AGILE READER REFERENCE PLATFORM
PROGRAM UPDATE

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AGENDA

• The RFID Reader Manifesto
• Agile Reader Project Goals
• Team introduction
• Current status update
• Design Overview
• Conclusion
The Reader Manifesto
(as articulated in November)

The RFID Reader of the Future will:

1. Operate on more than one band
2. Speak Internet protocols natively
3. Be part of a distributed, client-server system
4. Incorporate agent-like behavior to manage a tag population at a fine grained level
5. Not require human intervention to fix problems

The RFID Reader of the Future must have flexible software to match its flexible hardware.
PROJECT GOALS

Provide a practical reference design for an RFID reader which:

1. Operates on multiple bands- at least 13.56MHz, 868/915MHz bands
2. Provides a flexible back-end network interface (TCP/IP)
3. Complements the Savant’s scalable architecture
4. Is manufacturable at reasonable cost (~$100 OEM, 100K units)

Resulting in a reproducible, published open reference platform (and thus realizing the Manifesto)
VALUE OF REFERENCE PLATFORM

Auto ID Center
- Research platform that is easily modified and completely open
- Easy implementation of emerging EPC specifications for testing and evaluation

RFID Hardware Vendors
- Direct engineering applicability
- Open standard interface development

RFID Integrators and Service Firms
End Users
- RF level interoperability standards
- Software/Network level interoperability specifications
- Benefits of a common platform

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READER PROJECT TEAM

• ThingMagic R&D Team
  Matt Reynolds (RF and system architect)
  Joey Richards (DSP lead)
  Bernd Schoner (DSP, project management)
  Sumukh Pathare (DSP)
  Harry Tsai (Bamboo / Java software)
  Ravi Pappu (Prototype hardware build management)

• Auto ID Center
  Sanjay Sarma, Peter Cole, Dan Engels, Kevin Ashton, and Auto ID Center team

• Auto ID Center Sponsor Community
  OATSystems, Alien, Philips, Markem

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Project Scheduling

- Design work started August 2001
- Project duration 9 months ending Q2 2002
- Major milestones achieved
  - Evaluation hardware deployment at Field Test sites in Arkansas and Tennessee
  - Integrated with the Savant system
- Reference design (primary deliverable) being published Q2/Q3 2002- starting today
CURRENT STATUS

- Single band (900MHz CCAG) version currently deployed in the Field Test
- Dual band version (900MHz/13.56MHz) demo today undergoing lab testing to be deployed in the Field Test September ‘02 (jointly with Markem Corp.)
- CCAG915 support finalized and running
- CCAG13.56 support being finalized as the protocol emerges (current draft is implemented and being tested)
THE NETWORKED READER VISION

The Reader Is A Gateway Between Tags and the Network

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READER SYSTEM OVERVIEW

Design philosophy: flexibility and low cost

- Maximum of component and system reuse
- High level of inter-band integration in both HW and SW
- Make good use of DSP techniques
- Provide a standard, well documented TCP/IP interface to the outside world
General data handling approach

Two processors:

- Digital signal processor (DSP)
  Performs real time signal processing tasks
- Network processor (Bamboo™ Linux platform)
  Handles data, schedules reads, interacts with TCP/IP network
  Acts as a Savant database agent

Shared memory interface between DSP and network
HARDWARE DESIGN GOALS

• Complete hardware-software modularity
  Separate band modules (HW) from protocol modules (SW)
  (Any protocol module can talk to any band module)

• Simplify the hardware as much as possible
  Build the simplest HW consistent with good performance
  Use only standard COTS components for lowest possible cost

• Make good use of DSP
  Software can be easily field-upgradeable, while hardware cannot.
Overall Hardware Architecture

- **Antenna Subsystem Band 1**
  - RX
  - TX

- **Band Module Band 1**
  - Data
  - Control

- **DSP Subsystem**
  - Data
  - Control

- **Network Subsystem (Bamboo™)**
  - TCP/IP

- **Antenna Subsystem Band 2**
  - RX
  - TX

- **Band Module Band 2**
  - Data
  - Control

- **Antenna Subsystem Band n**
  - RX
  - TX

- **Band Module Band n**
  - Data
  - Control

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915MHz BAND MODULE SCHEMATIC
13.56 BAND MODULE SCHEMATIC

ANALOG OUTPUT

LOW PASS FILTER

RX INPUT

FM/PM INPUT

CRYSTAL OSC 13.56MHz

PA

BANDPASS FILTER

TX OUTPUT

TRANSMIT MODULATOR

MODULATION IN

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SOFTWARE DESIGN GOALS

• Complete hardware-software modularity
  Device drivers abstract the hardware from the software
  (Any protocol module can talk to any band module)

• Modularize the software as much as possible
  Combine common software elements into modules
  Provide real-time OS services to all software modules
  Communicate easily with non-real-time network processor

• Communicate fluently with the networked world
  Speak TCP/IP and SQL natively- with a built-in database server
  Interface directly with enterprise systems
REAL-TIME MODULARITY AND ABSTRACTION LAYERS
Overall Software Architecture
Network Software Architecture

Goal: Standards-based, stable, maintainable networked computing

Solution: Run Linux in the reader.

Protocols supported:
- IP, UDP, TCP, FTP, NFS, Telnet, HTTP, SQL, SNMP

Interfaces:
- Java based Web client (for humans)
- SQL interface (for computers)
CONCLUSION

Our RFID Reader is the Future!

It:

1. Operates in 13.56MHz, 868/915MHz bands
2. Intelligently maximizes band usage
3. Supports multiple and changing protocols via network-downloadable firmware
4. Speaks TCP/IP natively
5. Provides a flexible back-end network interface (TCP/IP)
6. Is part of a distributed, client-server system (Savant)
7. Is fully remotely maintainable

And it is freely available from the Auto-ID Center.