RFID-enabled Automation in Support of Factory Integration

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ControlGen’s Real Time Visibility Solution

http://www.controlgen.com
Point-of-care Service Scenarios

Service-oriented Community/Society

- Fast (real time)
- Accurate
- Easy to use
- Cheap (Standard)

Google?, or Yahoo!?
Point-of-need Service Scenarios

**SS1:** A traveler needs assistance.

**SS2:** An overturned truck loaded with hazardous chemicals.

**SS3:** A truck loaded with commodity that needs specific attention.

Supply chain management: Tracking and Control

“A crisis management team responds to a chemical spill by using local weather and soil models to estimate the spread of the spill, determining the impact based on population location as well as geographic features such as rivers and water supplies, creating a short-term mitigation plan (perhaps based on chemical reaction models), and taking emergency response personnel by planning and coordinating evacuation, notifying hospitals, and so forth.”

“The Anatomy of the Grid” by Foster, Kesselman, and Tuecke
Contents

- Can RFID help? How?
- Enterprise Service Computing?
- RFID: Value Proposition for Factory Integration?
Can RFID help? How?

Enterprise Service Computing?

Can Grid Computing help?
RFID Tag

Copyright © http://www.scs-mag.com/reader/RFID_Edge/index.htm
RFID Reader

[Diagram of RFID Reader components: Antenna, Receive, Data Processing, Transmit, Standard Data Interfaces, Host System]

A UPC is created using a 12-digit numeric sequence scheme. A series of light and dark lines are used to represent a UPC code, while a human readable numeric equivalent is given together with the standard symbol. An example of a barcode looks like

0.03456.89234.6
Numbering System Character.Enterprise ID Number.Serial Number (Model).Modulo check character
Electronic Product Code (EPC)

An EPC is created using a 96-bit numbering scheme. It consists of an 8-bit header and three data partitions, i.e.,

02.0006A66.56271F.0003476AB
8 bits.28 bits.24 bits.36 bits

“The 96-bit EPC provides unique identifiers for 268 million companies. Each manufacturer can have 16 million object classes and 68 billion serial numbers in each class, more than enough to cover all products manufactured worldwide for years to come.”
EPCglobal Architecture Framework

EPCglobal Core Services and other shared services

Peer-to-peer exchange of data about EPCs

EPCglobal Subscriber

EPCglobal Subscriber

Exchange of physical objects with EPCs

EPC Data Exchange Standards

EPC Infrastructure Standards

EPC Physical Object Exchange Standards
## EPCglobal Network: 5 Components

<table>
<thead>
<tr>
<th><strong>Electronic Product Code (EPC)</strong></th>
<th>Unique number that identifies a specific object in motion in the supply chain.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ID System</strong></td>
<td>The ID System consists of EPC tags and EPC readers. EPC tags* are RFID devices that consist of a microchip and an antenna attached to a substrate. The EPC is stored on this tag, which is applied to cases, pallets and/or items. EPC tags communicate their EPCs to EPC readers using RFID. EPC readers communicate with EPC tags via radio waves and deliver information to local business information systems using EPC Middleware.</td>
</tr>
<tr>
<td><strong>EPC Middleware</strong></td>
<td>EPC Middleware manages real-time read events and information, provides alerts, and manages the basic read information for communication to EPC Information Services (EPC IS) and a company’s other existing information systems. EPCglobal is developing a software interface standard for services enabling data exchange between an EPC reader or network of readers and information systems.</td>
</tr>
<tr>
<td><strong>Discovery Services</strong></td>
<td>A suite of services that enable users to find data related to a specific EPC and to request access to that data. Object Naming Service (ONS) is one component of Discovery Services.</td>
</tr>
<tr>
<td><strong>EPC Information Services (EPC IS)</strong></td>
<td>Enables users to exchange EPC-related data with trading partners through the EPCglobal Network.</td>
</tr>
</tbody>
</table>
The EPCglobal Network

real-time object movement data

Potential Benefits

<table>
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<tr>
<th>Industry Sector</th>
<th>Specific Use Examples</th>
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| Retail          | • Track and trace  
|                 | • Product recalls  
|                 | • Streamlined shipping and receiving  
|                 | • Automated invoice reconciliation  
| Healthcare      | • Red Cross: monitoring blood banks  
|                 | • Hospitals: monitoring medication routes from medicine cabinet to patient  
|                 | • Pharmacy: drug recall (product pedigree)  
|                 | • Prescription drugs: identifying counterfeit or falsely-labeled medications  
| Logistics       | • Asset utilization: asset (e.g., containers, trucks, etc.) management, tracking and maintenance  
|                 | • Improving operational efficiencies: volume planning and automated data capture through shipping route  
|                 | • Safety and security: shipment route tracing and positive identification of package contents  
|                 | • Automated customs  
| Automotive      | • Capital asset management: container and tool management  
|                 | • Part tracking: inventory management; assembly; theft control; brand authentication; distribution; recall; recycling  
|                 | • Vehicle related: car identification; access control; tire pressure  
| Food Industry   | • Mad Cow Disease/Bird Flu: cow/bird pedigree, herd/flock history and details about the release into the food chain  
|                 | • Restaurants: responding to outbreaks of food poisoning  
| Department of Defense | • Supplies and materials management: track and trace; streamlined receiving; etc.  
|                 | • Military assets management: asset utilization, tracking and maintenance  
| Airline         | • Baggage handling  

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The EPCglobal Network™ Demonstration

- **Product Authentication**
  - Gillette (along with solution providers Sun Microsystems and VeriSign, and trading partner Wal*Mart) demonstrated how a missing or mis-delivered Venus Case could be identified and re-associated with its order.

- **New Product Visibility**
  - Procter & Gamble (P&G), solution providers TIBCO, IBM, VeriSign, and retailer Wal*Mart demonstrated how suppliers and retailers could utilize the EPCglobal Network to gain visibility into the store sales floor and backroom.
Typical Example: DOD Logistics

Physical World

- Fast (global real time)
- Accurate/precise
- Easy to use
- Cheap (Standards)
Wal-Mart's Supply Chain

- Business Dynamics
- Fast (global real time)
- Accurate/precise
- Easy to use
- Cheap (Standards)

The EPCglobal Network: Viable Solution?

“Indeed, behind the scenes, the application is making use of the EPCglobal Network to direct it towards whichever resource is required at any given time. The EPCglobal Network itself is responsible for knowing where to point an application looking for information based on a particular EPC or class of EPCs. Similar to the Internet, the EPCglobal Network is continuously updated, and it will know within 60 seconds when EPC-tagged products have arrived and been read at various locations, whether these are manufacturers, retailers or distribution centers.”
When an EPC is used as an object identifier, a GIC consists of an 8-bit header and four or more data partitions, i.e.,

02.0006A66.56271F.0003476AB.IP.xxx
8 bits.28 bits.24 bits.36 bits.IP.options
Header.Enterprise.Product.Serial Number.IP.xxx
Real Time Visibility: Possible? How?

Source: GL AgilityTech, Inc
Global Real Time Visibility Solution?

Container-level

Item-level

Tracing Server

GIC

Devices

Universal Data Appliance Protocol?
Point-of-need Service Scenarios

SS1: a traveler needs assistance.
SS2: an overturned truck loaded with hazardous chemicals.
SS3: a truck loaded with commodity that needs specific attention.

Delivering Just-in-time Intelligent Service?
Healthcare Delivery Networks

Service-oriented Community/Society

Delivering Global Real Time Service?
Distribution Center (Precise Location?)
Value Proposition (Warehouse Example)

- Cycle counting
- Operational Accuracy
- Labor saving
- Lower inventory
- Avoiding theft
- Reducing loss of sale

- Supply On Demand
  - Sell one, replenish one

From an IT perspective, How can we support it?
Contents

- Can RFID help? How?
- Enterprise Service Computing?
- Can Grid Computing help?
Middleware is everywhere. Can you see it?

RFID tags are everywhere.
Catching Up the Changes
Business Aligning IT?

Complex

IT Infrastructure

Process Logic

Organization

Dynamic
Competitive Enterprise?
A Complex System?

- Multi-vendor
- Proprietary
- Complex information flows

- Asynchronous Processing
- Multiple interfaces
- Mission Critical
- How to manage changes?
“Only the change is certain”

- The business world is rapidly changing. The revolutionary technology of the Internet has led to the faster and more efficient interaction between customers, suppliers, and partners.

- A new trend is emerging where the performance and development of business processes is a collaboration between business partners (Internally and externally).

RFID ➔ EPC or GIC Networks?
BPM Merging With SOA Services

Business Process Layer:
- BPML/BPMN

Services Layer:
- BPEL

(Web) Services

Global Key Enabled Enterprise Service Computing?
→ Services Design, Modeling, Execution, Monitoring, Optimization

Layer
Contents

- Can RFID help? How?
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Control Hierarchy and Information Flow

Entry → D/A → D/A → D/A → Plasma → Oven → Exit

Overhead Track

Exception

Wire Bonder → 3rd Opt → Wire Bonder

Diagrams:
- Wire Bonder
- Controller
- Systems Model
- Physical Configuration
- Physical Model
- Controller
- Systems Model
- Physical Configuration
- Physical Model
A simplified process flow and identify hierarchy

- **P_1**: InStage
  - WaferSaw
  - DieAttach
  - DieAttach Cure
  - WireBond
  - Optical Inspection
  - Mark
  - Singulation
  - Inspection
  - OutStage

  Wafers in cassette.

  Strip in magazine.
  (Typically each strip holds 6 ~ 10 dies and each magazine stores 20 ~ 30 strips.)

  Chips in tray.

- Each process has its own specification defining requirements on set up, tools, consumables, etc.

**Physical Identifier:**
- Wafer cassette
- Strip magazine
- Individual chip

**RFID Tags:**
- Chip
- Magazine
- Cassette
Part state (Delivery In, Move In, Processing, Move Out, or Delivery Out), and other pertinent product and process information can be stored in an RFID tag. More information can be retrieved from its host application using the GIC technology.
Synchronization using agents and GIC hierarchy

- Factory Information System (IP)
- Office-level Information System
- Internet
- Different factory, facility or partner on the supply chain
- GICn (GICs’ relations can be part of optional parameters stored in a tag or data source managed by host applications)

**Office-level Information System**

**MCS**: Material Control System

**MC**: Machine Controller

**Cell**

1. GIC1
2. MC
3. MC
4. MC
5. GIC2

**Notes**:
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- Office-level Information System
- Internet
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- GICn (GICs’ relations can be part of optional parameters stored in a tag or data source managed by host applications)
A framework for the implementation of RFID-enabled factory integration

![Diagram of RFID-enabled factory integration framework]

- **Factories**
  - $\omega_n$ (Server)

- **Materials**
  - Control server

- **Planner, Scheduler, Dispatcher**

- **Database**

- **Business Integration Engine (BIE)**
  - Messaging-based Integration Middleware (XML conversion, synchronization algorithms, GIC event manager, GIC reference services, etc.): RFID-enabled Integration Backbone

- **Cell Controllers**
  - Equipment-specific Model
  - BUS Downlodable Interface Engine

- **Process service controller**
Value Proposition

- Standardized Data Exchange
- Ease of Factory Integration
- In Support of Fully Collaborated Supply Chain
I really appreciate your attention and time.

Questions?

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