The New Network
Smart Objects, Smarter Companies

Dirk Heyman
Chairman Technology Board Auto-ID,
EMEA Head Life Sciences Sun Microsystems Inc.

Christian Flörkemeier
M-Lab.
October 8, 2002

Making object (movement) visible

© Auto-ID Center

October 8, 2002
What is Auto-ID?

- A global collaborative effort, driven by
  - Several of the world’s leading (Fortune 500) companies
  - Government organizations
  - Standardization organizations
  - Academic institutions
  - Systems integrators
  - Technology hardware & software providers
- To create standards & technologies for smart objects
  - By identifying objects uniquely
  - By linking objects to the internet continuously and wirelessly
- Hence bridging the gap between the physical world (atoms) and the world of computers (bits)
  - So that computer systems can sense the real world
  - And information systems can make more significant decisions

October 8, 2002

How?

- Low cost RFID tags (goal is 5c and lower)
- ePC code: 64 or 96 bits long (future 256)
  - 96 bit ePC = header (8 bits).EPC manager (28-bits).Object Class (24-bits).Serial Number (36-bits)
  - Identifies every object uniquely

A vial of 5c tags from Alien Technology, the size of specs of dust (350 micron)

October 8, 2002

Source: Auto-ID Center
How?

- Multi-frequency readers reads ePC code sent by tag
- Savant middleware (Java) seeks right address via ONS (DNS) which points to the address where object data is stored
- Object is described via PML = Physical Markup Language (XML based)

Source: Auto-ID Center

Integrated networked technology

- Auto-ID Technology = standards for tags, readers, ePC, Savant, ONS & PML

Source: Auto-ID Center
Leading academic institutions

- M.I.T. (USA)
- Cambridge University (UK)
- Adelaide University (Australia)
- Associated with M-Lab (Switzerland)
  - University of St Gallen
  - ETH Zurich
- Planned:
  - Japan, PRC, Latin-America

October 8, 2002

Positive global momentum

- Industry (29)

- Standards (2)
  - Ean International, Uniform Code Council (UCC)

- Technology (37)
Alliance

- American Trucking Association (ATA)
- Association for Retail Technology Standards (ARTS) also NRF
- Auto-ID Manufacturers (AIM)
- Canadian Council of Grocery Distributors
- Consumer Electronics Association (CEA)
- Efficient Consumer Response Europe (ECR Europe)
- Electronic Commerce Council of Canada
- Food Marketing Institute
- Global Commerce Initiative (GCI)
- Grocery Manufacturers of America (GMA)
- Healthcare Distribution Management Association (HDMA)
- International Federation of Pharmaceutical Wholesalers (IFPW)
- International Hologram Manufacturers Association (IHMA)
- Material Handling Industry of America (MHIA)
- National Association of Chain Drug Stores (NACDS)
- National Association of Convenience Stores (NACS)
- National Retail Federation (NRF) also ARTS
- Point of Purchasing Advertising International (POPAI)
- Produce Marketing Association (PMA)
- Uniform and Textile Services Association (UTSA)
- ...

October 8, 2002

Significant business drivers

- Expl 1. Theft/shrinkage
  - $60bn of goods will be stolen in stores between now and 2004
  - Up to 20% of goods get lost between supplier and store
- Expl 2. Supply chain
  - 14 Sponsors estimate to have 555.3 bn items in supply chain (adjusted for double counting).
    - Out of stock estimated at 3-4% of total sales of store
    - Higher for promotional items
    - Shrinkage and shelf availability key issue
- AMR estimates cost of global supply chain at $10,000bn/year
  - Estimated potential savings by RFID: $180 to $300 bn/year
- Expl 3. Product tracking, pin-pointed product recall
  - Recalls of products monitored by the FDA have risen from 1,500 in 1998 to 4,500 in 2001 causing major problems for individual and institutional customers. Other agencies have seen a sharp increase as well (Department of Agriculture +24% 2001/2000). Return rate is ca 20%.
  - Gray markets, counterfeit…

October 8, 2002
Wide range of applications

- IDENTIFICATION (new generation barcode) and INSTRUCTION
- Supply chain benefits
  - Reduce out of stocks, reduce inventory, speed up delivery, check freshness, track and trace, produce to demand, identify sources of diversion, identify counterfeiting, authentication, theft prediction, faster recalls, waste and recycle management…
- Store benefits
  - Theft prediction, decreased out of stock, automated shelf reorder, optimized flow…
- Consumer benefits
  - Smart medicine, direct order from home, smart appliances, (e.g. microwave, washing machine, refrigerator), assisted living…
- Machine instructions
  - Heightened levels of efficiency, mass customization, make to order, batch of 1
- Asset management
- Product life cycle management

Business cases

- Business cases (www.autoidcenter.org) are focused on
  - Application areas
  - Determine conditions to achieve positive ROI
  - Help companies to plan forward
  - PWC published cases
    - Distribution centers manufacturer/retailer
    - Stores
  - Accenture published case
    - Consumer goods supply chain
  - Auto-ID Centers developed research papers
    - Production
    - 5c tags
    - Intelligent supply chain
    - Pharma/healthcare (smart medicine)
  - Cambridge University (sponsored by SAP) research on product life cycle management (Sun)…
Shareholder’s value

- Increase shareholder value
- Increase revenue
- Increase operating income
- Increase capital efficiency
- Increase working capital turnover
- Increase market share
- Increase volume
- Reduce cost of goods sold
- Reduce operating costs
- Increase fixed capital turnover
- Increase working capital turnover
- Increased retail promotion effectiveness
- Improved available inventory at retail
- Reduce losses from theft
- Reduce inventory handling cost
- Reduced warehouse, distribution & transportation costs
- Improved customer service, real time ATP
- Reduce write-off’s, reduce waste
- Improved inventory turns
- Improved cash flow management
- Reduced slow moving/obsolete SKU’s

Examples

- Field trials and proof-of-concepts
  - Transparent supply chain:
    - Field trial USA: Wal-Mart, P&G, Johnson & Johnson, Coca-Cola, Gillette... 8 states, pallet and case level
    - Field trial Japan: Sun, DNP, beverage company - 100 containers - 2450 planned
  - Gillette smart shelf (Boston USA)
    - Shoplifting detected in progress
    - Automatic inventory update & reorder by shelf & backroom inventory
  - Robots build to order (batch of 1)
    - Cambridge (UK) Gillette gift pack assembly line

Gillette pallet read at Chicago warehouse
Source: Auto-ID Center, Gillette
Example: smart shelf proof-of-concept

- Tracks high cost items movement on shelf
  - Alerts backroom to refill shelf when number of items on shelf drops below predetermined level.
  - Updates inventory systems of store, retailer distribution center... and can place refill order automatically
- Reduces out of stock experience for consumer.

Source: Gillette

Example: smart shelf proof-of-concept

- Tracks item movement on shelf
  - Alerts for unexpected movement, for example possible theft

Source: Auto-ID Center, Gillette, Oat Systems
Traceability of packaged goods

- ePC code allows for multiple standards/industries and multiple tagging technologies
  - ePC Alliance handles the management/inclusion of industry specific coding systems within the ePC coding structure
- It is clear that barcodes and RFID tags will coexist for some time

Pharmaceutical packaging demand (USA)

Source: The future of the US Packaging Market, William Martineau, The Freedonia Group
Published: Pharmaceutical Technology Europe, September 2002

Good validation practice

Regulated

Public Health > Discovery > Development > Reimbursement > Hospitals > Doctors > Patients
A steep rise in the volume of documents and data is happening as drug development efforts increase: more development -> more data
Validation is supported by Electronic Document Management Systems (EDMS)
   EDMS is currently under intense scrutiny due to CFR 21 part 11 enforcement
Conventional EDMS systems are challenged:
   Need to better control data and documentation
   Includes capture, storage and retrieval
   Ability to identify and retain the context of the document in their relationship with assets used
   - Business processes, plants, equipment, organization and people

Good validation practice

Planning
- GMP philosophy
- Validation strategy

Development
- Procedures
- Templates
- Protocols or assay

Results

Source: Quasi-validation or Good Validation Practice?, Keith Powell-Evans, Kvaerner
Published: Pharmaceutical Technology Europe, September 2002

Potential Use of RFID technology
Product life cycle management

- Discovery
- Research
- Development
- Manufacturing
- Shipping & distribution
- Sales & marketing
- Prescription hospitals & doctors
- Retail
- Patients
- Reimbursement

October 8, 2002

an increasingly complex set of relations
Product life cycle management

- Identify objects
  - Auto-ID program (www.autoidcenter.org)
- Identify people
  - Liberty alliance (www.projectliberty.org)
- Within their context
  - Status, organization, privileges, ownership, trusted circles or relationships, history (where, how, who)...
- The technology and end-user industries together with academia are working on these and it will allow for smarter processes which will be required to improve efficiency and effectiveness
- Specific examples for healthcare

Auto-ID technology in healthcare today

Audio labels on drugs for sight-impaired people

- RFID tag on a bottle of Aspirin
- The speaker enables sight-impaired people to hear spoken prescription instructions.
Auto-ID technology in healthcare today

Tracking of test tubes and samples

This is sample 23B456. It was filled on June 20th, 2002.

The RFID tag is not bothered about frozen samples and dirty labels.

October 8, 2002

Temperature monitoring of temperature-sensitive goods

This blood bag was stored at 20 degrees Celsius for a period of 10 h on September 12th, 2002.

October 8, 2002
Auto-ID technology in healthcare today

- Other applications of Auto-ID technologies in a healthcare environment include:
  - Tracking of medical equipment in hospitals
  - Protection against counterfeit of blister packs
  - Identification and tracking of patients in hospitals

- Although all of those solutions are currently in use and available from a variety of vendors, they still can be considered island solutions because
  - Low cost RFID tags & an open networking infrastructure for automatic identification are missing

Vision of Auto-ID technology in healthcare

- If each blister pack would be equipped with a low cost RFID tag with an open network for automatic identification available, .....
Vision of Auto-ID technology in healthcare

**Pharmaceutical Production & Distribution**
- Increased visibility in the supply chain
- Simplified compliance with legislative requirements that require inventory management at folding box level
- Temperature monitoring of sensitive goods

**Hospital/Pharmacy**
- Temperature monitoring of sensitive medications
- Medication error prevention through combination of patient and drug tracking
- Automatic replenishment
- Simplified product recalls

**Patient**
- Smart medical cabinet featuring:
  - Detection of out-of-date and recalled products
  - Improved contraindication visibility
  - Audio-labelling of products
  - Online product information

October 8, 2002

Auto-ID versus other ID systems

- **Auto-ID**
  - **Current focus is passive tag (others possible in future)**
    - Industrial high volume possible:
      - Low cost, very small, antennas & tag embedded in packaging
      - It does not have to be silicon or semiconductor
  - **All data is on the Internet (read/write)**
    - Capacity of information storage is large, flexible & secure
  - **Auto-ID is a ubiquitous networked system**
    - Access to information on the object, wherever you are
    - No physical link between information and object
  - **Global standard for an infrastructure, not an end-solution**
    - Same identification system for object, its components…
    - Same identification system for your partners, service agent, transportation company…
  - **Auto-ID standards are planned to be published November 2003**

October 8, 2002
Conclusion

The New Network
A Nova Rede
Le Nouveau Reseau
Das Neue Netzwerk
La Nuova Rete
La Nuova Red
革新的なネットワーク

October 8, 2002

Waves of the Internet: objects

An Internet of Computers
10^8
An Internet of Things That Embed Computers
10^11
An Internet of Things
10^14

Source: Greg Papadopoulos, CTO Sun Microsystems

October 8, 2002
October 8, 2002

Closed loop execution systems

BITs

Sensing
Computing Stuff
Effecting

ATOMs

“Monitor,
Decide,
Action.”
Scott McNealy, CEO Sun Microsystems Inc.
i2 Planet May 2002, Las Vegas

Source: Greg Papadopoulos, CTO Sun Microsystems

Waves of the Internet:

Source:
Greg Papadopoulos, CTO Sun Microsystems

October 8, 2002
How to start

- Join
- Build the right infrastructure (IT, readers, antennas…)
  - Auto-ID is developed on Unix (Linux) & Java is core component
  - Near the edge is current focus
    - POC’s and small pilots possible now
  - We are planning on the data center
  - Near time focus is trade/supply chain
    - Pallets
    - Cases
    - Totes
- Well defined project, limited scope is advisable

Sun Microsystems

- Sponsorship donation to MIT
- Auto-ID Center support
  - Equipment, SW (Java…)
- Share know-how
  - Access to engineers and SunLabs…
    - Detection & administration of appliances
    - PML
    - …
  - Access to lawyers
    - IP, licensing…
- Managing standards
  - Java Community Process
  - Support for business case research: Supply Chain and PLM (Product Life cycle Management)
- Participate in the field trials
- Participate in customer trials

October 8, 2002
M-Lab – a research institute investigating the integration of pervasive computing technologies in business environments.

Final word

- A lot has been achieved
- There is still a lot to be achieved in and around Auto-ID… but Auto-ID is real and coming
- The Auto-ID Centers deliver outstanding work
- Auto-ID:
  - It is standards based
  - It has significant potential for Pharma, Biotech and Healthcare
- We invite you to join us and become part of the future
Where to go for more information?

- At the R&D Leaders Forum
  - The Sun Microsystems booth in the exhibition hall
  - Small demonstration of a smart medical cabinet (identification of blister packs)
- For information on joining:
  - Brooke Peterson, Auto-ID Center
    brooke@mit.edu
  - http://www.autoidcenter.org

Thank You

Dirk Heyman
Sun Microsystems
2 Rue de Jargonnant
1207 Geneva
Switzerland
e-mail: autoid.core.team@sun.com

Christian Floerkemeier
Institute for Pervasive Computing
ETH Zurich
8092 Zurich
Switzerland
e-mail: floerkem@inf.ethz.ch

http://www.sun.com
http://www.m-lab.ch
http://www.autoidcenter.org