing our visibility throughout the supply chain,” states John Conner, Director of Information Systems for Global Berry Farms.

Global Berry Farms is a LLC owned by Michigan Blueberry Growers in Grand Junction, MI, Hortifrut, S.A. in Santiago, Chile and Naturipe Berry Growers in Salinas, CA. Global Berry Farms is committed to meeting the needs of produce trade customers by consistently supplying all types of fresh berries year-round to North American and global markets, with innovation, service and dependability.

The RFID pilot project will begin this quarter at WMU, when a group of engineering seniors develop and test a small-scale demo system under the supervision of electrical engineering professor Dr. Brad Bazuin. Upon completion of the first phase, a second group of WMU students will implement a RFID test environment at a MBG Marketing warehouse in Grand Junction. Once the production environment tests are complete, Global Berry Farms will conduct a market analysis of RFID tag costs and BlueGranite will assist with the implementation of the technology, ensuring that it integrates with Global Berry Farms’ existing accounting and warehouse management systems.
Global Berry Farms RFID

RFID System Specification

Detailed Description

The system shall use RF-ID technology consisting of RFID Tags, RF Readers with antennas, optional RF Writers, appropriate networked computer resources to identify and track product, and other supporting system components as required.

System operation will require the attachment of an RFID Tag to the appropriate blueberry container when initially picked and packaged. The standard container for identification and tracking will be a cardboard packaging container or flat capable of holding a number of plastic clam-shell fruit containers. The standard flat or container will be of United States or European dimensions that will be stacked on a standard shipping pallet.

…

As a system goal, RFID identification and tracking should be to the plastic clam-shell container level.
Blueberry Flats on a Pallet
Blueberry Flat with Model Clam Shells
RFID Tag Locations

3*4 crates
Total 55 testing planes

11 February 2004
RFID Performance Testing

Garage door

The width of the door

Antenna

The height of the antenna

RF signal coverage

Stack

Floor Jack

0 feet 3 feet 6 feet 9 feet 12 feet 15 feet 18 feet 20 feet

The height of the jack

The height of the door
Range Testing A-208

- Antenna
- RF signal coverage
- Wall
- Table

- 3 feet (36 inches)
- 15 feet & 5 inches (185 inches)
Global Berry Farms System Design

RF Signal Coverage

Probability of Detection

11 February 2004
Summary

RFID is a technology that will be pervasive
- A logical extension of emerging wireless technologies

The Universal Product Code (UPC) will be replaced with Electronic Product Codes (ePC)
- [http://www.epcglobalinc.org/index.html](http://www.epcglobalinc.org/index.html)
- Specifications

Technology Growth Areas
- Wireless Communications, RF Design, DSP, Software
- Tag Design Technologies: Integrated Circuits, Antennas, Power Supply
- Reader Design: Antenna, RF, DSP, Digital, Microcontroller, Network
- Distributed Network Design: Networking Software, Database, Tracking
Web Information

- http://www.aimglobal.org/technologies/rfid/
- http://www.rfidjournal.com/
- http://www.rfidinc.com/
- http://www.alientechnology.com/
- RFID Links http://home.att.net/~randall.j.jackson/rfidlinks.htm
- http://www.blue-granite.com/index2.html
- http://www.globalberryfarms.com/
- http://www.blueberries.com/
Questions

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